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Impacts of Infrastructure Spending on Interstate Migration: Empirical Evidence over Eleven Years

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I. Introduction

Inter-state economic migration[1] is a driver of labor market equilibrium, as residents choose to move to areas with higher returns, whether the returns are reflected in wages or job opportunities. The recession that began in 2008 led to high unemployment rates and a downturn of family income levels, which sparked the creation of the American Recovery and Reinvestment Act of 2009 (ARRA). The ARRA was a stimulus package worth $787 billion at the time of passing, and heavily expanded infrastructure expenditure as a way to create jobs (Government Publishing Office, 2009) Infrastructure jobs are location dependent, meaning the workers must be on the job site to work. However, the workforce could be highly mobile, as a construction job in Louisiana is similar to that in Connecticut. These characteristics mean that infrastructure workers are likely to move to find a job, suggesting that this legislation may have mobilized individuals to relocate to areas with better job opportunities. This study is motivated by the vacancy of clear evidence on the said mechanism, and aims to empirically test whether infrastructure spending could serve as a significant determinant of interstate economic migration.

Following economic downturns, federal, state and local governments often increase funding for infrastructure projects, aiming to increase job availability. Higher expenditure on these projects can incentivize out-of-state workers to move into the state because of better job availability. This aspect of public policy can become a significant pull factor, functioning as a labor market equalizer by moving individuals to areas with better opportunities. This study aims to examine a popular expansionary policy, infrastructure expenditure, and connect it with economic migration; tracking migration flows among the 50 states over 11 years, 2005 to 2015. The timeframe allows infrastructure spending through the ARRA to function as an exogenous shock to labor demand, spurring migration between states. Following the previous literature that uses gravity estimation to study economic migration, this study adds to the work on interstate migration by testing the exogenous impact of infrastructure, while controlling for significant determinants of bilateral migration flows such as distance, contiguity, income, and unemployment.

The American Recovery and Reinvestment Act of 2009 was passed by Congress and signed into law by President Obama in February 2009, a stimulus package intended to address the Great Recession. The purpose of this act was to make “supplemental appropriations for job preservation and creation, infrastructure investment, energy efficiency and science, assistance to the unemployed, and State and local fiscal stabilization.” (Government Publishing Office, 2009). To that end, the Act included extensive infrastructure funding for the purpose of short-term job creation and long-term economic benefits. In total, the fiscal package was a $787 billion stimulus, in the form of government spending, tax reductions and subsidies.

Over $105.3 billion of the $787 billion stimulus package was allocated towards infrastructure investment, geared to “create jobs.” Some examples of the spending for infrastructure include, but are not limited to, $100 million in infrastructure spending given to the US Customs and

Border Protection Department, $589 million to the National Park Service to be spend on critical infrastructure projects, $1.5 billion to the Department of Transportation for surface transportation infrastructure and $27.5 billion to the Federal Highway Administration for highway infrastructure investment.

The ARRA also allocated grants to the Department of Transportation for the creation of the Transportation Income Generating Economic Recovery (TIGER) program. TIGER grants are distributed to successful applicants for road, rail, transit and port projects, based on whether the project yields "desirable, long-term outcomes" for the United States. The grants are typically allocated to state governments, and used for smaller scale projects, such as renovations on a section of a highway or revitalization of a downtown area. The grants began in 2010 and are currently in their 7th rotation for the year 2017. In the first year, 2010, the TIGER I program allocated $1.5 billion to over 51 projects. The following year, TIGER II allocated $600 million to 42 projects, after which the grants leveled off, with $527 million for 46 projects for TIGER III in 2012, $500 million for 47 projects for TIGER IV in 2013 and $474 million for 52 projects for TIGER V in 2014. Overall, from 2009 to 2017, nearly $5.6 billion have been spent exclusively on TIGER grants.

The ARRA was designed with job creation as one of its goals. Infrastructure spending can create jobs by implementing construction projects that are built using manual labor. It can have a substantial impact on the demand for labor and, this study hypothesizes that the increased demand for local labor could end up attracting workers from outside the states if enough jobs were created. This process could potentially assist more efficient matching of unemployed workers to newly created vacancies, a process which is much needed in a recession. However, there is no conclusive evidence that this mechanism works.

Studies on just the impact of infrastructure spending, not specifically the ARRA, helps shed light on whether infrastructure is a policy the government is likely to repeat after future recessions, and it further motivates this work. The Congressional Budget Office (CBO) compiled a report in 2011 addressing the effects and successes of the Act. The CBO estimates that the ARRA created between 1.6 million and 4.6 million jobs from conception to the first quarter of 2011, and that stimulus reduced unemployment by between 0.6 and 1.8 points. Using time series data at the state level, Feyrer and Sacerdote (2011) found the ARRA was effective, creating one job for every $170,000 in stimulus spending. Blinder and Zandi (2010) used analytical models to estimate that the ARRA was responsible for creating 2.7 million jobs and reducing unemployment by 1.5 percentage points. It is reasonable to conclude that the ARRA had a positive effect on the economy, by reducing unemployment and creating jobs; and that high levels of infrastructure expenditure likely played a major role in job creation.

Pollin and Garrett-Peltier (2005) studied the employment effects of an additional $1 billion dollars of government spending on the US Economy in 2005. They use an input-output model to estimate direct and indirect job creation from spending by sector. They also estimate the expected average annual wage per worker in each sector. Below is a chart that estimates the number of jobs, average wage and total additional wages created from $1 billion spending in the respective target:

Government Spending Targets	*# of Jobs Created*	*Average Annual Wage*	*Total Wages from Employment*
Defense	8,555	$65,986	$564.5 million
Tax Cuts for Personal Consumption	10,779	$46,819	$504.6 million
Healthcare	12,883	$56,668	$730.1 million
Education	17,687	$74,024	$1,309.3 million
Mass Transit	19,795	$44,462	$880.1 million
Construction Weatherization/Infrastructure	12,804	$51,812	$693.7 million

The spending target most relevant to this paper is mass transit, which includes expanding mass transportation routes and constructing or repairing highways. Mass Transit creates the highest number of estimated jobs, 19,795 jobs, and is estimated to create about $880.1 million in total wages. This study suggests that direct government spending on infrastructure projects is an effective job created tool, giving the most "bang for your buck." Spending one billion dollars in this area will create the highest number of jobs. "Shovel ready" infrastructure is one of the most cost-effective way to create jobs essentially immediately, making it an attractive policy for job creation in times of need.

Therefore, it is reasonable to conclude that the infrastructure spending component of the American Recovery and Reinvestment Act of 2009 was effective in reducing the unemployment rate and promoting job creation. However, even following this Act, there are parts of America that continued to struggle, specifically areas in which industry has moved overseas and left vacancy and blight, with heavy structural unemployment. These communities were directly addressed in the 2016 Presidential Election, such as the left behind towns in the Rust Belt or the cities which lost major factories and manufacturing facilities.

These low-production areas with structural unemployment need long term solutions for better allocation of labor, such as the entry of new industry or out migration to areas with higher return. This study focuses on the latter: individuals moving out of low-production areas into places with expanding job opportunities. I test the effect infrastructure spending has on migration. If higher migration leads to migration, this signals that governmental policy has the ability to stimulate economic migration.

II. Literature Review

Theoretical models of migration illustrate that in the absence of migration costs, a worker will migrate to mitigate differences in economic opportunities, such as differences in wages or unemployment rates, or for personal reasons. However, in reality, migration costs are often very high. Bayer and Juessen (2002) find that inter-state migration within the Unites States can cost each migrant up to two-thirds of an average American's household income. The present value of the future wage benefit may not offset the cost of the move, locking in individuals who would have otherwise moved toward better opportunity.

However, even factoring in high costs of migration, inter-state migration within the United States is a common phenomenon. Using IRS data, Molloy et al. (2011) suggest that roughly 1.5 percent of the US population moves between the four Census regions (Northeast, Midwest, South and West) each year, and that about 1.3 percent of the population moves to a different state within the same region each year. The lifetime interstate migration rate, which tracks the proportion of the population that has moved to a new state at least once in their life, was 31.0% in 2009, measured using decennial Census micro data. This value has fluctuated around 30% since 1980, meaning that nearly one in every three individuals has changed states, a figure which shows the prevalence of interstate migration in the US.

The phenomenon of economic migration has been studied over recent decades to give more insight into the reasons migrants choose to move between states. Several studies focused on economic opportunity as a significant factor. McHugh and Gober (1992) studied the effects of the decline in oil prices in the 1980s and the subsequent migration out of the West South Central and Mountain regions that followed. McKinnish explores economic opportunity in three papers. McKinnish (2005) studied the impacts of welfare-induced migration from states with Aid to Families with Dependent Children (AFDC) participation in border counties against interior counties within states; McKinnish (2007) added demographic comparisons, finding further evidence of welfare migration. McKinnish (2017) studied the federal minimum wage increase, which changed both state-to-state differences in minimum wages and out-of-state commuting patterns, and found that as an aggregate, low-wage workers modestly commuted away from minimum wage increases rather than toward them, because the wage differentials between states was compressed, spurring migration. Bayer and Juessen (2012) explore economic opportunity and the problem of self-selection, solved by tracking migration incentives over time.

Environmental factors have influenced interstate migration. Beeson et al. (2001) study explored migration patterns from 1840 to 1990, and found that natural characteristics and newly built developments heavily influenced the movement of migrants. The distance of an interstate move is also a determinant of migration, Anjomani (2002) used income growth, employment growth, unemployment growth, population growth, gross migration, and employment in manufacturing as endogenous variables to test the impacts of distance. Modestino and Dennett (2013) explored the impact of job or house lock on interstate migration by studying the housing market crash of 2007, which caused many home owners to be underwater on their mortgages. They find evidence that the crash caused a “house lock” between 2007 and 2009, which decreased mobility between states. Gurak and Kritz (2000) analyze the impact of community on migration, analyzing differences in immigrant and native migration patterns, finding that the social capital of cultural groups has a strong influence over an immigrant’s decision to migrate.

These studies examine relevant causes of interstate migration, but studies that analyze public subsidies and policy have the highest connection to this work. Government policy has long been analyzed on its ability to influence individual behavior (Bovenberg and Jacobs, 2005; Heady et al., 2000; Giulietti and Wahba, 2012). There has been little work done specifically on the impact of infrastructure spending on interstate migration, but studies analyzing public expenditure can offer the most insight on the methodology and statistical technique, as well as decisions and characteristics that internal migrants consider when moving. These can then be applied to the impact of infrastructure spending on a migrant's decision to move.

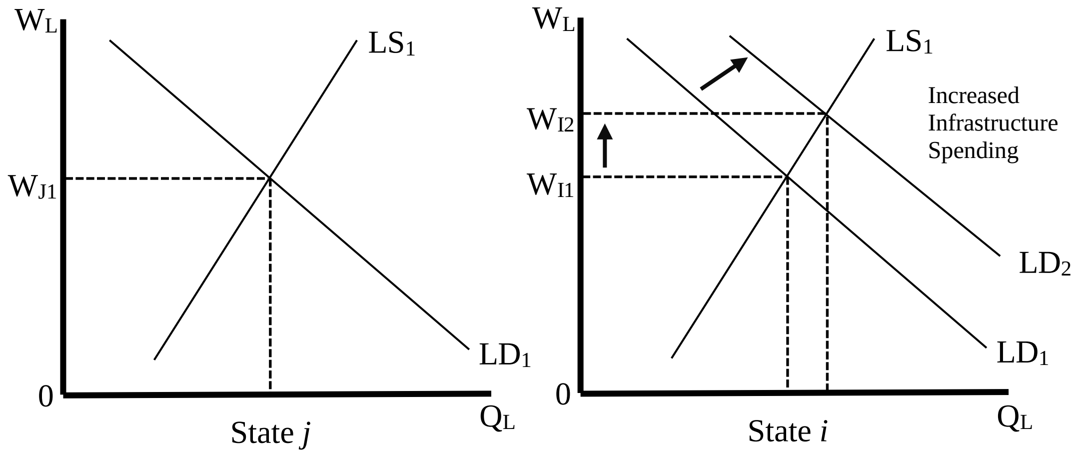
Walker (1994) explores migrants moving into states with high welfare expenditure as a pull factor for the migrants and finds no clear evidence of any impact. Allard and Danziger (2000) analyze the Federal Welfare Reform in 1996 to see whether families made interstate moves to capture higher welfare benefits. They find that few households moved to capture benefits, and that welfare benefits were not a significant determinant. Alm and Enami (2017) examine the impacts of the Massachusetts Health Care Reform (MHCR) of 2006, finding that a state-wide pull effect to better healthcare was insignificant, but there was a border effect, where families outside the border moved into Massachusetts to seek better healthcare.

The work most relevant to this study is by Cebula and Alexander (2006), who analyze U.S. Census Bureau unilateral migration data to explore determinants of net migration inflow. The methodology used analyzes the net migration rate into a state from 2000 to 2004. The regressions test median family income, cost of living for a 4-person family, employment growth rate from 1996 to 2000, average temperature, toxic waste facilities in state, education expenditure per pupil, and tax burdens per capita for each receiving state. They find that state and local spending per pupil on education is a positive and significant pull factor to a state, and that the state income tax level is a statistically significant and negative, meaning high taxes discourage migrants from moving to a state. In addition to methodological similarities, this research suggests that migrants react to changes in public spending, meaning they are results relevant to this paper.

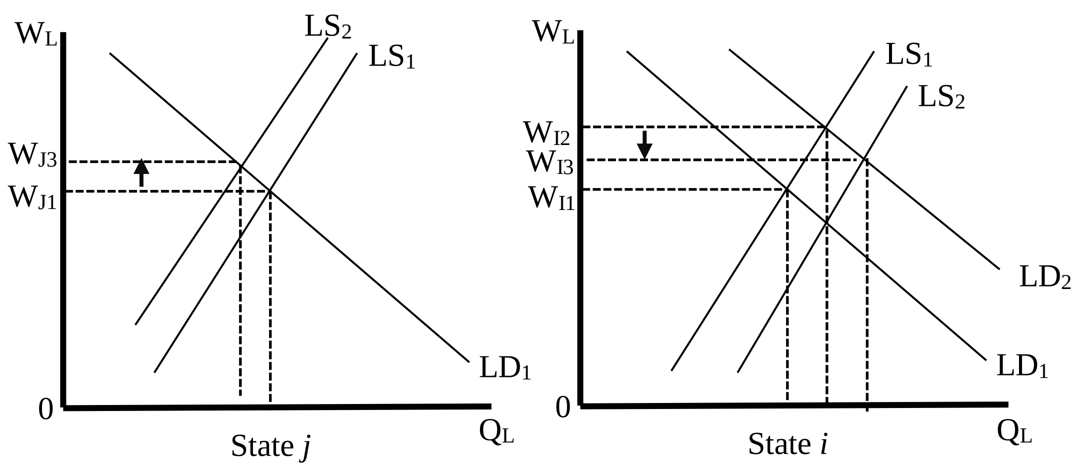
III. Theory

Infrastructure spending can become a catalyst for migration, as a state that experiences dramatic increases in state infrastructure spending is likely to have an increase in the state's labor demand. If infrastructure spending is increased within a state, the money is likely to fund construction projects that are labor intensive. These projects are often building, repairing or maintaining physical structures, such as "highways, streets, roads, and bridges; mass transit; airports and airways; water supply and water resources; wastewater management; solid-waste treatment and disposal; electric power generation and transmission; telecommunications; and hazardous waste management" (National Research Council). Infrastructure jobs are location dependent, meaning the workers must be on the job site to work, but the workforce is highly mobile. An individual working on a highway project in Connecticut would be doing similar work on highway in South Carolina, and therefore, is more likely to be able to pick up and move to a place of greater job availability.

Initially, two states, state *i* and state *j* are at labor market equilibrium, reached where $LS_1 = LD_1$ in both states, at W_{E1}. State *i* experiences increased infrastructure spending, causing an upward shift in the demand for labor in the state, to LD_2. This will lead to an increase in the wage rate, from W_{E1} to W_{E2} in state *i*. The increased wage creates a differential between state *i* and neighboring state *j*, which did not experience increased infrastructure spending.



This wage difference will create an incentive for individuals to move from state *j* to state *i*, in order to receive the higher wage rate in state *i*. Assuming free mobility, this begins a process of migration that mitigates the wage differential. As individuals leave state *j* and enter state *i*, the labor supply of state *j* decreases and the labor supply of state *i* increases, shown in the shift to LS_2 is state *j* and the shift to LS_2 in state *i*. The movement of labor supply will stop when there is no longer a wage differential between the two states, and the labor market is returned to equilibrium at W_{E3}, indicated by the orange line below.



The labor economics behind increased infrastructure spending leads to a main observation. Increased infrastructure expenditure should correlate with increased migration flows because by nature, infrastructure work is highly location dependent with a mobile workforce, therefore, individuals are likely to move to where demand for work is high, which is means a higher wage or higher job availability.

The terminology used in migration economics includes "migrant flow", which is the movement of individuals into a certain location over a specific period of time. The locations involved are the "sending state", which refers to the state the migrant had left in the prior year; and the "receiving state", which is the state the migrant has relocated to over the prior year, and where the migrant currently resides. The total number of migrants who choose to move into the receiving state is the total migrant flow in a particular year, and the bilateral migrant flow between the sending and receiving state is the number of migrants that choose to move from the particular sending state to the particular receiving state over the past year. The "pull" factors indicate specific characteristics of a location that "pull" individuals to move into the location, for example, high GDP or high availability of jobs. The "push" factors are characteristics of a location that "push" individuals out of the location, such as an economic downturn or fewer educational opportunities.

This theory gives structure to an econometric analysis which test the hypothesis that infrastructure can impact interstate migration. An increase in infrastructure spending in a receiving state is likely to act as a pull factor, attracting individuals who seek a higher wage and better job opportunities. A decrease in infrastructure spending in a sending state will likely be a push factor, because residents will have less job availability and/or lower wages. The current study examines all 50 states over the period 2005 to 2015, to see if there is a statistically significant relationship between sending state and receiving state infrastructure spending and the migrant flow between the two states, controlling for other economic factors, in both sending and receiving states, that influence migration flow.

The ARRA has created millions of dollars of funding, through Federal grants. The Department of Transportation (DOT) has received over $5 billion for TIGER grants since 2009, which are given to individual infrastructure projects. The TIGER program is unique because it allows the DOT to select projects through an application and approval process. The DOT is able to use a "rigorous merit-based process to select projects with exceptional benefits," meaning, the funds are given to projects that will create the most benefit to the economy once built. The TIGER grants are not need based, meaning a state that is economically struggling is not more likely to receive a TIGER grant than a state that is prospering. This unique characteristic of TIGER grants has two implications. First, not all states received equal amounts of TIGER grant funding, there are states that received more funding as compared to others. Second, a state's economic conditions are not the main factor in whether or not the state passes the application process, meaning the TIGER grants are relatively exogenous to the state's economic conditions. Some portion of total state infrastructure spending is exogenous to economic conditions, such as GDP and unemployment. TIGER Grants allocated through an application and approval process meant that only certain states received a higher amount of funding which created an upward shock of infrastructure spending. In 2010, fewer than 30 states received the first round of TIGER funding in the first year, highlighting the disproportional allocation that creates shocks to certain states.

The uneven distribution of TIGER and Federal grants across states creates differentials. States that received more funding will have more infrastructure projects, and a higher demand for construction labor, in turn leading those states to have higher wage rates and availability of jobs in these sectors, impacting state-to-state migration. If migration due to infrastructure spending is a statically significant economic phenomenon, moving individuals from low-return to high-return areas can function as a labor market stabilizer that can allow for a quicker recovery post-recession.

IV. Data

To empirically analyze evidence of the impact of infrastructure spending on inter-state migration, bilateral flows of migration between states are paired with quantitative information on infrastructure spending. *The American Community Survey*, implemented through the US Census, tracks state to state migration each year, which creates a dataset of bilateral flows between the 50 states. This data is based on sampling, and therefore, there is a degree of uncertainty arising from sampling error. The data spans the period from 2005 to 2015 and is panel data that defines a *Sending State*, which is where the migrant lived 1 year prior, and the *Receiving State*, the state where the migrant currently resides. The *Migrant Flow* is defined as the number of people that moved from the *Sending State* to the *Receiving State* in the past year. This data also tracks the *Total Migrant Flow*, which is the total number of migrants who moved into a *Receiving State* over the past year.

To analyze bilateral migration flows, characteristics about both the sending and receiving states will be used in the analysis. There are 50 sending and receiving states, making 50 x 49 unique pairs over 11 years, meaning there are 50 x 49 x 11 = 26,950 observations. Unilateral flows are flows that track migrants moving into a state without factoring where the migrant came from. Therefore, characteristics of only the receiving state are used in the regression analysis. There are just 50 receiving states over 11 years, meaning there are 50 x 11 = 550 observations.

There are two variables in the dataset that control for geography. The first is distance, an important measure for inter-state migration, because as distance increases, migration costs increase and migration levels will fall. The measure of distance between states is found by using the distance between the longitude and latitude of each capital city in a state. The distance measurement follows the surface of the Earth, giving a "bird path" of distance, the path a bird would fly, not the mileage a car would drive.

The second is an indicator variable that indicates whether the *Sending State* and the *Receiving State* share a border. In this data set, this variable counts as a measure of contiguity, how closely connected the two states are. Contiguity has been a standard variable in migration literature, indicating linguistic and cultural proximity. Language and culture are not applicable for the 50 US states, but it is important to include a measure of contiguity in the regression. There is no data available on the contiguity of the 50 states, so I choose to use an indicator variable that identifies whether the origin and destination state share a border. Bordering states are likely to share characteristics like climate, cultural patterns and political views, making it a good proxy for cultural proximity. Bordering states (more contiguous states) are likely to have a higher migration flow, because it is likely easier and less inexpensive for migrants to move to a neighboring state. There are 220 unique borders, making the dataset 220 state pairs by 11 years, making 2,420 observations. This variable is used in regressions as an indicator variable, but also allows me to analyze migration patterns in just bordering states, as a separate regression.

The US Census Bureau publishes the *Annual Survey of State Government Finances*, containing state expenditure and revenue for each year, divided into categories, measured in thousands of dollars. The Census also publishes the *Government Finance and Employment Classification Manual* to help users understand the financial reports published. The *Census Bureau Statistical*

Surveys are tabulated in three categories, the Federal government, state government, and all local government totals; this study will analyze just the *State Statistical Surveys*.

The Census Bureau defines the "state government" as not only the executive, legislative and judicial branches of the government, but also the agencies, institutions, commissions and public authorities that operate separately from the state government, but over which the state government maintains administrative or fiscal control. The Census goes further to define that the state government totals "consist of the state government plus all local governments within the state," meaning it is an aggregate of all government-related expenditure in state, regardless of whether it was state-wide, county or in a single school (Government Finance and Employment Classification Manual, Section 1.6.1, 2006).

The 50 state governments provide data from the accounting systems of their agencies. The financial information from the other state-controlled institutions, commissions or public authorities are collected by analyzing the financial records of the entities. The data is merged, compiled and edited. Since each individual state collects financial data differently, there is risk of some variability or error.

The final Annual Survey is compiled and categorized into sections, General Revenue, Total Debt, Total Expenditure, General Expenditure, and Cash and Holdings. Of these categories, two contain information on state-wide spending Total Expenditure and General Expenditure. These are different in that they measure total government expenditure in two different ways, by characteristic and by function. The characteristic classification divides government expenditure by spending type, and includes categories such as current operations, capital outlay, interest on debt, grants and subsidies or payments to other governments. The function classification divides government expenditure according to purpose, such as into health, hospital, education, airports, parks and police protection expenditure.

The second important section of the Annual Survey is General Revenue. The main sources of General Revenue are taxes, federal grants and service charges. Every year, the Census publishes a report on the aggregate trends of state finances and explaining any outliers. The *2013 Statistical Survey Annual Report* shows that the General Revenue aggregated for all 50 states decreased 1.9% from 2012 to 2013, directly affected by lower federal fund availability. Federal funds, which usually make up about 30% of general revenue, fell due to a drop in the ARRA funding availability. The tie between federal funding and general revenue affects general expenditure, which is largely based on the revenue. Although there is no "Recovery and Reinvestment Act of 2009" spending category in the Annual Surveys, the federal grants received following the stimulus affected the spending ability of states. Therefore, it is reasonable to conclude that the spending allocations in the American Recovery and Reinvestment Act of 2009 did reach states and had a significant impact on state government finances.

In the Surveys, there is no clear category for infrastructure spending. Within Total Expenditure, there is a category for *Capital Outlay*, which refers to a state's spending to build, maintain, repair or upgrade capital structures, including government facilities and other structures. Within the General Expenditure category, there is a section for *Highway Expenditure,* which refers to expenditure to build, maintain, repair or upgrade highway systems within the states. While

Capital Outlay and *Highway Expenditure* are separate, there is likely an overlap between the two. Some highway expenditure, particularly the building and upgrading of highways, falls in the category of capital outlay spending because capital outlay is total spending for new construction by the government. The highway expenditure category refers to the purpose of spending (highways), and the capital outlay refers to the type of spending (construction). Therefore, spending on highway construction will fall in both the highway category and the capital outlay category, meaning it is important to keep these two measures separate in regressions to prevent double counting.

The migration data and infrastructure spending are combined with quantitative information for each state, including the geographic data discussed above and GDP and the unemployment rate, which control for other factors that influence an individual's decision to move to a different state. GDP influences a migrant's decision to move, as they are drawn to areas of higher production and job opportunity. The Bureau of Economic Analysis, tracks GDP per state per year, based on the total amount of income generated in the state, in millions of dollars per year. GDP data is tracked for both the *Sending State* and *Receiving State*. The GDP is divided by the state population published by the American Community Survey to create GDP per capita, which is a better measure of average state income.
The Bureau of Labor Statistics publishes data on the unemployment rate of each state, based on responses from the American Community Survey which is issued by the US Census Bureau. Migrants are likely to factor unemployment into their decision to move, choosing to move into states with lower unemployment rates, as they will have more job opportunities. This is also tracked for both the *Sending State* and *Receiving State*. Below is a table of summary statistics for unilateral flows into the 50 states, which can help show the prevalence of interstate migration.

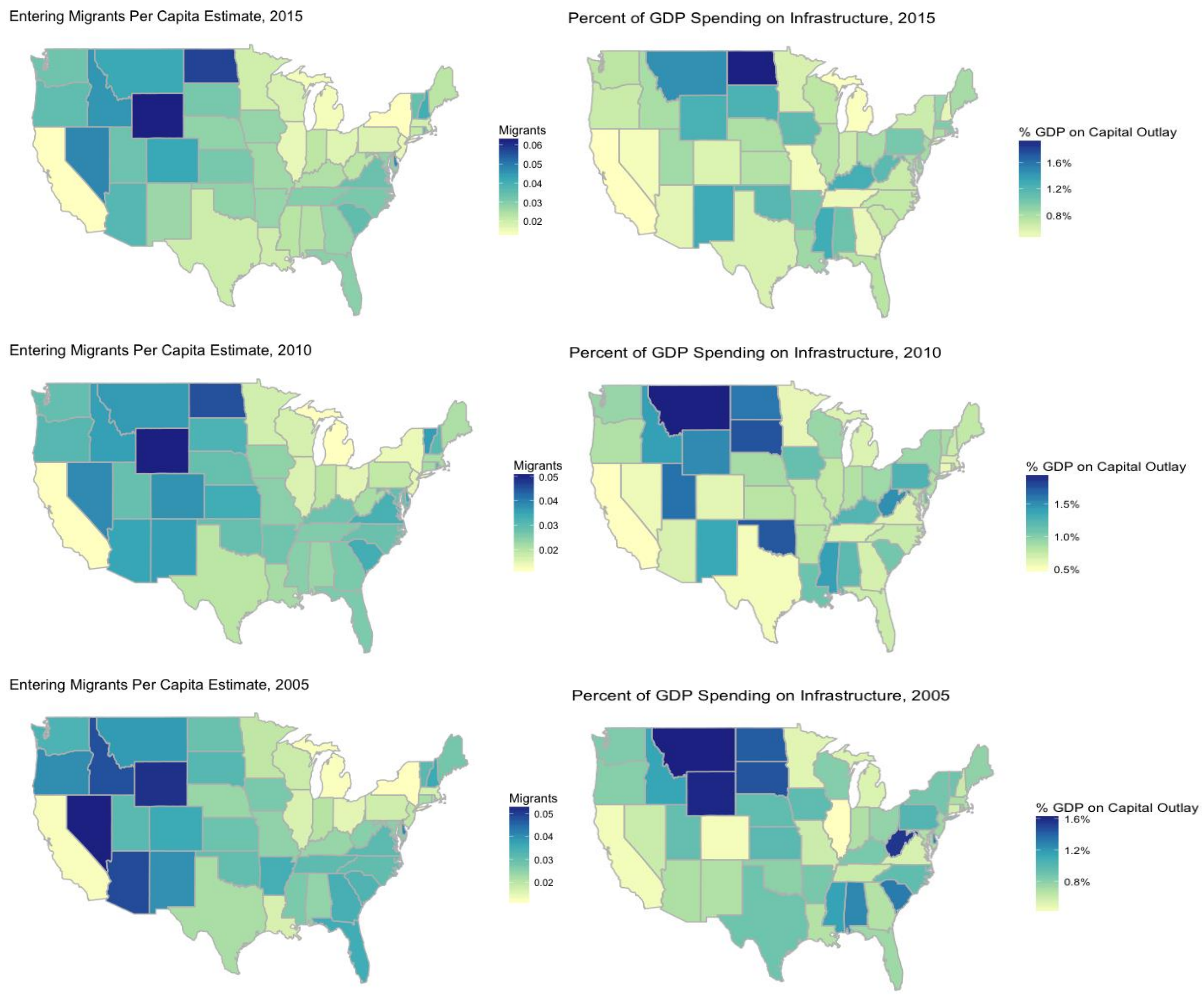
Table 1

Statistics	*Mean*	*Std. Dev.*	*Min*	*Max*
Total Population	6,125,715	6,767,296	509,294	38,675,135
Total Migrant Inflow	143,088	120,707	18,594	631,686
General Revenue	31,397,700,000	35,815,215,000	2,995,027,000	265,498,842,000
Total Expenditure	37,115,717,000	44,699,507,000	3,265,838,000	330,502,626,000
Capital Outlay Expenditure	2,268,635,000	2,238,861,000	202,115,000	11,705,347,000
Highway Expenditure	2,146,461,000	2,116,801,000	201,869,000	13,326,933,000
Unemployment Rate	6.02%	1.96%	2.70%	13.50%
Total GDP	303,997,000,000	372,624,000,000	23,539,000,000	2,505,853,000,000
GDP Per Capita	48,528.18	10,244.07	27,961.50	84,430.37

The total population and total migrant inflow are in absolute terms. The largest total migrant inflow was into Texas in 2006, which received 631,686 migrants, and the smallest was into North Dakota in 2005. State finances and GDP are in dollar amounts. New York in 2011 leads

Capital Outlay Expenditure with over $11 billion, and California in 2010 leads in Highway Expenditure, spending over $13 billion. State-level unemployment rate peaked in Nevada in 2010 at 13.5%, and was the lowest in North Dakota in 2014, at just 2.7%. The next variables are GDP and GDP per Capita. California in 2015 has the highest GDP, at over $2 trillion, and Vermont in 2005 is the smallest GDP in the dataset, at about $23 billion. The maximum for GDP per Capita in this dataset was in Alaska in 2012, with an income of $82,000 per capita; and the minimum was Mississippi in 2005, at just under $28,000 per person.

I created a few maps to visualize the data. The maps are for 2005, pre-crisis; 2010, post passing of the ARRA, and 2015, post recovery. The maps illustrate the migrant inflow per capita, a way to standardize state size for comparison, and the state's capital outlay expenditure as a percent of GDP. The lower 48 states are shaded between a pale yellow and dark navy indicating the level of entering migrants per capita and the level of capital outlay expenditure as a percent of GDP. The darker navy and pale yellow indicates higher values and lower values on the scale, respectively.
Figure 1:



I notice that northern states of the Midwest, such as Idaho, North Dakota and South Dakota spend the highest portion of their GDP on capital outlay. Perhaps this is reflective of the emergence of fracking and expansion of the oil industry, introducing a need for better infrastructure. California and Texas, the two largest of the 48 states, have consistently spent a low proportion of the state GDP on infrastructure expenditure. The 2005 map has more blue states than the 2010 and 2015, which indicates that in general, states were spending a higher proportion of their GDP on infrastructure. This is likely tied to the heavy level of expansion in new developments prior to the crash of the housing market. Wyoming leads with highest migrant inflow per capita, followed by other Midwestern and Western states such as Nevada, North Dakota and Idaho. The Rust Belt, which includes the states of Pennsylvania, West Virginia, Ohio, Indiana and Michigan, has low levels of migrant inflow per capita, indicated by their pale yellow shading. These graphics offer insight into major trends, but do not offer any explanation of such trends.

Figures 2 and 3 in the Appendix are additional data graphics. Figure 2 in the Appendix tracks total capital outlay expenditure for states over time. To make the data visualization easier to read, the states are divided into four regions: Southern, Northwestern, Midwestern and Western regions. The total capita outlay expenditure estimates the total number of infrastructure jobs in the state; which can help identify which states will be popular for migrants searching for jobs. Figure 3 in the Appendix tracks the total migrant inflow per capita per year. The addition of a per capita measurement standardizes the migrant inflow to the size of the state, so migration trends are more comparable.

V. Methods

The impact of infrastructure spending is initially tested in an ordinary sum of least square regression using unilateral migration data, testing for the economic reason a migrant may chose to move into a state without observing the state the migrant left. The unilateral data requires re-organized bilateral data, flattened to report only the total migrant inflow into a state from all other states in a given year. The regression is in linear form, testing the impact of infrastructure spending on the migrant flow into a state, controlling for the state's GDP level, unemployment rate and tax level. The unilateral model is given as:

$$Migrant_{it} = Inf_{it} + y_{it} + Unp_{it} + State_i + Year_t + \epsilon$$

Where *Migrant* is the number of migrants moving into state *i* at time *t*, *Inf* is the level of infrastructure spending of state *i* at time *t*, *y* is the level of the gross domestic product per capita of state *i* at time *t*, *Unp* is the unemployment rate of state *i* at time *t*, *State* is the state fixed effect, *Year* is the fixed effect for the year at time *t* and ϵ is a random error term. The regression does not analyze the economic situation and state effects of the sending states. Any effect of infrastructure spending on migrant flow is strictly based on the level of infrastructure spending in a receiving state. This is an analysis of infrastructure spending as only a pull factor, as a characteristic of a state that will incentivize individuals to move into it.

A more descriptive approach to analyze bilateral trends in migration patterns requires the utilization of both a classic gravity model and an adjusted gravity model using a Poisson Pseudo Maximum Likelihood approach. The econometric gravity approach is based on of the work of Jan Tinbergen (1962), who pioneered the gravity equation of trade. The idea behind this is similar Newton's law of universal gravitation, which states that the gravitational force between two objects, *i* and *j* is directly proportional to the product of the object masses and inversely proportional to the distance between the two objects. The Newtonian gravity equation is:

$$GF_{ij} = C\frac{M_i M_j}{D_{ij}}$$

Where GF is the gravitational force, M is the mass of object *i* and object *j*, D is the distance between the two objects and C is the gravitational constant. Jan Tinbergen related the theory of the importance of mass and distance to create a 'gravity of trade' measure, relating the 'mass' of a country to its GDP. The trade flow from country i to country j is based on a weighted product of their GDPs and is inversely proportional to the distance between the countries:

$$\mathrm{T_{ij}} \;=\; \mathrm{a\, Y_i^{\alpha 1}\, Y_j^{\alpha 2}\, D_{ij}^{\alpha 3}}$$

Where Y is GDP and D is distance, and the alphas are unknown parameters. The stochastic version of this gravity model accounts for errors:

$$\mathrm{T_{ij}} \;=\; \mathrm{a\, Y_i^{\alpha 1}\, Y_j^{\alpha 2}\, D_{ij}^{\alpha 3}\, \eta_{ij}}$$

Where $\mathrm{\eta_{ij}}$ is an error factor, with $\mathrm{E(T_{ij}|Y_i, Y_i, D_{ij})} = 1$, assuming the errors are statistically independent from the sample. This leads us to:

$$\mathrm{E(T_{ij}|Y_i, Y_i, D_{ij})} \;=\; \mathrm{a\, Y_i^{\alpha 1}\, Y_j^{\alpha 2}\, D_{ij}^{\alpha 3}}$$

The econometric tradition is to log-linearize the equation and estimate the parameters by the sum of least squares, adding population to control for country size, creating the model:

$$\ln \mathrm{T_{ij}} = \ln \alpha_0 + \alpha_1 \ln \mathrm{Y_i} + \alpha_2 \ln \mathrm{Y_j} + \alpha_3 \ln \mathrm{D_{ij}} + \alpha_4 \ln P_i + \alpha_5 \ln P_j + \ln \eta_{ij}$$

This model of trade can be transformed to predict the flow migration due to changes in GDP or unemployment level. The gravity model is adjusted from trade flow to the flow of human capital by measuring a level of migration flow based on a various number of explanatory variables.

Migration theory suggests that wage differentials between states spur migration. Empirical literature indicates that interstate migrants are willing to move for job opportunities and past research has found that significant factors that influence migration include median family income, unemployment, distance and welfare levels.

In this paper, I follow the gravity model estimates suggested by Biene, Bertoli and Moraga (2016). Their work explored the econometrics and application of gravity models of migration, and analyzed various gravity models, including random utility maximizing (RUM) and Poisson pseudo-maximum likelihood (PPML) models. They reviewed existing empirical evidence to determine some important determinants of international migration. While international migration is different than interstate migration, this work offers an idea of which explanatory variables are necessary in the gravity regressions estimating state-to-state migration, because economic migrants often react on similar economic phenomena, regardless if the movement is international or within a country.

I control for a list of variables as suggested by Beine, Bertoli and Moraga (2016) and previous literature. The gravity model is rooted in the importance of distance, so the first determinant of this econometric model is the log of the distance between the sending and receiving state. The second determinant is the income in the origin and destination states, estimated using income per capita. This is the best proxy of a migrants' earnings at a destination, and the earnings the migrants are choosing to forgo by leaving the origin. Some past work has factored in taxes by subtracting taxes per capita from income per capita, to create a measure of disposable income per capita. The log of the unemployment levels of the sending and receiving states are important measures that are included in interstate migration research, as measures of job opportunity. The log of welfare expenditure per capita is also included, as literature suggests this is a significant determinant of state-to-state migration. This study tests the impact of infrastructure spending, making it imperative to include the log of the infrastructure spending in both the sending and receiving states, using both state highway expenditure and capital outlay expenditure. The last determinant suggested by Beine, Bertoli and Morage (2016) is linguistic and cultural proximity, which is very significant in international migration because of the ease of assimilation if migrants speak the same language. As mentioned in the data section, there is no clear contiguity data available for the 50 states, so an indicator variable of whether or not states share a border will take its place.

The data spans from 2005 to 2015, which could include migration trends can are time dependent, making it necessary to include a fixed time effect, Year_t. The model should also include state fixed effects, accounting for the time-invariant state characteristics, such as the beautiful weather of California or low income taxes in New Hampshire. Lastly, an indicator variable that identifies bordering states is included in the regression, which functions as a measure of contiguity between two states. The final gravity model for the impact of infrastructure spending on migrant flow is given as:

$$\begin{aligned} MF_{ijt} = \alpha_0 + \ & \alpha_1 ln\, y_{it} + \ \alpha_2\, ln\, y_{jt} + \ \alpha_4 ln\, Ump_{it} + \alpha_5 ln\, Ump_{jt} + \ \alpha_6\, ln\, Inf_{it} \\ & + \ \alpha_7\, ln\, Inf_{jt} + \ \alpha_{10} \ln D_{ij} + \ Year_t + SendState_i + \ RecieveState_j \\ & + Border_{ij} + \ \eta_{ij} \end{aligned}$$

Where *MF* is the number of migrants moving from state *i* to state *j* at time *t*, *y* is the level of the gross domestic product per capita of state *i* and state *j* at time *t*, *Ump* is the unemployment rate of state *i* and state *j* at time *t*, *Inf* is the level of infrastructure spending of state *i* and state *j* at time *t*, *Year* is the fixed effect for the year at time *t*, *SendState* is the state fixed effect for the sending state *i* at time *t*, *ReceiveState* is the state fixed effect for the receiving state *j* at time *t*, and *Border* indicates if state *i* and state *j* share a border.

This model can be regressed using the ordinary least squares approach to estimate the effects of infrastructure spending on the migrant flow from state *i* to state *j* at time *t*. However, recent literature points to some shortcomings of the gravity model in its empirical application, specifically due to the appropriate estimation technique of the model, and the structure of the model itself.

The work by Santos Silva and Tenreyo (2006, 2011), finds that the traditional OLS gravity model is not the ideal solution for employing panel data techniques for two reasons. First the OLS gravity model does not allow for the existence of zero-flows of trade. Zero-trade flows are common in trade data and an estimation technique that does not remove these observations is needed. Second, the logarithmic transformation of the equation may cause the OLS estimators to be inconsistent in the presence of heteroscedasticity, meaning there is a pattern to the variance. Santos Silva and Tenryo recommend a Poisson Pseudo Maximum Likelihood (PPML) model, which uses non-linear estimators and allows zero-trade in bilateral observations. The PPML method also provides unbiased and robust estimators. This study was met with controversy, and studies opposing the recommendations, (such as Burger et al., 2009, Martinez-Zarzaso, 2013, and Helpman et al., 2008), introduced alternative strategies. In response, Santos Silva and Tenreyro (2008), argued that although different statistical methods can sometimes outperform PPML, the PPML is an ideal benchmark model to be used as a basis for bilateral trade flows. The Poisson Pseudo Maximum Likelihood takes a same form as the OLS to estimate bilateral flows between states.

$$MF_{ijt} = \alpha_0 + \alpha_1 ln\, y_{it} + \alpha_2\, ln\, y_{jt} + \alpha_4 ln\, Ump_{it} + \alpha_5 ln\, Ump_{jt} + \alpha_6\, ln\, Inf_{it} + \alpha_7\, ln\, Inf_{jt} + \alpha_{10} \ln D_{ij} + Year_t + SendState_i + RecieveState_j + Border_{ij} + \eta_{ij}$$

The final model above is regressed to analyze bilateral flows of migrants between the 50 states from 2005 to 2011.

VI. Results

The results which analyze the unilateral flows of migration into states are found in Table 2. The regressions contain the year fixed effects for years 2005 to 2015, and the state effect for each of the 50 states that accept migrants. It is run as a typical Ordinary Least Squares model predicting the natural log of Total Migrant Flow in a year into a state, using the natural log of the explanatory variables. The first regression is a baseline, predicting migrant flow into a state by using the state GDP per capita and state and year fixed effects. The model finds that the GDP per capita is statistically significant at the 1% level, which is in line with economic theory because we expect states with a higher level of GDP per capita to have an increased flow of migrants attracted by the the high income.

The second regression adds the log of highway expenditure and the third regression adds capital outlay expenditure. Both measures of infrastructure are found insignificant. The fourth regression expands the second regression and adds the unemployment rate of a state, testing the impact of highway expenditure on migrant flow into a state, controlling for both GDP and unemployment. In this regression, GDP continues to be statistically significant at the 0.01 level, and unemployment rate is statistically significant at the 0.01 level as well. The coefficients for the GDP per capita indicate the income elasticity, and for regressions 1 through 7, it is estimated that a 10% increase in GDP per capita would lead to an estimated 95% to 124% increase in migrant inflows. The change in migrant inflow due to a 10% increase in income per capita is dramatic, but indicates the willingness of migrants to move to a different state for even a marginal increase in income. In addition, many states have very similar standards of living, meaning that income differentials tend to be very small. Large changes in income would severely impact migrant inflow because it would dramatically change the wage differential, and thus, the incentive to migrate.

The sign on unemployment is negative, which indicates that states with high unemployment rates will have a lower level of migrant in flow. This is in line with theory, as migrants will prefer to avoid states with lower job opportunity. The coefficients for unemployment rate for regressions 4 through 7 are interpreted as a 10% increase in the unemployment rate will lead to an estimated 1.48% to 1.5% decrease of total migrant inflows. There is no evidence that highway expenditure has any effect on the migrant flow into a state.

The fifth regression expands the third regression and adds the unemployment rate of a state, finding the effect of capital outlay expenditure on migrant flow, controlling for unemployment and GDP, and again, only GDP and unemployment are statistically significant. The sixth and seventh regressions test welfare expenditure per capita. The remaining regressions do not find evidence for the impact of infrastructure spending, either capital outlay or highway expenditure. The two significant factors are GDP per capita and unemployment, both significant at the 99% confidence level, and both with signs that align with predictions from economic theory. This suggests that infrastructure had no effect on total migrant inflow into states between 2005 and 2011. The residual plots for regressions six and seven are shown in Figure 4 in the Appendix. The regressions meet normality, zero mean and heteroscedasticity assumptions.

Table 2

Migrant Inflow Results – Present Year Variables

	Dependent variable:						
	Log Total Migrant Inflow						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log GDP Per Capita	12.437***	12.458***	12.262***	9.742***	9.594***	9.691***	9.538***
	(1.420)	(1.526)	(1.528)	(1.712)	(1.704)	(1.713)	(1.706)
Log Highway Expenditure		-0.001		0.008		0.011	
		(0.025)		(0.025)		(0.025)	
Log Capital Outlay Expenditure			0.008		0.014		0.017
			(0.025)		(0.024)		(0.025)
Log Unemployment Rate				-0.148***	-0.148***	-0.149***	-0.150***
				(0.044)	(0.044)	(0.044)	(0.044)
Log Welfare Per Capita						-0.070	-0.073
						(0.084)	(0.084)
Observations	550	550	550	550	550	550	550
R^2	0.991	0.991	0.991	0.991	0.991	0.991	0.992
Receiving State Fixed Effects?	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects?	YES	YES	YES	YES	YES	YES	YES

Note: * p < 0.10 ** p < 0.05 *** p < 0.001

The next regression table is run using lagged variables, meaning the characteristics of the previous year explain the migration in the current year. The lag variables allow migrants to have a year to react and be able to move. Migrants may have trouble immediately reacting and migrating to a new state, so the lagged variables control for the migrants who decided to move into an appealing state, but for whom it took a year to actually migrate. The model includes lagged GDP per capita, lagged unemployment rate of a receiving state, lagged welfare expenditure per capita and lagged infrastructure spending, as both lagged highway expenditure and lagged capital outlay expenditure. The results shown in Table 3 are similar to the current variable unilateral regressions, again finding no statistical significance of infrastructure spending as a pull factor.

Table 3

Migrant Inflow Results – Lagged Variables

	Dependent variable:						
	Log Total Migrant Inflow						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log GDP Per Capita (t–1)	10.312^{***}	10.380^{***}	10.106^{***}	8.809^{***}	8.548^{***}	8.706^{***}	8.447^{***}
	(1.424)	(1.526)	(1.532)	(1.749)	(1.743)	(1.755)	(1.748)
Log Highway (t–1)		-0.003		0.002		0.005	
		(0.025)		(0.025)		(0.025)	
Log Capital Outlay (t–1)			0.009		0.012		0.015
			(0.025)		(0.025)		(0.025)
Log Unemployment Rate (t–1)				-0.080^{*}	-0.081^{*}	-0.083^{*}	-0.084^{*}
				(0.044)	(0.044)	(0.044)	(0.044)
Log Welfare Capita (t–1)						-0.074	-0.079
						(0.095)	(0.095)
Observations	500	500	500	500	500	500	500
R^2	0.992	0.992	0.992	0.992	0.993	0.993	0.993
Receiving State Fixed Effects?	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects?	YES	YES	YES	YES	YES	YES	YES

Note: $^{*}p < 0.10$ $^{**}p < 0.05$ $^{***}p < 0.001$

The first regression tests just GDP, which is significant at the 0.01 significance level. The sign on GDP per capita coefficients align with economic theory, acting as a pull factor that attracts migrant. When infrastructure spending is added, and both capital outlay and highway expenditure are found to be insignificant, meaning that there is no effect on the decision to move into a state. The fourth and fifth regressions add the lagged unemployment rate, which is statistically significant at the 90% confidence level and negative, which aligns with theory. Migrants are not moving into states with high unemployment rates the previous year, likely because states with high unemployment rates have low job availability. The lagged results indicate that migrants react to the GDP per capita and the unemployment rate of the previous years, but do not react based on welfare or infrastructure spending. The coefficients for the lagged unemployment rate for regressions 4 through 7 are interpreted as a 10% increase in the unemployment rate in the previous year will lead to an estimated 0.80% to 0.84% decrease of total migrant inflows. The coefficients for the lagged GDP per capita for regressions 1 through 7 are interpreted as a 10% increase in the GDP per capita in the previous year will lead to an estimated 84.5% to 103.12% increase in total migrant inflows. The residual plots for regressions six and seven are shown in Figure 5 in the Appendix. The regressions meet normality, zero mean and heteroscedasticity assumptions.

The final unilateral regressions include both lagged and normal explanatory variables, to explore how migrants react based on the current and previous year. The regressions in Table 4 contain both lagged and normal variables.

Table 4

Migrant Inflow Results – Both Present and Lagged Variables

	Dependent variable:						
	Log Total Migrant Inflow						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log GDP Per Capita	4.734*	4.870**	4.841**	1.942	1.848	1.854	1.740
	(2.428)	(2.449)	(2.443)	(2.565)	(2.557)	(2.571)	(2.563)
Log GDP Capita (t–1)	6.667***	6.824***	6.568***	7.650***	7.252***	7.595***	7.184***
	(2.347)	(2.420)	(2.438)	(2.517)	(2.511)	(2.521)	(2.515)
Log Unemployment Rate				-0.182***	-0.187***	-0.184***	-0.191***
				(0.058)	(0.059)	(0.058)	(0.059)
Log Unemployment Rate (t–1)				0.048	0.048	0.046	0.047
				(0.057)	(0.057)	(0.058)	(0.057)
Log Welfare Per Capita						-0.024	-0.032
						(0.092)	(0.092)
Log Welfare Per Capita (t–1)						-0.068	-0.074
						(0.104)	(0.103)
Log Highway Expenditure		-0.013		-0.006		-0.005	
		(0.027)		(0.027)		(0.027)	
Log Highway Expenditure (t–1)		0.002		0.005		0.009	
		(0.027)		(0.027)		(0.027)	
Log Capital Outlay			-0.012		-0.004		-0.002
			(0.028)		(0.028)		(0.028)
Log Capital Outlay (t–1)			0.015		0.022		0.026
			(0.027)		(0.027)		(0.027)
Observations	500	500	500	500	500	500	500
R^2	0.993	0.993	0.993	0.993	0.993	0.993	0.993
Receiving State Fixed Effects?	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects?	YES	YES	YES	YES	YES	YES	YES

The second and third regressions test the impact of infrastructure controlling for just both GDP per capita and GDP per capita lagged one year. The GDP per capita of the current year and the prior year are both statistically significant and positive, functioning as pull factors that attract migrants. GDP per capita of the prior year is more significant and more positive, indicating it is a more powerful explainer than the current level of GDP per capita. This means migrants often take time to react to decisions, and that the decision to move in a current year is more heavily based off the economic conditions of the previous year.

The fourth through seventh regressions add unemployment and welfare expenditure per capita. Infrastructure spending, in the form of highway expenditure and capital outlay expenditure, continues to be insignificant. The unemployment rate of the current year is negative and significant at the 99% confidence level, which is in line with theory, because it suggests that migrants avoid moving into states with high unemployment levels because of the lower job availability. The unemployment rate lagged one year and welfare expenditure of the current and previous year are statistically insignificant. When the unemployment rate is introduced, GDP per capita loses its significance, while GDP per capita lagged one year continues to be statistically significant at the 99% confidence level. This indicates that migrants are making decisions based on state income level of the previous year and the current unemployment rate.

The results are interesting and the signs of the coefficients align with theory, as GDP per capita is a positive pull factor and unemployment rate is a negative pull factor. The coefficients for lagged GDP per capita in regressions 1 through 7 are interpreted as a 10% increase in GDP per capita of the previous year will lead to an estimated 66.7% to 71.8% increase of total migrant inflows. Again, these large increases of migrant inflow due to a small change in income per capita indicate the willingness of individuals in the US to capture small income differentials. The coefficients for unemployment rate in regressions 4 through 7 are interpreted as a 10% increase in unemployment the current year will lead to an estimated 1.8% to 1.9% decrease of total migrant inflows. Infrastructure spending is statistically insignificant in all the regressions, meaning there is no impact of current or previous infrastructure spending on the migrant inflow into a state. The residual plots for regressions six and seven are shown in Figure 6 in the Appendix. The regressions meet normality, zero mean and heteroscedasticity assumptions.

The full dataset, panel data tracking bilateral flows between the 50 states for 11 years is analyzed using Poisson Pseudo Maximum Likelihood regression and the results are shown in Table 5. The most robust regression are models 6 and 7, which control for all the variables: GDP per capita, unemployment and welfare of both the receiving and sending states, and the distance between the states, and test the impact of highway expenditure in model six, and the impact of capital outlay expenditure in model seven.

No matter what combination of economic variables are put into place, there is no significance of infrastructure spending as a factor in a migrant’s decision to move for any of the seven models. Distance, the first explanatory variable, is negative and significant at the 99% confidence level for all seven models, meaning that as the distance between two states increases, the migrant flow between the two states will decrease, which is in line with theory. The coefficients for distance indicates that a 10% increase in distance will cause an estimated 6.8% decrease in migrant flow between states.

There are two significant receiving state explanatory variables. The receiving state GDP per capita is statistically significant at the 99% confidence levels for regressions 1 through 3, then, once unemployment is added to the regressions, the significance falls to 95%. The coefficient is positive, and is interpreted as when a states GDP per Capita increases by 10%, it will experience an estimated 43% to 88% increase in the migrant flow into the state. The increase of migrant inflow is in line with literature. The receiving state unemployment has a negative coefficient and is significant at the 99% confidence level. A 10% increase unemployment rate of a receiving state is estimated to cause a 2.2% decrease migrant flow into the state, making it a negative pull factor. This is in line with theory because a higher unemployment rate means low job availability, incentivizing fewer migrants to move into a state. The models do not find any significance in the level of infrastructure spending in a state. This indicates that there is no effect of infrastructure spending in a state on migration patterns.

The residual plots for regressions six and seven are shown in Figure 7 in the Appendix. The PPML regressions are slightly screwed, as seen in the QQ plot, so the model does not completely meet the normality assumption. The histogram illustrates that the zero mean condition is met, as the errors are concentrated at zero. The fitted value and residuals plot indicates constant variance, so the heteroscedasticity assumption is met.

The next regression table also analyzes the bilateral flow of migrants in the United States over 11 years, but the data is separated into states that share a border and states that do not share borders. There are 2,450 unique state pairs, 50 states paired with 49 states. Of the 2,450 state pairs, 220 unique pairs share a border, meaning that there are 2230 pairs that are not bordering. This means a data of bilateral migration flows over 11 years will have 2420 observations for all the neighboring states, and 24,530 observations for the non-neighboring states.

The analysis of just bordering states can test if migrants are willing to move across a state border for an infrastructure job. A migrant may be more likely to move from Connecticut to Massachusetts for an infrastructure job, rather than from Connecticut to California. The regressions of the bordering states are compared to non-bordering states. Infrastructure spending is significantly insignificant for both bordering-state and non-bordering state regressions. This last model find conclusion of this empirical evidence finds that there is no significant impact of infrastructure spending on interstate migration.

Table 5

Gravity Estimation Results - Poisson Pseudo Maximum Likelihood Results

	Dependent variable:						
	Migrant Flow						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log Distance	-0.681***	-0.681***	-0.681***	-0.681***	-0.681***	-0.681***	-0.681***
	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
Border	0.740***	0.740***	0.740***	0.740***	0.740***	0.740***	0.740***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Log Sending GDP Per Capita	5.184***	5.630***	4.981***	7.215***	6.390***	7.219***	6.377***
	(1.696)	(1.766)	(1.773)	(1.975)	(1.958)	(1.979)	(1.961)
Log Sending Unemployment				0.081*	0.075*	0.081*	0.075*
				(0.043)	(0.042)	(0.043)	(0.043)
Log Sending Welfare Capita						0.004	-0.004
						(0.043)	(0.043)
Log Receiving GDP Per Capita	8.834***	9.192***	9.094***	4.178**	4.281**	4.199**	4.300**
	(1.695)	(1.776)	(1.789)	(2.025)	(2.017)	(2.026)	(2.018)
Log Receiving Unemployment				-0.225***	-0.224***	-0.224***	-0.223***
				(0.043)	(0.043)	(0.044)	(0.043)
Log Receiving Welfare Capita						0.013	0.014
						(0.044)	(0.043)
Log Sending Highway		-0.021		-0.026		-0.026	
		(0.023)		(0.024)		(0.024)	
Log Receiving Highway		-0.015		-0.0005		-0.001	
		(0.023)		(0.023)		(0.023)	
Log Sending Capital Outlay			0.010		0.008		0.008
			(0.024)		(0.024)		(0.024)
Log Receiving Capital Outlay			-0.011		-0.005		-0.005
			(0.024)		(0.024)		(0.024)
Observations	26,950	26,950	26,950	26,950	26,950	26,950	26,950
State Fixed Effects?	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects?	YES	YES	YES	YES	YES	YES	YES

Note: $^{*}p < 0.01$ $^{**}p < 0.05$ $^{***}p < 0.001$

Table 6

Poisson Pseudo Maximum Likelihood Results - Border and Non-Border States

	Dependent variable:							
	Bordering State Migrant Flow				Non-Bordering State Migrant Flow			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Distance	-0.672***	-0.672***	-0.672***	-0.672***	-0.778***	-0.778***	-0.778***	-0.778***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.006)	(0.006)	(0.006)	(0.006)
Log Sending GDP Per Capita	1.874	0.477	2.231	0.725	8.114***	7.493***	8.131***	7.507***
	(4.428)	(4.411)	(4.442)	(4.422)	(1.907)	(1.890)	(1.908)	(1.891)
Log Sending Unemployment	0.130	0.122	0.135	0.124	0.047	0.042	0.047	0.041
	(0.097)	(0.097)	(0.098)	(0.097)	(0.042)	(0.041)	(0.042)	(0.041)
Log Sending Welfare Per Capita			0.076	0.059			0.005	0.0001
			(0.092)	(0.091)			(0.042)	(0.042)
Log Receiving GDP Per Capita	2.063	2.211	1.707	1.942	5.132***	5.137***	5.168***	5.125***
	(4.376)	(4.370)	(4.390)	(4.381)	(1.988)	(1.983)	(1.988)	(1.983)
Log Receiving Unemployment	-0.175*	-0.163	-0.180*	-0.167*	-0.259***	-0.263***	-0.252***	-0.257***
	(0.100)	(0.099)	(0.100)	(0.099)	(0.042)	(0.042)	(0.042)	(0.042)
Log Receiving Welfare Per Capita			-0.083	-0.077			0.073*	0.070
			(0.093)	(0.093)			(0.043)	(0.043)
Log Sending Highway	-0.030		-0.036		-0.025		-0.025	
	(0.047)		(0.048)		(0.023)		(0.024)	
Log Receiving Highway	0.043		0.050		-0.027		-0.032	
	(0.048)		(0.048)		(0.023)		(0.023)	
Log Sending Capital Outlay		0.025		0.022		0.002		0.002
		(0.048)		(0.049)		(0.024)		(0.024)
Log Receiving Capital Outlay		0.039		0.044		-0.028		-0.031
		(0.048)		(0.049)		(0.023)		(0.023)
Observations	2,420	2,420	2,420	2,420	24,530	24,530	24,530	24,530
State Fixed Effects?	YES	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects?	YES	YES	YES	YES	YES	YES	YES	YES

Note: $^{*}p < 0.01$ $^{**}p < 0.05$ $^{***}p < 0.001$

The bordering state regressions have two explanatory variables that are statistically significant, the distance and receiving state unemployment rate. The distance variable, significant with 99% confidence, estimates that a 10% increase in distance between states will decrease the migrant flow by 6.7%. This negative sign aligns with theory, which suggests that as distance between states increases, the migrant flow between the states will decrease. It is quite interesting that distance is significant for just bordering states, because it indicates that distance of the move still matters, even if it is just across the border. These results suggest there is more movement across border in states that are smaller, and therefore, there is less distance from any point in the state to a border. These results suggest there is more movement in an area like New England than the Midwest. This implies there is more migration between states like Vermont and New Hampshire, in which at any place in Vermont you are a 3-hour car ride to New Hampshire, than between states such as North Dakota and South Dakota, where the distance between two town in each state can be a 9 hour car ride.

The Receiving state unemployment rate is significant at the 90% confidence level. A 10% increase in the receiving state unemployment rate is estimated to reduce migrant flow into the state by about 1.6 to 1.8%. States with high unemployment rates will have a lower rate of migration flow into the state because migrants are not attracted to poor job markets.

The non-bordering states have more significant explanatory variables, which may indicate that migration between bordering state is more random and harder to be explained using economic characteristics, while non-bordering state migration is more planned out, and therefore, better described using economic analysis. Migration between non-bordering states is explained by distance, the sending state GDP per capita, receiving state GDP per capita and receiving state unemployment rate. Distance is negative, aligning with theory, and a 10% increase is distance is estimated to decrease migrant flow by about 78%. The sending state GDP per capita is significant and positive, because a 10% increase in the sending state GDP per capita is estimated to increase migrant flow out of the state by 74% to 81%. This indicates that migrants a likely to leave a state with a higher income level, which is contrary to theory, and indicates an area of future research. Receiving state GDP per capita is positive, because a 10% increase in the receiving state GDP per capita is estimated to increase migrant flow into the state by 51%. This means that migrants are attracted to areas with high income, which is in line with economic theory. Lastly, receiving state unemployment is negative, because a 10% increase in the receiving state unemployment rate will lead to a 2.5% decrease in the migrant flow into the state. This indicates that unemployment rate functions as a negative pull factor, which is in line with theory.

There is no impact of infrastructure on interstate migration in any of the regressions above. A hypothesis to explain the lack of impact of infrastructure spending on state migration during this time is perhaps because infrastructure jobs were immediately soaked up by people living in the state due to the fact these jobs are by nature “shovel ready.” Therefore, although infrastructure creates jobs, the jobs are less likely to be filled by migrants, because individuals in-state already filled the position. Future work can be done to further explore the determinants of interstate migration, as well as track where the workers that fill infrastructure positions live.

VII. ARRA Data:

Data from the American Recovery and Reinvestment Act of 2009 was downloaded from Recovery.gov, before the site was shut down, and now sits in a National Bureau of Economic Research archive. The dataset contains information on over $250 billion worth of contracts, grants and loans awarded by the ARRA, from February 17, 2009 to June 30, 2012. This data set contains over half a million observations. I cleaned and aggregated the data to test if the shock of ARRA spending has any influence on total migrant inflow, controlling for the receiving state's GDP per capita, the unemployment rate, and welfare per capita. This data can test for a specific effect of the exogenous shock of the ARRA funding alone, which may have a more important impact that state infrastructure expenditure, because it is exogenous to state characteristics.

The data contains information on every recipient of ARRA funding, information such as recipient name and address, and how much was awarded. First, the data is cleaned to ensure that a value exists for the total amount of funding awarded and the state in which the recipient is located. Then, the total amount of funding each state received is calculated. This does not refer to the state government, it is a measure of every penny of ARRA funding that entered a state, to any kind of recipient, whether it is a school system, a construction company, or a local town. This variable is the total shock of spending availability a state received, which would allow it to create more jobs and therefore, incentivize migrants to move into the state.

The average amount of ARRA spending each state received between 2009 and 2012 was about $254.58 per person per year. There is a lot of variability in this figure. In 2012, Alaska and Vermont received $1431.00 and $1193.00 per person, respectively. This is almost five times the average amount, and these two states were the only two to surpass an award of over $1000 per person. The differentials in ARRA distribution likely created wage differentials in the job market, which can be tested for evidence of economic migration, by running a unilateral regression similar to the regressions found in Table 2.

The unilateral regression that tests the impact of ARRA funding on migrant inflow takes the form:

$$Migrant_{it} = ARRA_{it} + y_{it} + Unp_{it} + Welfare_{it} + State_i + Year_t + \epsilon$$

Where $ARRA_{it}$ is the total amount of ARRA funding state *i* receives at time *t*, y_{it} is the GDP per capita of state *i* at time *t*, Unp_{it} is the unemployment rate of state *i* at time *t*, $Welfare_{it}$ is the welfare expenditure per capita of state *i* at time *t* and $State_i$ and $Year_t$ are the state and time fixed effects. This regression is run on 200 observations, the 50 states over 4 years, from 2009 to 2012.

Table 7

Unilateral Results - ARRA				
	Dependent variable:			
	Log Total Migrant Inflow			
	(1)	(2)	(3)	(4)
Log GDP Per Capita	3.218	3.224	2.487	2.431
	(3.302)	(3.314)	(3.326)	(3.336)
Log Total ARRA Expenditure		0.001	0.0005	0.0005
		(0.007)	(0.007)	(0.007)
Log Unemployment Rate			-0.187	-0.194*
			(0.114)	(0.115)
Log Welfare Per Capita				-0.087
				(0.163)
Observations	200	200	200	200
State Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
R^2	0.995	0.995	0.995	0.995

Note: * $p < 0.01$ ** $p < 0.05$ *** $p < 0.001$

The results are shown on Table 7 above. The table indicates that the state unemployment rate is the only significant determinant of the migrant inflow between into states between 2009 and 2012. The coefficient on unemployment rate is negative, which is in line with theory, and it is significant with 90% confidence. The total ARRA funding expenditure is not statistically significant, meaning it did not impact a migrants' decision to move into a state. There is no indication that ARRA funding was large enough to incentivize any migration. This data can be further explored, and used in a gravity model in future work. The main reason there is little significance in state GDP per capita and unemployment rate is because of the presence of both state and time fixed effects. State effects capture the effects of any time invariant trends and time effects capture any time variant trends that effected all states, such as the Great Recession. With only 4 years of data and just 200 observations, the presence of 50 state fixed effects and 4 time fixed effects have a lot of explanatory power. In addition, this time period was in the middle of a unique recession, because of the housing crisis created through issuing subprime mortgages. Many Americans could have been locked into their homes, due to underwater mortgages, meaning that the mortgage was more expensive than the value of the home. This meant they would not have been able to migrate even if was desirable to do so, because they were not able to move out of their homes. Therefore, this time frame is unique and harder to study. Future research with this data is needed.

VIII. Conclusions

Inter-state migration in the United States is a driver of the labor market equilibrium, and allows residents to move to areas with higher returns, whether the returns are reflected in wages or job opportunities. Infrastructure expenditure can therefore become a significant pull factor which functions as a labor market equalizer, moving individuals to areas with better opportunities. This work analyzed the effect of infrastructure spending in the 50 US States over 11 years. The results of this empirical study found indicate there is no significant effect of infrastructure spending on a migrant's decision to leave or move to a state. The significant decision makers for the move between states include the distance between the states, sending and receiving state GDP level and the sending and receiving state unemployment rate. Migration inflow is estimated to heavily increase due to a small change in income per capita, which reflects migrants' willingness to capture any wage differentials in the United States. Further work includes exploring other variables which influence interstate migration, and the presence of state-boundary commuters in infrastructure jobs or major projects.

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X. Appendix

Figure 2: Capital Outlay Expenditure by Region:

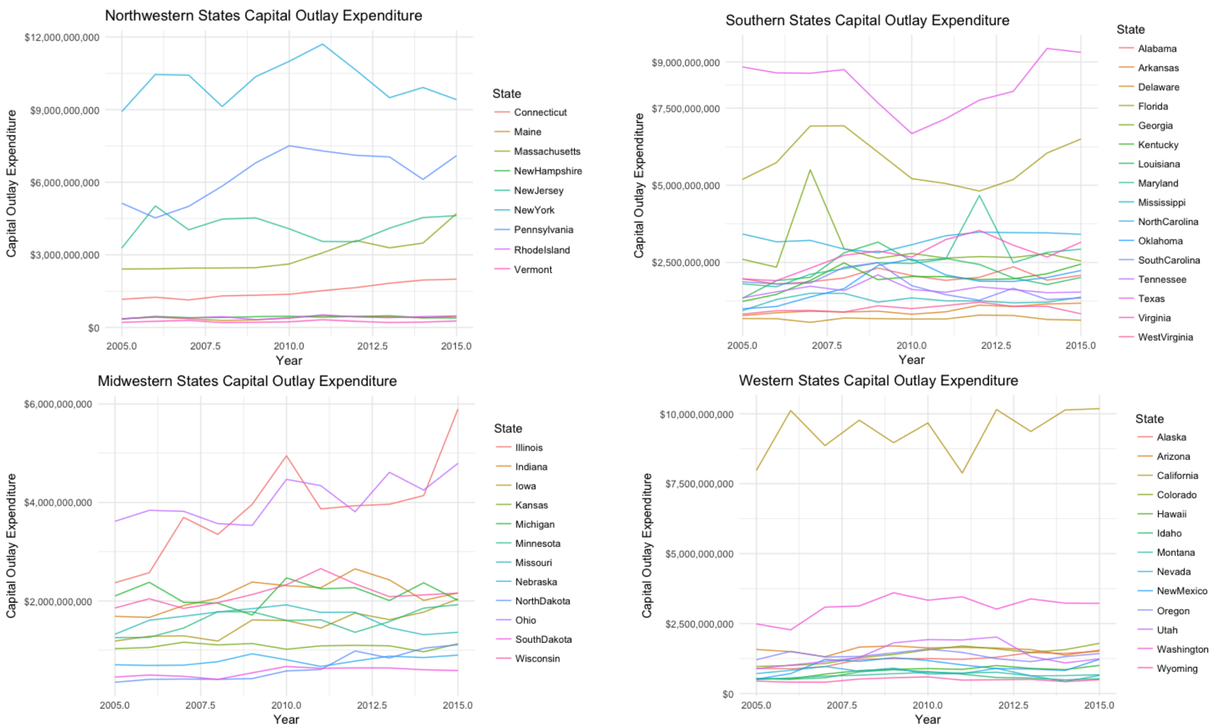


Figure 3: Total Migrant Inflow Per Capita by Region:

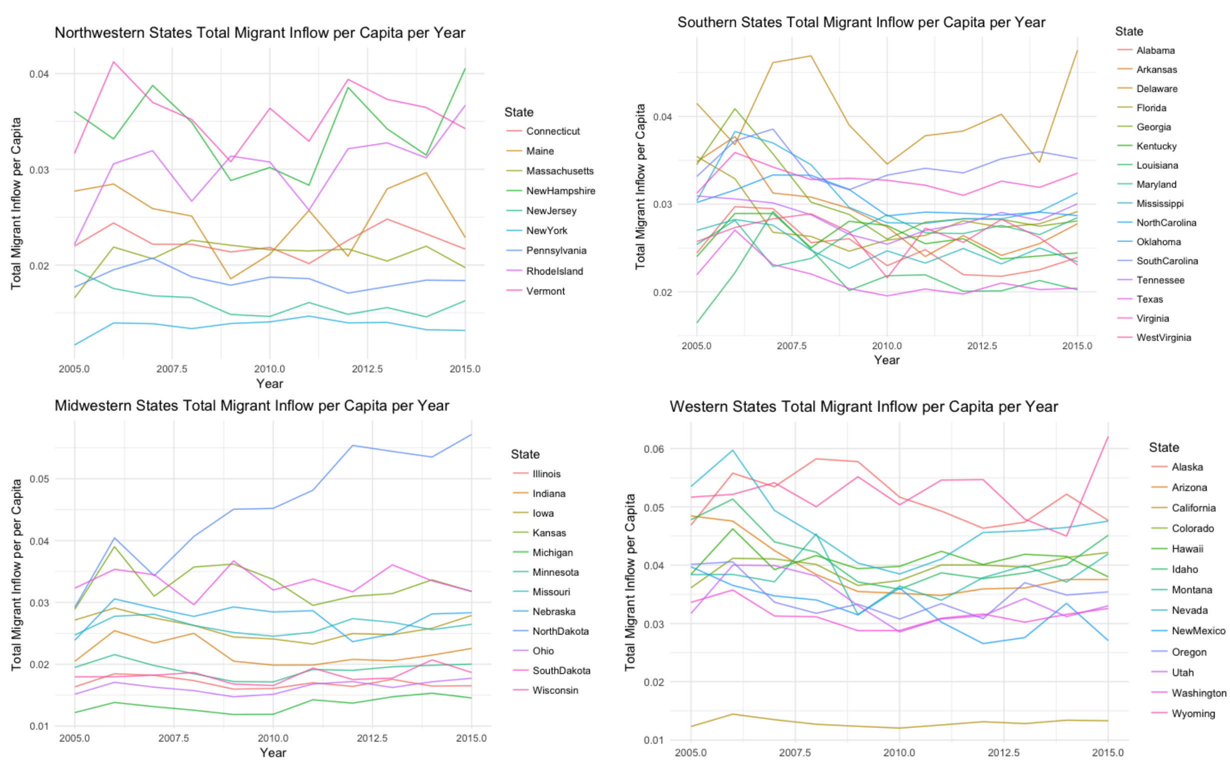
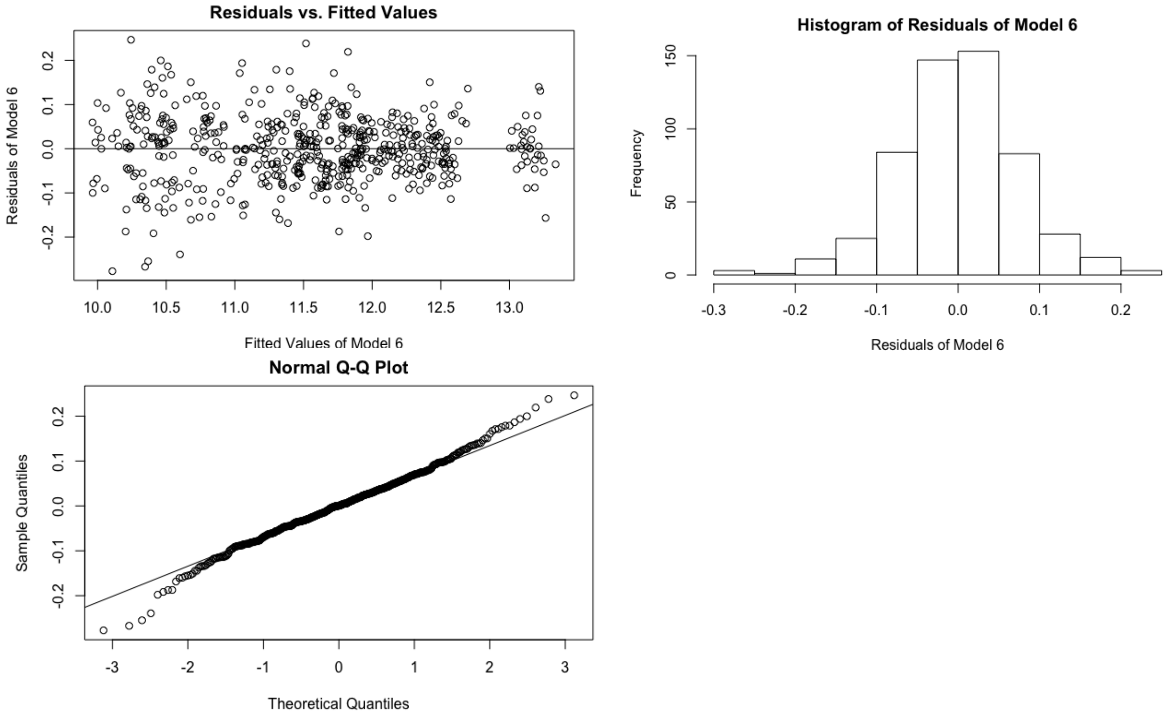


Figure 4: Residual Plots for Table 1: Unilateral Migrant Inflow – Present Year Values: Residual vs. Fitted Values, Histogram of Residuals, Q-Q Plot for Model 6:



Residual vs. Fitted Values, Histogram of Residuals, Q-Q Plot for Model 7:

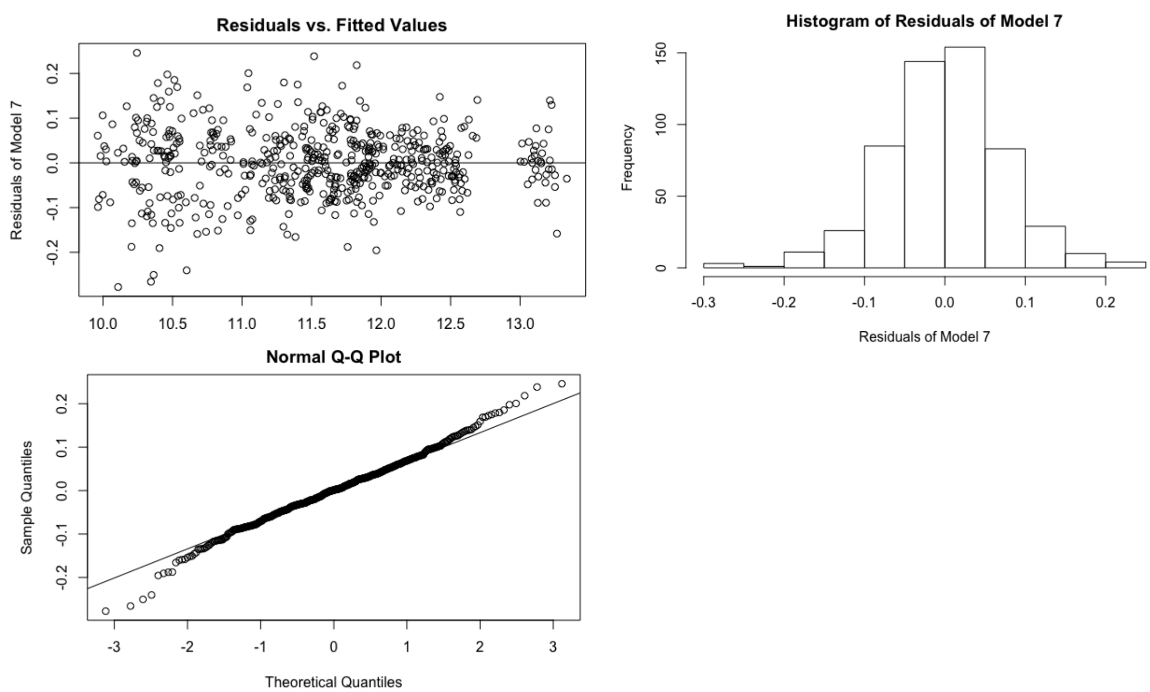
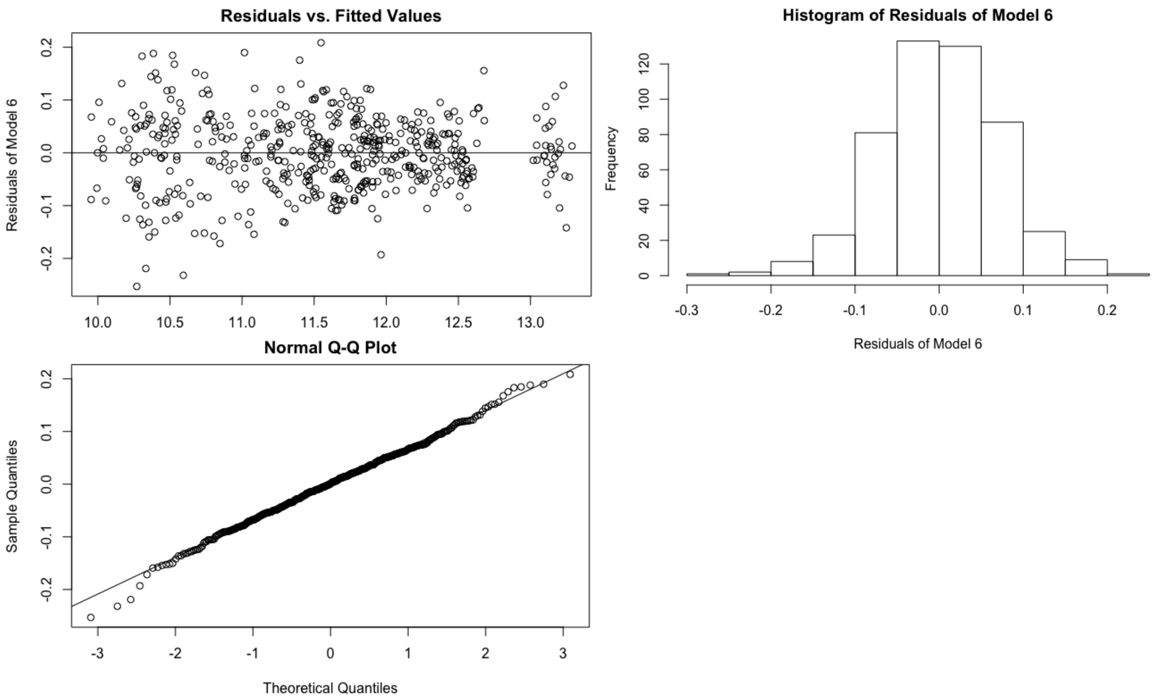
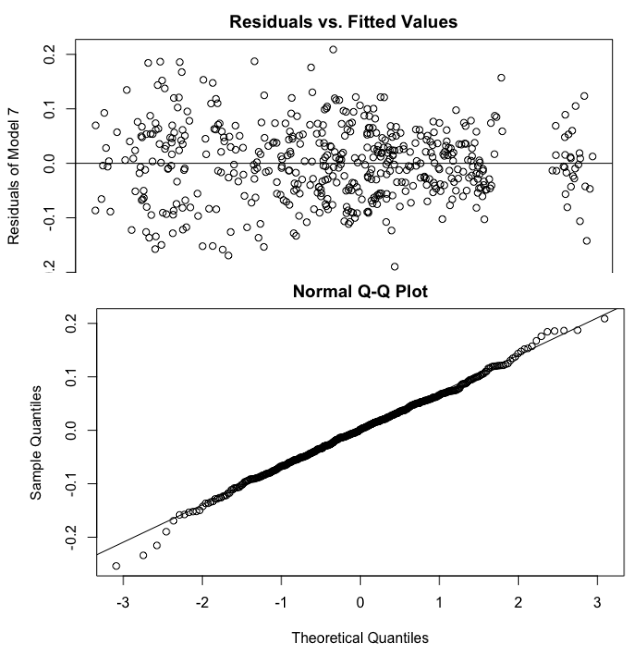
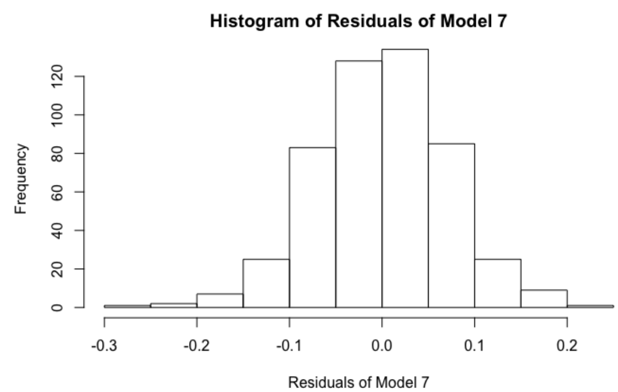


Figure 5: Residual Plots for Table 2: Unilateral Migrant Flow Results – Lagged Variables
Residual vs. Fitted Values, Histogram of Residuals, Q-Q Plot for Model 6:



Residual vs. Fitted Values, Histogram of

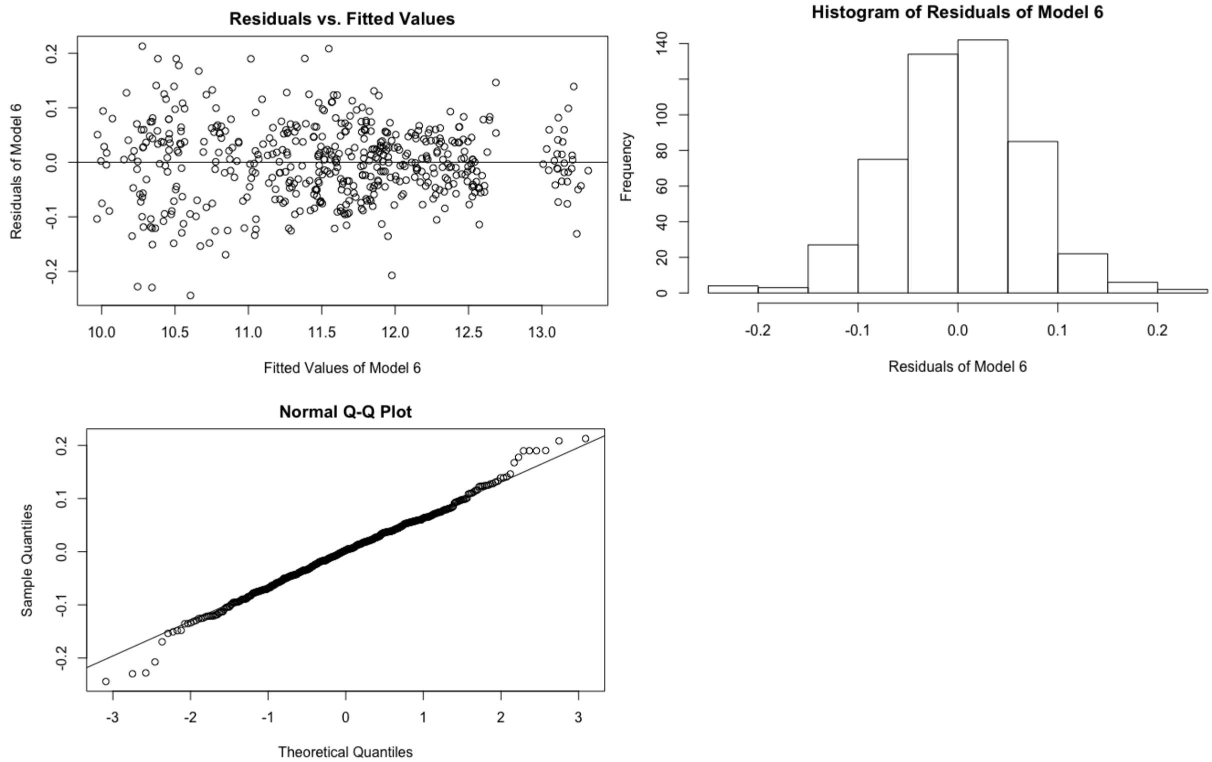




Residuals, Q-Q Plot for Model 7:

Figure 6: Residual Plots for Table 3: Unilateral Migrant Flow Results – Both Present and Lagged Variables

Residual vs. Fitted Values, Histogram of Residuals, Q-Q Plot for Model 6:



Residual vs. Fitted Values, Histogram of Residuals, Q-Q Plot for Model 7:

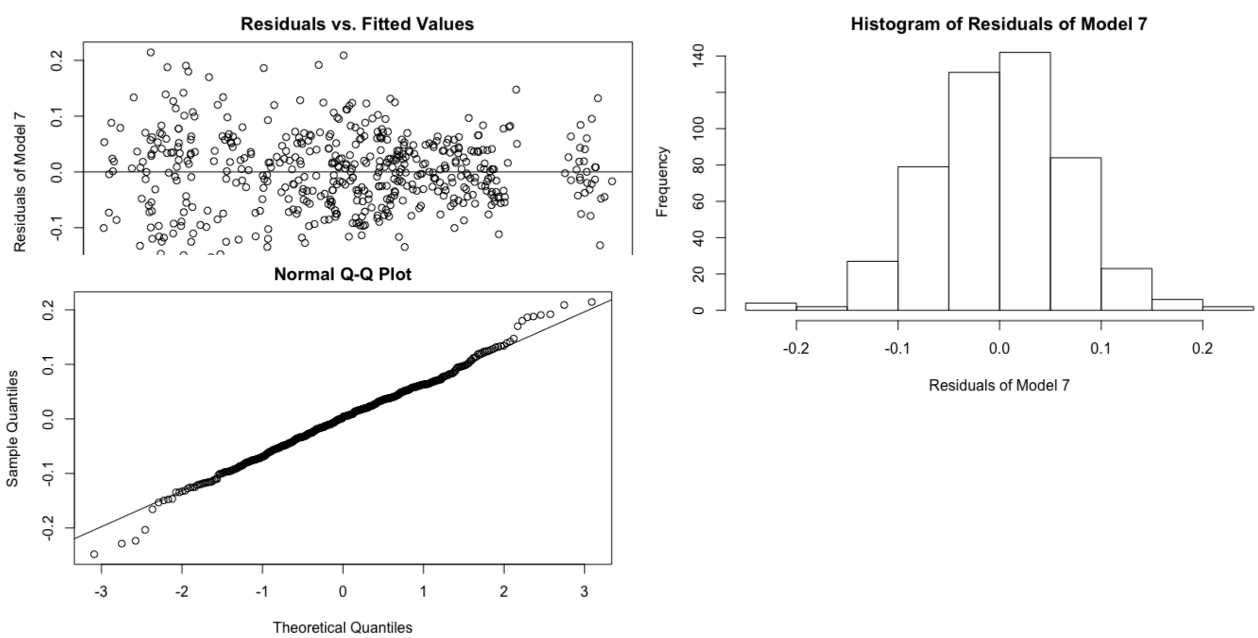
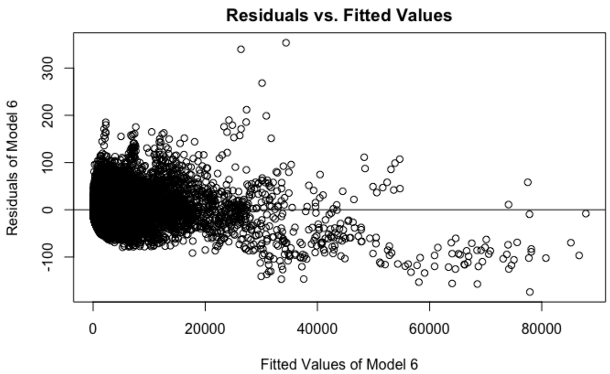
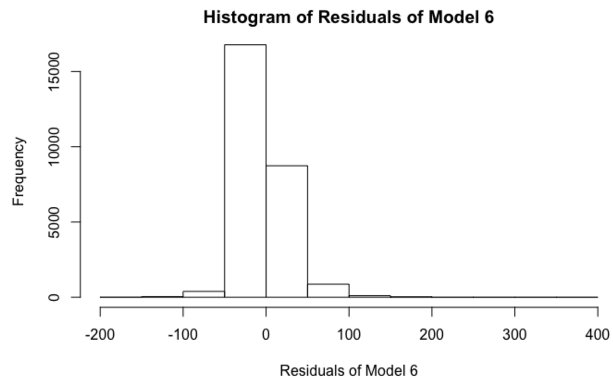
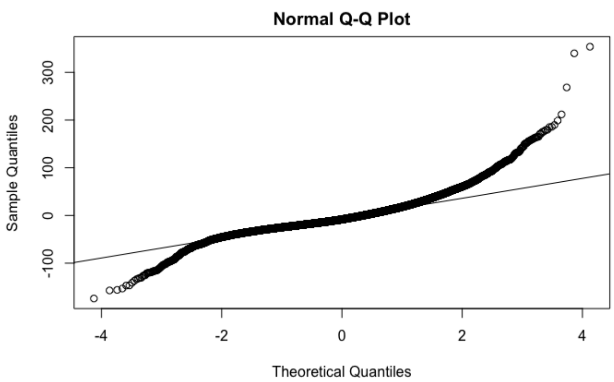


Figure 7: Residual Plots for Table 5: Poisson Pseudo Maximum Likelihood Results







Residual vs. Fitted Values, Histogram of Residuals, Q-Q Plot for PPML Model 6:

Residual vs. Fitted Values, Histogram of Residuals, Q-Q Plot for PPML Model 7: