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UNITED STATES' DOMESTIC TRADE AND DOMESTIC MIGRATION DURING 1993 - 2017 : THE ROLE OF POLITICS, FOREIGN IMPORT, AND SIZE

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by

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Submitted in Partial Fulfillment of the Requirements for the

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MAJOR PROFESSOR: Dr. Sajal Lahiri

In this dissertation, we study the United States' domestic trade and domestic migration with special focus on Politics, Foreign Import and Size. This study sheds light on the literature of International Economics, Regional Economics, and Development Economics. In Chapter 1, using a Gravity model for trade between the U.S. states and employing CFS data of the year 1993 - 2017, we find that politically and economically similar states trade more among themselves. We use three different definitions of political similarity based on election outcomes, and they all give similar results. For economic similarities, we follow the literature on Linder's hypothesis. In Chapter 2, by using the same CFS data and Gravity model which we have used in Chapter 1, we analyze the impact of foreign imports by the States on their domestic exports. We find fairly strong support for our hypothesis that foreign imports promote domestic exports. We carry out a series of robustness checks, and the qualitative results remain the same. Chapter 3 investigates the impact of size on the U.S. inter-state migration over the period of 1998-2017 employing structural gravity model of migration. We use population, GDP and Land area as a proxy to measure the size of the states. We find that people are moving from big states to small states. We find that the American's are moving from big states to small states. We also find that increase in income tax as a proportion of population in U.S. states, positively affect the interstate migration in the origin state but negatively affect the destination state.

DEDICATION

I dedicate this dissertation to my mother Bimala Paudel, my father Khaga Prasad Paudel and my dear brother Arjun Paudel.

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CHAPTER 1

DO POLITICALLY AND ECONOMICALLY SIMILAR STATES IN THE U.S.A. TRADE MORE WITH EACH OTHER?

1.1 Introduction

Do politically and economically similar states trade more with each other in the United States? This is the main question that this paper addresses. An answer to this question has significant implications for policy makers as more trade between the states is likely to foster growth in the U.S., and attempts should be made to take down barriers to domestic trade in the form of, for example, political similarities.

For trade between countries, several studies have examined the effect of politics on trade flows. Pollins (1989a, 1989b) show that bilateral trade flows are significantly influenced by political relationship between nations, and relative cooperativeness or hostility in bilateral political ties. Marrow et al. (1998) find that trade flows are greater between nations with similar political interests than those dissimilar interest. According to Simmons (2005), cordial relation between trading partners helps them to enjoy joint gains from trade. As for trade between the states of the United States, political polarizations since the 1970s – as noted by Glaeser and Ward (2006) and Abramowitz and Saunders (2008) – raise the question if such polarization acts as a barrier to domestic trade between the states. Ishise and Matsuo (2015) made an attempt to test this hypothesis and found evidence for the existence of such a barrier.

The reasons why politically similar states in the U.S. may trade more is possibly very different from why political relationships between nations affect international trade. In the case of domestic trade, perhaps network formations have something to do with it. In any case, for reasons mentioned above, it is interesting to test if politically similar states in the United States trade more with each other or not.

For trade between countries, Linder (1961) put forward product quality and intra-industry trade as two reasons why economically similar nations might trade more with each other. Bergstrand (1990) found a greater similarity in per-capita income was associated with more intra-industry trade between nations. Other studies, using bilateral international trade data and the Gravity model, have tested the Linder hypothesis, and found overwhelming support for it (see, for example, Thursby and Thursby, 1987; Tang, 2003; Baltagi et al., 2003). In fact, Baltagi et al. (2003) found that without the Linder's effect, the regression would suffer from misspecification error. Similar arguments might apply to U.S. domestic trade as well. Dingel(2017), using three years CFS data at the micro levels individual product trade between U.S. cities, finds support for Linder's hypothesis.

There are a few other studies that examine interstate trade in the U.S.A., using Gravity analysis (see, for example, Wolf, 2000; Millimet and Osang, 2007). Wolf (2000) and Millimet and Osang (2007) use CFS data for the years 1993 and 1997. Their purpose was to test the existence or otherwise of border effect.

In this paper, we apply the gravity model of trade to analyze U.S. inter-state trade of the years 1993, 1997, 2002, 2007, 2012 and 2017. Presidential, Gubernatorial and Senate election data are used to generate our political similarity variables. For the Linder variable, we follow the literature and consider absolute value of differences in per-capita income.

As mentioned before, Dingel (2017) also tests the Linder's hypothesis using inter-state trade data for the U.S., albeit for three years only and six years as we do. More importantly, his data is much more micro than our data. Although more micro data is useful to check for the validity of the hypothesis for each product and for trade between cities, the state-level data is likely to be subject to less noise because of the law of large numbers and therefore we work with more stable variables. Dingel (2017) does not consider the political issue of trade between blue states and red states. Ishise and Matsuo (2015), on the other hand, uses inter-state trade data like us, though not six years like us but for four years, and tests if political dissimilarities between the states acts as a barrier to trade. They do not consider Linder's hypothesis. There are other important differences between our analysis and that of Ishise and Matsuo (2015).

Using four years CFS data, Ishise and Matsuo (2015) define a blue-red dummy which is time invariant. Like Egger et al.(2011) —study about the bilateral international trade, they use cross-sectional analysis for each of the four years. They include importer and exporter fixed effects. We use a longer time period (six years) and define the political variable as time-dependent. Given the existence of quite a few so-called swing states, our approach seems more reasonable. Not all states can be labeled as a blue or a red state for all years; the distinction between the two is not that black and white. Given that our data is at five year intervals, the dependence of the political variable on time is even more justifiable.[1] We also use two alternative definitions of the red-blue divide in terms of gubernatorial and senate elections, apart from using Presidential elections as the yardstick. There are also differences in terms of the econometric methodology used. Whereas Ishise and Matsuo (2015) use non-linear (Probit) Generalized Method of Moments (GMM) mode with instrumental variable to deal with endogeneity, we follow the recent literature on gravity analysis with our panel data and employ Poisson Pseudo Maximum Likelihood (PPML) method (see, for example, Yotov et al., 2016). Our approach allows us to use pairwise fixed effects and importer-time and exporter-time fixed effects. Thus, we are able to focus on the border effect and at the same time deal with a rich set of fixed effects to deal with endogeneity arising from unobserved heterogeneity.

The rest of the paper is organized as follows. Section 2 describes the estimation methodology and the data. We report our OLS and PPML estimation in various specification and perform several robustness checks with different definitions of politics and Linder and explain our empirical results in Section 3. In section 4 we present our concluding remarks with policy implications.

[1]Given that the adjustment of trade in response to changes in a covariate can take time, Cheng and Wall (2005) suggested the use of interval data even when annual data are available. In gravity analysis, it is common to use data at intervals of 3-5 years (see, for example, Trefler, 2004; Baier and Bergstrand, 2007; Olivero and Yotov, 2012; Anderson and Yotov, 2016). For us, the interval is not a choice; this is how the data are available.

1.2 Data

United States inter-state domestic trade flow data of years 1993, 1997, 2002, 2007, 2012, and 2017 are obtained from the Commodity Flow survey (CFS) data, generated by the Bureau of Transportation Statistics (BTS) and the U.S. Census Bureau (USCB). The CFS track shipments, measured in million-dollar value, by the modes of transportation: Truck, Rail, Inland water, Great Lakes, Deep Sea, Air, Pipeline, Parcel, U.S. Postal Service, or Courier. The CFS data covers on shipments originating from selected types of business establishments located in the 50 states and the District of Columbia; it does not cover Puerto Rico and other U.S. possessions and territories. Data on the political variables were obtained from the Mit Election Data Science Lab,[2] and Wikipedia.[3] Data on per-capita income was obtained from the Bureau of Economic Analysis (BEA) and data on Hispanic and Latino population from the U.S. Census Bureau. A table of summery statistics is provided below.

Table 1.1: Descriptive Statistics

Variables	Observations	Mean	Std Dev	Min	Max
Xijt (in million $)	15276	2177.41	4767.69	0	78028
President ijt	15300	0.0505	0.499	0	1
Presidentij(t-1)	12750	0.51	0.499	0	1
Governor ijt	12750	0.492	0.499	0	1
Senator ijt	15300	1.07	0.755	0	2
Linderijt (in $)	15300	6561.67	6027.045	0	43227
Linderijt1	15300	7937.84	15407.35	0	186857
Linderijt2	15300	0.1803	0.135	0	0.7765
HPOPijt	15300	11.83	59.97	0.0005	1871

1.3 Empirical Strategy

The structural gravity equation we use is similar to the one estimated by Anderson and Van Wincoop (2003), Anderson and Yotov (2010), and Bergstrand et al. (2015). The estimable econometric specification of these models have been developed by these

[2]https://electionlab.mit.edu/data

[3]https://en.wikipedia.org/wiki/1993 and https://en.wikipedia.org/wiki/Alabama_Senate.

author from theoretical micro-foundations, and, *inter alia*, these include multilateral resistances and bilateral transaction costs.

Since bilateral trade data with many countries have many zero observations, according to Silva and Tenreyro (2006, 2011) the Poisson Pseudo-Maximum Likelihood (PPML) estimates generate more robust results than traditional OLS estimates, besides being consistent in the presence of heteroskedasticity. Since in our data set less than 1% of all observations take zero values, we use both the PPML and OLS methods. The model that we estimate is:

$$X_{ijt} = \begin{cases} Y_{ijt}, & \text{for OLS} \\ \\ e^{Y_{ijt}}, & \text{for PPML,} \end{cases}$$

where $Y_{ijt} = \beta_0 + \beta_1 \text{POLITICS}_{ijt} + \beta_2 \text{LINDER}_{ijt} + \beta_3 \text{HPOP}_{ijt} + n_{it} + \theta_{jt} + \delta_{ij} + \epsilon_{ijt}$, and X_{ijt} is the U.S. domestic trade flows between state i and state j at time t, ϵ_{ijt} is the error term, and n_{it}, θ_{jt} and δ_{ij} are respectively exporter-time, importer-time, and bilateral, fixed effects. As stated by Head and Mayer (2014) and Yotov et al. (2016), the importer-time and exporter-time fixed effects will capture all state-specific, time-dependent variables, and similarly, the bilateral fixed effects will absorb all time-independent, bilateral variables like distance. Therefore, spurious correlation arising because of omitted variables of those kinds will not occur (Baier and Bergstrand, 2007).

POLITICS_{ijt} is one of the main variables of interest, and three different alternative definitions of it – political similarities between states – are derived from Presidential, Gubernatorial, and Senate election results. For Presidential and Gubernatorial elections, it takes the value 1 if both states i and j voted for the same political party in the last election, and 0 otherwise. For Senate elections, it takes the value 0 if both seats were taken by different parties in the two states, 2 if both seats were won by the same parties, and 1 otherwise.

Our second variable of interest is LINDER which represents economic similarities between the states. Following the literature, we take the absolute difference between the per-capita income (PCI) of the states to represent it (see, for example, Baltagi et al., 2003; Tang, 2003). That is, $\text{Linder}_{ijt} = |\text{PCI}_{it} - \text{PCI}_{jt}|$. For robustness check, we also try a different definition for this variable, namely, $\text{Linder1}_{ijt} = (\text{PCI}_{it} - \text{PCI}_{jt})^2$.[4] and $\text{Linder2}_{ijt} = |\ln(\text{PCI})_{it} - \ln(\text{PCI})_{jt}|$.

Since Rauch and Trindade (2002) found ethnic compositions of countries influence trade via network effects, we have added the ratio of the share of Hispanic and Latino population in the two states as an additional variable: $\text{HPOP}_{ijt} = \text{HPOP}_{it}/\text{HPOP}_{jt}$ where HPOP_{it} is the share of Hispanic and Latino population in state i at time t.[5]

1.4 Results

The basic results are presented in Table 1.2 and Table 1.3. For the Linder's variable, we use absolute difference in per-capita income, and for political similarity we consider similarities in outcome in Presidential elections: the variable takes the value 1 if both states voted for the same political party and 0 otherwise. Moreover, we also use Governor and Senator election outcome to further verify the result.

The coefficient of the variables, President_{ijt} and Governor_{ijt} are positive and significant both in PPML and OLS estimation. Similarly, the coefficient of Linder is negative and significant. We run both linear OLS and PPML regressions. The coefficient of the variables ratio of the share of Hispanic and Latio population (HPOPijt) and Senator (ijt) are positive and significant only in the OLS regressions, but not in PPML. All the regressions include importer-time, exporter-time, and pair-wise fixed effects. The signs of the President_{ijt} (more trade among politically

[4] This variable is very large in magnitude, we divide all the values by 10,000.

[5] Note that HPOP_{ijt} is defined as the ratio of two shares. Therefore, this variable does not get absorbed by the importer-time and exporter-time fixed effects.

similar states) and Linder_{ijt} (more trade among economically similar states) coefficients are statistically significant throughout the regressions.

In terms of the magnitude of the effects, the states which vote for the candidate from the same political party, on an average, trade about $70 million worth more than the other states. The coefficients in the PPML regressions are much smaller as they are non-linear regressions. However, the comparable marginal effect in the PPML regression is $40 million which is about half of that in OLS regression. As for the Linder's effect, a difference in $1000 in per-capita income implies a higher trade between the pair by $13 million (PPML) and $48 million (OLS).

Table 1.4 and Table 1.5 provides more robustness checks. We also use different definitions of the LINDER_{ijt} variable; Linder1_{ijt} and Linder2_{ijt} with different definitions of POLITICS_{ijt}. The qualitative results remain the same. As mentioned before, the inclusion of the different fixed effects take care of possible endogeneity arising from omitted variables. In case there is endogeneity because of two-way causality – which is unlikely in our context, we take one-year lag of the variable President. The qualitative nature of the results remain quite robust.

1.5 Conclusion

Using recent developments in gravity analysis and using inter-state trade data for the USA for six years (1993, 1997, 2002, 2007, 2012 and 2017), this paper examines if states that economically and politically similar trade more among each other or not. We use different alternative definitions of political and economical similarities. We find, in a fairly robust way, that both politically similarity and economical similarity result in significantly more trade.

Table 1.2: Basic Result: PPML Estimation (Marginal Coefficients)

X_{ijt}	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
President_{ijt}	36.80*	41.15**	41.37**					
	(0.053)	(0.03)	(0.029)					
Linder_{ijt}		-0.0131***	-0.0132***		-0.0123***	-0.0122***	-0.125***	-0.0127***
		(0.000)	(0.000)		(0.000)	(0.001)	(0.000)	(0.000)
Governor_{ijt}				29.40**	24.60*	24.39*		
				(0.039)	(0.081)	(0.081)		
Senator_{ijt}							5.5	5.722
							(0.72)	(0.709)
HPOP_{ijt}			-0.566		-0.523			-0.5393
			(0.391)		(0.417)			(0.411)
R-Squared	0.979	0.9786	0.9786	0.9786	0.9786	0.9786	0.9786	0.9786
Observations	15276	15276	15276	15276	15276	15276	15276	15276
Exp Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Imp Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PAIR FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

P-value are in parenthesis. ***, ** and * indicate statistically significant at 1%, 5% and 10% respectively.

Table 1.3: Basic Results: OLS Estimation

X_{ijt}	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
President_{ijt}	64.78*	73.26*	73.19*					
	(0.093)	(0.058)	(0.058)					
Linder_{ijt}		-0.0493***	-0.0495***		-0.0482***	-0.0484***		-0.0478***
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)
Governor_{ijt}				88.79**	77.78***	77.10***		
				(0.001)	(0.004)	(0.004)		
Senator_{ijt}							121.8***	105.1**
							(0.000)	(0.001)
HPOP_{ijt}			4.367**			4.347**		
			(0.017)			(0.017)		
Constant	2144.7***	2462.7***	2412.0***	2132.7***	2453.2***	2403.0***	2135.7***	2453.6***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-Squared	0.9161	0.9165	0.9166	0.9161	0.9165	0.9166	0.9161	0.9165
Observations	15276	15276	15276	15276	15276	15276	15276	15276
Exp Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Imp Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PAIR FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

P-value are in parenthesis. ***, ** and * indicate statistically significant at 1%, 5% and 10% respectively.

Table 1.4: Robustness Check: PPML Estimation(Marginal Coefficients)

X(ijt)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
President(ijt)	43.11**	38.76**							
	(0.023)	(0.041)							
President(ijt-1)			62.49***	60.10**	66.63***				
			(0.009)	(0.012)	(0.006)				
Linder(ijt)			-0.0145***						
			(0.000)						
Linder1(ijt)	-0.0062***			-0.0064***		-0.0058***		-0.0060***	
	(0.000)			(0.000)		(0.000)		(0.000)	
Linder2(ijt)		-0.143*			-0.183**		-0.126*		-0.129*
		(0.063)			(0.033)		(0.100)		(0.092)
Governor(ijt)						21.87	28.52**		
						(0.12)	(0.043)		
Senator (ijt)								3.478	12.96
								(0.82)	(0.395)
HPOP (ijt)	-0.629	-0.429	0.076	0.0261	0.177	-0.589	-0.406	-0.597	-0.406
	(0.34)	(0.513)	(0.918)	(0.972)	(0.812)	(0.367)	(0.534)	(0.362)	(0.534)
R-Squared	0.9787	0.9786	0.9794	0.9794	0.9793	0.9786	0.9786	0.9786	0.9786
Observations	15276	15276	12726	12726	12726	15276	15276	15276	15276

All specifications in the above table includes exporter time fixed effects, importer time fixed effects and pair fixed effects. P-value are in parenthesis. ***, ** and * indicate statistically significant at 1%, 5% and 10% respectively. Linder is defined as the absolute difference in per capita income between states. Linder1 is defined as square of the Per capita income difference between two states and divide by 10000. Similarly, Linder2 is defined as the absolute log difference in per capita income between state(i) and state(j).

Table 1.5: Robustness Check: OLS Estimation

X(ijt)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
President(ijt)	79.74**	66.7*							
	(0.04)	(0.084)							
President(ijt-1)			203.9***	189.4***	211.9***				
			(0.000)	(0.000)	(0.000)				
Linder(ijt)			-0.0456***						
			(0.000)						
Linder1(ijt)	-0.0219***			-0.0201***		-0.0213***		-0.0212***	
	(0.000)			(0.000)		(0.000)		(0.000)	
Linder2(ijt)		-503.8*			-555.2**		-491.9**		-492.2**
		(0.022)			(0.02)		(0.025)		(0.025)
Governor(ijt)						67.01**	88.15***		
						(0.013)	(0.001)		
Senator(ijt)								90.06***	119.9***
								(0.005)	(0.000)
HPOP (ijt)	4.327**	4.337**	2.95	2.962*	2.909	4.311**	4.315**	4.278**	4.270**
	(0.017)	(0.017)	(0.107)	(0.103)	(0.111)	(0.017)	(0.017)	(0.018)	(0.018)
Constant	2257.6***	2183.1***	2529.7***	2393.6***	2303.7***	2259.6***	2170.4***	2261.6***	2174.3***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-Squared	0.9168	0.9162	0.9324	0.9325	0.9321	0.9168	0.9162	0.9168	0.9162
Observations	15276	15276	12726	12726	12726	15276	15276	15276	15276

All specifications in the above table includes exporter time fixed effects, importer time fixed effects and pair fixed effects. P-value are in parenthesis. ***, ** and * indicate statistically significant at 1%, 5% and 10% respectively.

CHAPTER 2

DO FOREIGN IMPORTS BY STATES PROMOTE DOMESTIC EXPORTS BY THE STATES IN THE UNITED STATES?

2.1 Introduction

Do foreign imports by the states in the U.S.A. promote their domestic exports by states? This is the main research question that this paper addresses. Since inter-state trade is an indicator for the vibrancy of the domestic economy, the answer to this question has implications for the effect of trade policy on the domestic economy.

The effect of international trade on various aspects of an economy has been examined by many researchers. Halpern et al. (2015) and Acharya et al. (2009), for example, have analyzed the importance of imports for productivity, growth and international exports. Kasahara and Rodrigue (2008) and Amiti and Konings (2007) have shown that cheaper imported inputs can raise productivity via learning, variety, and quality effects.

United States is the leading importing country with total imports of imports worth $2.5 trillion in 2019.[1] Out of total goods import, around 90% of it consists of the imports of capital goods, industrial machinery, intermediate inputs, and automotive vehicles. Cavallo and Landry (2018) show that capital-goods imported by the United States have contributed 14 percent growth in U.S. gross domestic products.

Eaton and Kortum (2001, 2002) analyze the importance of trade in capital goods by connecting it to productivity differences and technological progress. Lee (1995) examined the importance of imports of capital and intermediate goods on economic growth and showed that more imports of intermediate inputs increased efficiency and thereby economic growth. Increasing imports of intermediate inputs can also significantly expand the volume of international exports, as shown by Bas and Strauss-Kahn (2014) and Feng et al. (2016). Hummels et al. (2001) showed that growth in the vertical specialization - the use of imported inputs in producing goods that are

[1] U.S. Census, https://www.thebalance.com/u-s-import-export-components-and-statistics-3306270.

exported - accounts for 30 percent of the growth in these countries' exports.

With this background, in this paper we examine the effect of imports from abroad on another aspect of domestic economic activities, *viz.* on the levels on inter-state trade in the U.S.A., using the well-known gravity analysis. The channels via which foreign imports can affect domestic or inter-state trade can be any of the channels discussed above.

On inter-state trade in the U.S.A., there is a small literature. For example, Wolf (2000) and Millimet and Osang (2007), using Gravity analysis and Commodity Flows Survey (CFS) data for the years 1993 and 1997, test for the existence or otherwise of border effect. Coughlin and Novy (2013) investigate international and domestic border effects using CFS data on foreign and domestic exports by the U.S states for the years 1993, 1997 and 2002. Using four years CFS data and taking each year at a time, Ishise and Matsuo (2015) examine if 'blueness' or 'redness' of states act as borders.

We use CFS data for six years (1993, 1997, 2002, 2007, 2012 and 2017) and apply latest developments in gravity analysis (see, for example, Yotov et al., 2016; Head and Mayer, 2014) . In particular, we include pair-wise, importer-time and exporter-time ffixed effects. Since imports by states is a state-specific, time-variant variable, its coefficient cannot be identified in a one-step gravity model as it will get absorbed by the fixed effects. We shall therefore follow the literature on gravity analysis and employ a two-step method to identify the coefficient of foreign imports (see, for example, Agnosteva, 2014; Egger and Nigai, 2015; Anderson and Yotov, 2016).

The remainder of the paper is organized as follows. Section 2.2 describes the data source and variables definition. Section 2.3 discusses about the empirical methodology. Section 2.4 states and discusses the main findings of the paper. In Section 2.5, we conduct a number of robustness checks. Finally, in section 2.6 we made some concluding remarks and discuss the policy implications.

Table 2.1: Definition of the variables

Variable	Definition
Domestic Trade(ijt)	U.S domestic trade in million $(1993-2017)
Domestic Trade1(ijt)	U.S total domestic trade in million $ (2007 -2017)
Domestic Trade2 (ijt)	domestic trade no Oil in million $ (1993-2007)
Linder (ijt)	Absolute difference in per capita income (PCIit - PCIjt)
POP (ijt)	Populationit * Populationjt
IMPORT(it)	Foreign Import by states in period t.
IMPORT-PC(it)	Import Per Capita by States I in period t (in million $)
POP(it)	Population by states(i) in period t.
GDP-PC(it)	Per Capita GDP by States(i) in period t.
D2007(it)	IMPORT for year 2007 =1 , otherwise zero
D2007-IMPORT(it)	D2007(it) * IMPORT(it)
Dummy(it)	Dummy = 1 if IMPORT =0 and Dummy(it)= 0 if IMPORT is not equal 0
D-IMPORT(it)	Dummy(it) * IMPORT(it)

Table 2.2: Descriptive Statistics

Variables	Observations	Mean	Std Dev	Min	Max
Domestic Trade ijt (in million $)	15582	3893	26052	0	1400000
Domestic Trade1 ijt	7779	5109	33884	0	1400000
Domestic Trade2 ijt	10404	3044	17383	0	835974
Linder ijt	15606	6433	6037	0	43227
POP ijt	15606	32	69	0.46	2112
IMPORT it (million $)	306	31981	57058	288	440715
IMPORT-PC it	306	4505	3335	400	19911
GDP-PC it	306	51385	26742	5605	245562
POP it	306	5.5	6	0.46	39.4
Dummy it	306	0.5	0.51	0	1
D-IMPORT it	306	6681.559	30648.15	0	348269
D2007 it	306	0.17	0.37	0	1
D2007-IMPORT it	306	6681.559	30648	0	348269

2.2 Data

We use the Commodity Flow Survey (CFS) data of the years 1993, 1997, 2002, 2007, 2012 and 2017 generated by the U.S. Census Bureau (USCB) and Bureau of Transportation statistics (BTS), that covers on shipments originating from selected type of business establishments located in the 50 states and the District of Columbia; it does not cover Puerto Rico and other U.S. possessions and territories. The CFS tracks shipments measured in million-dollar value. Also, the CFS tracks shipments by the modes of transportation for examples Truck, Rail, Inland water, Great Lakes, Deep Sea, Air, Pipeline, U.S. postal service or courier.

Data on IMPORT is obtained from the U.S. Census Bureau. Due to the unavailability of data on foreign imports by states data of the years 1993, 1997 and 2002, we extrapolate the missing data using the U.S. total import. We proportionately divide the U.S. total import to all states based on the available import data. For robustness check, we also run regressions only for the years for which imports data are available (the ‘Complete Case’) and also run the regressions for all the years using the well-know dummy-variable method for missing values, rather than interpolating the missing values. Import by states data is available from 2008, we use 2008 data for 2007. Data on per-capita income, Population and GDP are obtained from the Bureau of Economic Analysis (BEA). Tables of variables definition and summery statistics are presented below.

2.3 Empirical Methodology

We use the same structural gravity equation estimated by Anderson (1979), Anderson and Van Wincoop (2003), Anderson and Yotov (2016), and Bergstrand et al. (2015). These authors include multilateral resistances and bilateral transaction cost in the econometric specification of the model. Silva and Tenreyro (2006, 2011) suggest that Poisson Pseudo-Maximum Likelihood (PPML) method generate more robust results than traditional Ordinary Least Squares (OLS) estimates. Besides being consistent in the presence of heteroskedasticity, this method also provides a natural way to deal with zero observations of the dependent variable. In our data set, 2.3% of data on domestic trade have zero values. Therefore, in order not loose these observation, when we estimate our model by OLS method, we use a linear model, and not log-linear one.

To identify the impact of foreign import on the domestic export by states in the United States, we use two-step procedure as suggested by Anderson and Yotov(2016). The model that we estimate in the first stage is:

$$X_{ijt} = \begin{cases} Y_{ijt}, & \text{for OLS} \\ \\ e^{Y_{ijt}}, & \text{for PPML,} \end{cases}$$

where $Y_{ijt} = \beta_0 + \beta_1 \text{LINDER}_{ijt} + \beta_2 \text{POP}_{ijt} + \eta_{it} + \theta_{jt} + \delta_{ij} + \epsilon_{ijt}$, and X_{ijt} is the exports by state i to state j at time t, ϵ_{ijt} is the error term, and η_{it}, θ_{jt} and δ_{ij} are respectively exporter-time, importer-time, and bilateral fixed effects. The exporter-time and importer-time fixed effect capture all state specific time-dependent variables and a the pairwise fixed effect absorb all time-independent, bilateral variables like distance (see, for example, Yotov et al. (2016) and Head and Mayer (2014)).

Linder (1961) argued that countries with similar per capita income trade more with each other. Bergstrand (1990) found that a greater similarity in per-capita income was associated with more intra-industry trade between nations. Moreover, Baltagi et al. (2003) found that without the Linder's effect, the regression would suffer from misspecification error. We define the Linder as the absolute difference ($Linder_{ijt}$ = $|\mathrm{PCI}_{it}$ - $\mathrm{PCI}_{jt}|$) between the per-capita income (PCI) of the states as suggested by Baltagi et al.(2003) ,Tang (2003) and Dingel (2017). A negative value of the coefficient will confirm Linder's hypothesis. The variable POP_{ijt} is defined to be $\mathrm{POP}_{it} \times \mathrm{POP}_{jt}$ where POP_{it} is the total population of state i. We estimate the first stage regression with and without POP_{ijt}.

From the first stage estimates, we take the estimated values of η_{it}, the exporter-time fixed effects, and denote it by EXFTE_{it}. We then estimate the following equation by the OLS method:

$$\mathrm{EXFTE}_{it} = \beta_0 + \beta_1 \mathrm{IMPORT}_{it} + \beta_2 \mathrm{POP}_{it} + \kappa_i + \alpha_t + \mu_{it},$$

where μ_{it} is the error terms, and κ_i and α_t are the state fixed effects and time fixed effects, respectively. The state and time fixed effect will account for any unobservable variable that contribute to shift the overall level of export or import of a state (Head and Mayer, 2014). IMPORT_{it} is the main variables of interest and it is defined as total foreign limports by state i at time t. For robustness check, we also try a different definition for this variable as import per capita, $\mathrm{IMPORT\_PC}_{it}$. When we have POP_{ijt} in the first-stage regression, we do not include POP_{it} in the second stage. We use cluster robust that yields OLS estimation with heteroskedastic-robust standard error as suggested by Cameron and Miller(2015).

2.4 Results

The first stage benchmark regression results are presented in the Table 2.3. We use Linder and POP variables, in the first stage. For the Linder, we use absolute difference in per-capita income. All the first stage regressions include exporter-time, importer-time and pairwise fixed effects. Both coefficients are significant in the first stage PPML estimation. The coefficient of Linder is negative which means more trade among economically similar states and positive coefficient of population means higher the economic size higher the trade flows. We run both linear OLS and PPML regressions.

We present the second stage benchmark regressions corresponding with the first stage in Table 2.4. We estimate the exporter time fixed effects (EXTFE) in the first stages which is the second stage dependent variable.

All the second stage regressions include exporter state and time fixed effects. The coefficient of the main variable of interest, state-wise foreign import (IMPORT) is positive and significant throughout the OLS and PPML regressions. In the PPML estimation we present the marginal coefficient. We quantify the magnitude of the effects of the PPML estimation, the states which imports $1 million value of goods from the foreign countries, on an average, promotes the state's export to other states domestically by $300 thousand.

2.5 Robustness Check

We provide various methods of robustness checks to examine the consistency of our results. First of all, we use the alternative definition of $IMPORT_{it}$ as $IMPORT\_PC_{it}$ in the second stage. We present the results in Table 2.5 which is consistent and significant to our baseline results. Moreover, we also present the second stage regression in Table 2.7, using OLS in the first stage. The qualitative nature of the results remain the same.

Second, we separate the available foreign import data from the extrapolated data and run the first stage and second stage regression using last three years of data (2007-2017). The coefficients signs in Table 2.4, column 3a, 3b and 4 are consistent and significant. Third, we remove oil from the U.S. domestic trade for the first four year (1993, 1997, 2002 and 2007)[2] data. One could argue that domestic trade between the U.S. states is also on oil trading so to analyze the impact of foreign import on domestic trade we have to remove the oil and oil products from the domestic trade data. Accordingly, we use the domestic trade data without oil and estimate the first and second stage regressions. The results are presented in Table 2.4, columns 5 and 6 for the first stage and column 5a, 5b and 6 for the second stage.

Finally, we consider and compare three different cases for the second stage: with our estimation of missing values, omitting the missing values, and the dummy variable method. We use the dummy variable method as suggested by Cohen et al. (2013) to handle the issue of missing foreign import data. We substitute the missing value of foreign import by zero (0). The Dummy variable is 1 if import variable is missing and if import variable presents the Dummy variable is zero(0). We present the results in Table 2.9. We use Trend variable since Dummy variable is collinear with the time fixed effect. We find that import has consistent positive and significant effect on exporter time fixed effect as our empirical findings in earlier section. However, the Dummy variable method gives a somewhat lower value of the coefficient.

Moreover, as we already mentioned in the data source discussion part, import by states data is available from 2008, we use 2008 data for 2007. Since there was a recession in 2008 in U.S., we use dummy called $D2007_{it}$ variable to take care this issue. The dummy variable $D2007_{it}$ is defined as import for 2007 is equal to 1, otherwise 0. The result is presented in Table 2.8. Also in the same table we present the results without outliers - the extreme values of variable. Both 2007 dummy and with out outliers in PPML estimation gives significant and consistent result of import as the baseline result.

[2]Oil data for the year 2012 and 2017 is not available separately.

2.6 Conclusion

We use gravity model of trade and Commodity Flow Survey (CFS) data of the years (1993, 1997, 2002, 2007, 2012 and 2017) to examines whether importing states promote domestic export or not. We use different alternative definitions and different years of data to check the robustness of the results. We find, in a fairly robust way, that foreign import by states promote domestic export by states in the U.S.A.

Table 2.3: Baseline Results –First stage PPML Estimation(Marginal Coefficients)

CFS Data	1993 -2017		2007 - 2017		1993 -2007 (Without Oil)	
X_{ijt}	(1)	(2)	(3)	(4)	(5)	(6)
Linder (ijt)	-0.0693***	-0.0545***	-0.0463***	-0.0330***	-0.0646***	-0.0638***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
POP (ijt)		1.289***		4.400***		0.167
		(0.000)		(0.000)		(0.720)
R-Squared	0.9973	0.9974	0.9983	0.9983	0.9967	0.9967
Observations	15582	15582	7779	7779	10404	10404
Exporter Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Importer Time FE	Yes	Yes	Yes	Yes	Yes	Yes
PAIR FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 2.4: Second Stage Estimation – Marginal Coefficients

EXTFE	(1a)	(1b)	(2)	(3a)	(3b)	(4)	(5a)	(5b)	(6)
IMPORT(it)	0.303***	0.227***	0.228**	0.335***	0.326***	0.326***	0.232***	0.178**	0.222***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.029)	(0.000)
POP (it)		5.402			2.507			4.731	
		(0.168)			(0.402)			(0.326)	
R-Squared	0.8771	0.8793	0.867	0.9028	0.9033	0.9005	0.8938	0.894	0.8927
Observation	306	306	306	153	153	153	204	204	204
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

P-values are in parenthesis. ***, ** and * indicate statistically significant at 1%, 5% and 10% respectively.

Table 2.5: Second stage: Different Explanatory Variables

EXTFE	(1a)	(1b)	(2a)	(2b)
IMPORT_PC (it)	0.00198** (0.031)	0.00294** (0.019)	0.00172* (0.058)	0.00220** (0.022)
GDP_PC (it)		-0.0000397* (0.082)		-0.0000146* (0.085)
R-Squared	0.8619	0.8627	0.8577	0.858
Observations	306	306	306	306
State FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

P values are in parenthesis. ***, ** and * indicate statistically significant at 1%, 5% and 10% respectively.

Table 2.6: First Stage –OLS Estimation

CFS Data	1993 - 2017	
X_{ijt}	(1)	(2)
Linder(ijt)	-0.379*** (0.001)	-0.369*** (0.000)
POP ijt		92.22 (0.147)
Constant	6319.5*** (0.000)	3297.8* (0.055)
R-Squared	0.8322	0.8371
Observations	15582	15582
Exporter Time FE	Yes	Yes
Importer Time FE	Yes	Yes
PAIR FE	Yes	Yes

P-values are in the parenthesis. ***, ** and * indicate statistically significant at 1%, 5% and 10% respectively.

Table 2.7: Second stage Estimation – OLS in First stage

EXTFE	(1a)	(1b)	(2)	(1a)	(1b)	(2a)	(2b)
IMPORT(it)	0.0787*** (0.000)	0.0660*** (0.000)	0.0528*** (0.000)				
POP (it)		484.2* (0.081)					
IMPORT-PC(it)				0.369*** (0.001)	0.419*** (0.000)	0.371*** (0.000)	0.327*** (0.000)
GDP-PC(it)					-0.01002 (0.110)		0.0133* (0.084)
Constant	-2513.8*** 0.000	-4787.4** 3.21	-1683.1*** (0.000)	-1663.6*** (0.001)	-1368.7*** (0.004)	-1662.8*** (0.000)	-2057.1*** (0.000)
R-Squared	0.9596	0.9644	0.9813	0.8796	0.8802	0.7541	0.7564
Observations	306	306	306	306	306	306	306
State FE	YES	YES	YES	YES	YES	YES	YES
TIME FE	YES	YES	YES	YES	YES	YES	YES

P-values are in parenthesis. ***, ** and * indicate statistically significant at 1%, 5% and 10% respectively.

Table 2.8: Second Stage - Without Outliers and 2007 Dummy -PPML First stage

	2007 Dummy			1993 -2017 Without Outliers		
EXTFE	(1a)	(1b)	(2)	(1a)	(1b)	(2)
IMPORT (it)	0.309*** 0.000	0.227*** (0.001)	0.229*** (0.004)	0.280*** (0.000)	0.223*** (0.000)	0.255*** (0.000)
D2007_IMPORT (it)	-0.0154 (0.615)	-0.0224 (0.16)	-0.0164 (0.956)			
POP (it)		5.4 (0.993)			4.073 (0.172)	
R-Squared	0.8772	0.8793	0.867	0.8879	0.8891	0.8778
Observations	306	306	306	306	306	306
Time FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES

P values are just below the coefficients. ***, ** and * indicate statistically significant at 1%, 5% and 10% respectively.

Table 2.9: Second Stage - Dummy Variable Method(1993-2017)-PPML in First stage

EXTFE	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)	(2a)	(2b)
IMPORT (it)	0.193***	0.160***	0.208***	0.174**	0.249***	0.252***	0.152***	0.162***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.002)	(0.005)
Dummy (it)					6.99	7.372		
					(0.188)	(1.17)		
POP (it)		4.313		3.844	4.669	4.62		
		(0.189)		(0.214)	(0.239)	(0.16)		
D_IMPORT (it)			-0.00029	-0.0000737		-0.0000103		-0.0000658
			(0.615)	(0.273)		(0.837)		(0.353)
Trend(it)					21.40***	21.38***		
					(0.000)	(0.000)		
R-Squared	0.8814	0.8828	0.882	0.8813	0.8741	0.8741	0.8729	0.8712
Observations	306	306	306	306	306	306	306	306
TIME FE	YES	YES	YES	YES	NO	NO	YES	YES
STATE FE	YES	YES	YES	YES	YES	YES	YES	YES

P-values are in parenthesis. ****, ** and * statistically significant at 1%, 5% and 10% respectively.

CHAPTER 3

AN EMPIRICAL ANALYSIS OF INTER - STATES MIGRATION IN THE UNITED STATES : THE ROLE OF SIZE

3.1 Introduction

The internal migration rates between states, regions or cites in the United States are higher than other countries (Molloy, Smith, and Wozniak, 2011). Local labor markets in the United States are characterized by enormous differences in worker earnings, factor productivity and firm innovation (Enrico, M., 2011). The workers and firms are free to move in search of welfare and profits. Movers to and from the South make up the largest domestic migration flows in the United States at the regional level. Moreover, at the state and county levels the large flow of interstate migration is in the South or in the West. Considering the largest states and country level flows are to or from Florida, California or Arizona.[1]. It has a great implication in the policy level to know where and why Americans' are moving from one state to another.

From the basis for most modern research on migration Ravenstein (1885) in the paper "The Law of Migration" states that people migrate even to considerable distance in order to find work or employment. Hicks, j. (1963) states,"... differences in net economic advantages – chiefly differences in wages, are the main causes of migration". Todaro, M. P. (1969) finds in the model of labor migration that as long as the origin and destination real income differential continue, migration between two different location is remained.

For United States interstate migration several empirical studies have examined the effect of economic factors on migration. Greenwood (1975 and 1985) shows that the difference in income is one of the most influential factor of migration. Treyz et al. (1993) find that the dynamic response of net interstate migration is induced by amenity differentials and the various components of relative economic opportunities.

[1] https://www.census.gov/library/stories/2019/04/moves-from-south-west-dominate-recent-migration-flows.html

Greenwood (1997) studies the internal migration in the developed countries including the United States and finds that local unemployment in the United States has a significant influence on the migration decisions of the unemployed and those who are seeking new jobs. Kennan and Walker (2011) show a significant effect of expected income differences on interstate migration in the USA for white male high-school graduates using panel data from the National Longitudinal Survey of Youth. In the cross-section analysis of interstate migration, Karahan and Rhee (2014) find that aging population and availability of local job make to decrease the interstate migration rate.

Similarly, Anjomani, A. (2002) finds that states with lower income growth and larger increases in unemployment will produce out-migrants to states with lower crime rates, lower population densities, and high population growth. Cebula, R. J. (2005) investigates the determinants of internal migration in the U.S. over the period 1999 - 2002 and finds that expected income and actual income each play an important role on the migration decision. Also state in-migration was an increasing function of the availability of state parks, recreation, warmer temperatures. In a study of wage dynamics of internal migration with in United States, Yankow, J. J. (1999) finds that the young interstate migrants receive significant positive returns that is superior wage growth relative to non-migrants.

Moreover, in the U.S. interstate migration Liu and Ngo (2020) analyze the effect of political competition on U.S inter-state migration Using IRS and U.S census migration data from 1940 to 2010 and find that political competition positively effect the U.S. inter-state migration. similarly, Li et al. (2020) find that the human and natural environments such as; human development index, education grade, climate, cost of living index, house price index, and crime rate, had a great impact on population movement in the United States. Also, Chakrabarti and Sengupta (2017) find that differences in industrial and regional total factor productivity positively affect the inter-state migration in the U.S.

To investigate the relationship between GDP rate and net-migration in

Central and Eastern European (CEE) countries, Simionescu at el. (2016) use panel data (1991 - 2013) and Bayesian approach. They find that GDP rate in country i at time t has negative influence on the net migration in country i at time t in CEE countries. Fedotenkov (2015) analyzes the relation of international trade and migration to country size. Using an international trade model, he explains why smalls countries have larger percentage of migrants in their populations. He concludes that higher wages in the small country incite migrants to come.

Our study fulfills the research gap found in the migration literature by analyzing the effect of size in the the U.S. interstate migration. We utilize the ratio of GDP, Population and Land mass as a proxy of size. We use the recently developed structural gravity model employing 20 years (1998 - 2017) of panel data.

The paper is organized as follows. In the next section, we explain about the data and variables. In section 3.3, we discuss about the estimation methodology. We present our PPML and OLS estimation in different specification using first-stage and second stage in section 3.4. A separate analysis about the effect of income tax on U.S.interstate migration is presented in section 3.5. To check the robustness of the result we use different definition of variables, which is presented in Section 3.6. We present the conclusion of the paper in section 3.7.

3.2 Data Sources

We use U.S. domestic migration yearly data collected by Internal Revenue Service (IRS)[2] covering 20 years period of 1998 to 2017 by including fifty states plus District of Columbia as the unit of analysis. The data are based on year - to - year address changes by number of individuals reported on individual income tax returns filed with the IRS. For the data on median weekly wage in dollar ($Wage - Ratio_{ijt}$) and employed percent of labor force ($EMP - Ratio_{ijt}$), we use U.S. Bureau of Labor Statistics[3]. We obtain the data of expected wage ratio ($EXP - Wage - Ratio_{ijt}$) by multiplying

[2]https://www.irs.gov/statistics/soi-tax-stats-migration-data
[3]https://www.bls.gov/

median weekly wage and employed percent of labor force. Similarly, the data of population ($POP - Ratio_{ijt}$), gross domestic product in millions dollar ($GDP - Ratio_{ijt}$) come from Bureau of Economic Analysis(BEA)[4]. We also use the time invariant variables $LAND - Ratio_{ij}$, $DT - Capital - Cities_{ijt}$ and $DT - Big - Cities_{ijt}$ [5]. We collect the data of Income Tax by States which is defined as Income $\text{Tax}_{ijt} = \frac{Income-Tax_{jt}}{IncomeTax_{it}}$ from the U.S. Census Bureau. We get the data of Per Capita Personal Income by states PCI_{it} from U.S. Bureau of Economic Analysis. The tax variables – log of income tax as a proportion of population by states is defined as Log PC Income Tax_{it} and log of income tax as a proportion of GDP by states is defined as Log Income Tax GDP_{it}. The detail definition of the variables and summary statistics are presented in the Table 3.1 and Table 3.2 respectively.

3.3 Empirical Methodology

As in trade model, migration model is also driven by the gravity force between the origin and destination countries or states. We use the same structural gravity equation estimated by Anderson (1979), Anderson andVan Wincoop (2003), Anderson and Yotov (2016). The gravity equation has been derived theoretically by Anderson (2011):

$$M_{ij} = \frac{L_j * N_i}{N} * \left(\frac{\alpha_{ij}}{\Omega_i * \omega_j}\right)^{1-\theta}$$

where, M_{ij} denotes the flow of migration from State i to State j, L_j is the total labor supply in State j, N_i is the population stock in State i and N is the U.S. labor supply. Ω_i and ω_j represent respectively outward and inward multilateral

[4]https://www.bea.gov/

[5]Total area of land is in square miles by states $LandAreaRatio(ij) = (landarea_j)/(land - area_i)$. We get the data from https://statesymbolsusa.org/. Driving Time in hours between states from Capital cities $DT - Capital - Cities_{ij}$ - We get the data from https://www.google.com/maps. The data for Driving Time between the States from Big Cities $DT - Big - Cities_{ij}$. We get the data from https://www.google.com/maps

Table 3.1: Definition of the Variables

Variables	Definitions
ln M (ijt)	Domestic Migration between the States of the U.S.A. We use Log of Migration= ln (Migration+1) to estimate OLS and Migration to estimate PPML. We get the Migration data from Internal Revenue Service (IRS). Migration is defined as the number of residents leaving a State.
ln M.POP (ijt)	Migration as a proportion of population. Log Migration-POP (ijt)= ln[(Migration+1)/(Population(jt)]
Wage Ratio (ijt)	Median Weekly Wage in dollar. Wage Ratio(ijt)= Wage_ j/Wage_ i. We get the data from the U.S Bureau of Labor Statistics
EMP-Ratio (ijt)	Employed Percentage of Labor force in states. Employ Rate Ratio(ijt)= Employment_j/Employment_i. We get the data from the U.S. Bureau of Labor Statistics.
EXP-Wage-Ratio (ijt)	Wage Ratio(ijt) *Employment Rate Ratio (ijt).
GDP-Ratio (ijt)	Gross domestic product by states. GDP Ratio(ijt)= gdp_j/gdp_i. We get the data from the Bureau of Economic Analysis (BEA)
POP-Ratio (ijt)	Total population by states. POP Ratio (ijt)= pop_j/ pop_i. We get the data from the Bureau of Economic Analysis (BEA).
Income Tax (ijt)	Per Capita Income Tax by States. Income Tax(ijt)= Income-Tax (jt)/(Income Tax (it). We get the individual income tax (in thousand dollars) by State Government data from the United States Census Bureau.
Land-Area-Ratio (ij)	Total area of land in square miles by states. Land Area Ratio (ij) = (land area_j)/(land-area_i). We get the data from https://statesymbolsusa.org/.
DT-Capital-Cities (ij)	Driving Time in hours between states from Capital cities. We get the data from google map.
DT-Big-Cities (ij)	Driving Time between the States from Big Cities. We get the data from google map
lnPC Income Tax(it)	Per Capita Income Tax by Origin states. Log PC Income Tax(it)= ln (Income-Tax)/ln (Population). We get the individual income tax in thousand dollars by State Government data from the United States Census Bureau.
ln Income Tax GDP(it)	Income tax as a proportion of GDP by Origin States. Log PC Income Tax(it) = ln (Income-Tax)/ln (gdp).
ln PCI (it)	Per Capita Personal Income in dollar by Origin States. Log PCI (it) = ln (per capita income). We get the data from U.S. Bureau of Economic Analysis.
ln PC Income Tax(jt)	Per Capita Income Tax by Destination states.
ln Income Tax GDP jit)	Income tax as a proportion of GDP by Destination states.
ln PCI (jt)	Per Capita Personal Income in dollar by Destination States.

Table 3.2: Descriptive Statistics

Variables	Obs	Mean	Std. Dev	Min	Max
ln(M-POP) ijt	50897	0.000499	0.001032	0	0.023613
ln(M) ijt	50897	6.603291	1.552173	0	11.45704
Wage-Ratio (ijt)	51000	1.015942	0.161964	0.567164	1.763158
Exp-Wage-Ratio (ijt)	51000	1.021596	0.257172	0.101173	9.424403
EMP- Ratio (ijt)	51000	1.006126	0.210795	0.125392	7.975
GDP-Ratio (ijt)	51000	2.793525	5.468166	0.011504	86.93006
POP-Ratio (ijt)	51000	2.776988	5.292343	0.014142	70.71219
Income Tax (ijt)	45322	8.177289	131.1598	0	20073.83
Lag Wage Ratio (ijt)	48450	1.016116	0.161942	0.572917	1.745455
Lag GDP Ratio (ijt)	48450	2.790112	5.451279	0.011726	85.28381
Lag POP Ratio (ijt)	48450	2.776361	5.28841	0.014142	70.71219
LAND- Ratio (ij)	2550	24.60394	225.9493	0.00012	8350.029
DT Capital Cities (ij)	2550	19.27357	13.52532	0	78
DT Big Cities (ij)	2550	19.7469	14.11405	0	65
Log PC Income Tax (it)	946	0.993148	0.107689	0.561498	1.324478
Log Income Tax GDP (it)	946	1.255311	0.147948	0.723784	1.766047
Log PCI (it)	1020	10.52364	0.24849	9.912447	11.27794
Log PC Income Tax (jt)	946	0.98647	0.069377	0.60803	1.308247
Log Income Tax GDP (jt)	946	1.248273	0.09348	0.729853	1.634075
Log PCI (jt)	1020	10.52364	0.248492	9.912447	11.27794

resistances[6], α_{ij} denotes migration cost from State i to State j, and θ is the constant relative risk aversion of migration between two States. As with the trade gravity model, outward multilateral resistance gives the sellers' incidence of the migration costs and the inward multilateral resistance gives the buyers incidence of migration cost. Baldwin and Taglioni (2006) claim that the multilateral resistance terms are not directly observable by the researcher and policy makers and fail to control the multilateral resistance terms is a "Gold Medal Mistake".

Silva and Tenreyro (2006) suggest to use PPML estimator in order to account for heteroskedasticity and also the PPML estimator generate more robust results than traditional OLS estimates. We use both the OLS and PPML methods since our data contains less than 1% zero observations. In OLS estimation, not to loss the observation, we add one to dependent variable and take lag. The gravity model of migration can be

[6]See Beine et al. (2014); Bertoli and Moraga (2013) and Anderson (2011)

empirically estimated by using the following equations:

$$ln(M.POP_{ijt}) = \beta_0 + \beta_1\text{Wage-Ratio}_{ijt} + \beta_2\text{SIZE}_{ijt} + \beta_3\text{EMP-Ratio}_{ijt} + \\ \beta_4\text{EXP-Wage-Ratio}_{ijt} + \beta_5\text{TIME}_{ij} + \eta_{it} + \theta_{jt} + \delta_{ij} + \epsilon_{ijt} \quad \text{for OLS}$$

$$M.POP_{ijt} = exp[\beta_0 + \beta_1\text{Wage-Ratio}_{ijt} + \beta_2\text{SIZE}_{ijt} + \beta_3\text{EMP-Ratio}_{ijt} + \\ \beta_4\text{EXP-Wage-Ratio}_{ijt} + \beta_5\text{TIME}_{ij} + \eta_{it} + \theta_{jt} + \delta_{ij}] + \epsilon_{ijt} \quad \text{for PPML}$$

where M-POP$_{ijt}$ is the U.S. domestic migration flows between state i and state j as a proportion of population at time t, ϵ_{ijt} is the error term, and n_{it}, θ_{jt} and δ_{ij} are respectively Origin-Time fixed effect, Destination-Time fixed effect, and bilateral fixed effects.

We use Origin State Time fixed effect, Destination State Time fixed effect as suggested by (Anderson and van Wincoop, 2003) to control the unobservable multilateral resistance and observable state-specific characteristics that vary over time. Moreover, Head and Mayer (2014) and Yotov et al. (2016) state that the Origin State Time fixed effect, Destination State Time fixed effects will capture all state-specific, time-dependent variables, and similarly, the bilateral fixed effects will absorb all time-independent, bilateral variables like distance (Egger and Nigai, 2015; Agnosteva et al., 2014). The pair fixed effects are able to account for endogeneity (Baier and Bergstrand, 2007).

Hicks (1963) and Raimon (1962) found wage differences between origin and destination states influence migration, we have added the ratio of wages in two states as $Wage - Ratio_{ijt}$= $Wage_{jt}/Wage_{it}$, represents the average weekly wage in dollar. Our main variable of interest is $SIZE_{ijt}$ and we use three alternative definitions of it as $GDP - Ratio_{ijt}$, $POP - Ratio_{ijt}$ and $LAND - Ratio_{ij}$. Kennal and Walker (2011) and Anjomani (2002) showed that income and expected income differences between states induce migration and Harris and Todaro (1970) found that individuals migrates in response to expected income differential. We use ratio of employment rate in two states as $EMP-Ratio_{ijt}$= $EMP-Ratio_{jt}/EMP-Ratio_{it}$ and ratio of expected wage as $EXP-Wage-Ratio_{ijt} = WAGE-Ratio_{ijt} * EMP-Ratio_{ijt}$. Bogue and Thompson (1949) discuss about the United states domestic migration and distance. Instead of distance we use $TIME_{ij}$ defines as driving time travel between the stats from capital cities ($DT-Capital-Cities_{ij}$) and big cities ($DT-Big-Cities_{ij}$).

We can not identify the coefficients of time invariant variables for example Land Ratio and driving time between states like time variant variables. Agnosteva et al. (2014) and Anderson and Yotov (2016) suggest to use two - stage procedure, where the estimates of the pair fixed effects from the first - stage structural gravity equations are regressed on standard gravity variables in a second - stage estimation. We can estimate the coefficient of the time invariant bilateral variable by using the following second step equation:

$$\hat{\delta}_{ij} = \beta_0 + \beta_1 \text{LAND-Ratio}_{ij} + \beta_2 \text{TIME}_{ij} + \eta_i + \theta_j + \mu_{ij}$$

where $\hat{\delta_{ij}}$ is the estimated pair fixed effect (PAIR FE) from the first step, η_i and θ_j are the Origin State and Destination State fixed effects and μ_{ij} is the error term.

3.4 Results

In this section we present our empirical results with various robustness checks. The first stage PPML and OLS basic results are presented in Table 3.3 and Table 3.5, respectively. To analyze the effect of $SIZE$ on inter - state migration, we use $GDP-Ratio_{ijt}$ and $POP-Ratio_{ijt}$, in the first stage. All the first stage regressions include origin state time fixed effects, destination state time fixed effects and pair wise fixed effects. We find the coefficients of $GDP-Ratio_{ijt}$ and $POP-Ratio_{ijt}$ negative and significant in both OLS and PPML estimation. The control variables; $Wage - Ratio_{ijt}$, $EMP - Ratio_{ijt}$ and $EXP - Wage - Ratio_{ijt}$ are all positive and significant in OLS. But the coefficient of $Wage - Ratio_{ijt}$ and $EXp - Wage - Ratio$ are not significant in PPML estimation. The OLS estimation with the dependent variable in logarithmic form gives a similar interpretation of the PPML coefficient. The negative coefficient of GDP ratio and POP ratio signify that the American's are moving from big states to small states. Most of the international migration in the world, people are moving from countries with relatively low GDP per capita to countries with relatively high GDP per capita. Our case is different as we are analyzing inter - state migration. Our finding from the first stage OLS and PPML estimation show that, 1% increase in the GDP ratio and Population ratio between states leads to 2.4 % and 2.2 % decrease in interstate migration, respectively.

Similarly we present the second stage results in Table 3.4 and Table 3.6. In the second stage we have another Size variable LAND - Ratio_{ij}. The negative and significant coefficient of the LAND - Ratio_{ij} further endorse our previous finding–American's are moving from big states to small states. For the TIME variable, we use driving time between states from the capital cities. We also use driving time from largest cities. Both time variables give negative and significant results. We find the inverse relation between driving time and the U.S. inter-migration.

3.5 Income Tax and Inter-state Migration

While analyzing the effect of size on U.S. interstate migration, we can not skip the impact of income tax on mobility of U.S. people. Income taxes vary enormously from state to state in the United states. Does people migrate between the state, in response to the tax differences ? This is the another important research questions in this paper.

There are many literature that examine the U.S. inter - state mobility of people in responses to income taxes. Kleven at el. (2020) conclude that taxes can affect the geographic location of people both within and across countries. Akcigit et al. (2018)

examine the effect of corporate and personal taxes on innovation in the United States over the twentieth century. They find that the Personal income taxes significantly affect the over all mobility of investors and quantity of innovation. Feldstein and Wrobel (1998) conclude that the relatively unfavorable tax makes the affected individuals to migrate out and the favorable tax rates attract in-migrants until the wage changes fully offset tax changes across US states. Moretti and Wilson (2017) analyze the effect of state tax on the geographical location of top earners, using data on the universe of U.S. patents filed between 1976 and 2010. They find that top inventors are strongly mobile across U.S. states. The state taxes have significant effect of the geographical location of star scientists and possibly other highly skilled workers. Young and Varner (2011) find that millionaires only moderately mobile within the US state due to income tax.

To identify the effect of state-wise income tax on inter-state migration, we follow the same two stage procedure as discussed above. In the first stage, we estimate the origin state time fixed effect (OTFE) and destination state time fixed effect (DTFE) in both OLS and PPML estimation. From the first stage estimates, we take the estimated values of η_{it}, the origin state-time fixed effects, and denote it by OTFE_{it} and we take the estimated values of θ_{jt}, the destination state-time fixed effects, and denote it by DTFE_{jt}. We then estimate the following equations by the OLS method:

$$\text{OTFE}_{it} = \beta_0 + \beta_1 \text{Log PC Income Tax}_{it} + \beta_2 \text{Log Income Tax GDP}_{it} + \beta_3 \text{Log PCI}_{it} + \kappa_i + \alpha_t + \mu_{it}$$

$$\text{DTFE}_{jt} = \beta_0 + \beta_1 \text{Log PC Income Tax}_{jt} + \beta_2 \text{Log Income Tax GDP}_{jt} + \beta_3 \text{Log PCI}_{jt} + \kappa_j + \alpha_t + \mu_{jt}$$

where μ_{it} and μ_{jt} are the error terms, κ_i and α_t and κ_j and α_t are the origin state fixed effects, destination states fixed effects and time fixed effects, respectively. The state and time fixed effect will account for any unobservable variable that contribute to shift the overall level of migration of the origin state and destination states (Head and Mayer, 2014).

We estimation the coefficients of Log PC Income Tax$_{it}$ and Log PC Income Tax$_{jt}$, respectively, using $OTFE_{it}$ and $DTFE_{jt}$ as a dependent variable, in the second stage estimation. $OTFE_{it}$ and $DTFE_{jt}$ are estimated using OLS and PPML in the first stage. Second Stage estimation for Origin State using OLS in First stage is presented in Table 3.10 and Table 3.11 and PPML in the first stage is presented in the Table 3.14 and Table 3.15. Similarly for the destination state, the second stage results using OLS and PPML in the first stage are presented in Table 3.12, Table 3.13 and Table 3.16 and Table 3.17.

The coefficient of the variable using $OTFE_{it}$ as a dependent variable gives all positive and significant results. Increase in income tax in the origin state in a given time leads to increase out-migration from that that state. In case of the $DTFE_{jt}$ as a dependent variable, we have negative coefficient.

3.6 Robustness Check

To examine the consistency of our baseline results, we use an alternative definition of dependent variable migration as $ln(M)_{ijt}$, keeping all the explanatory variable as in the baseline result. We find the coefficients- GDP and POP are quite significant and consistent with baseline results in both OLS and PPML estimation. We present the result in Table 3.7. In Table 3.8, We take one-year lag of the explanatory variables Wage, GDP and POP to address the issue of endogeneity arising from two way causality, if in case, which is unlikely in our case. To check the further robustness of the result, we control the size variables by income tax in Table 3.9. We find the results are robust and consistent. To check the consistent effect of income tax on inter-state migration, we use Log of income tax as a proportion of GDP (Log Income Tax GDP$_{it}$ and Log Income Tax GDP$_{jt}$), as the alternative definition of the variable, income tax.

3.7 Conclusion

Using U.S. inter-state IRS migration data over the period of 1998 - 2017 and employing structural gravity model of migration, this paper analyzes the effect of Size and income tax on inter - state migration. We use different definitions of the variables to check the robustness of our result. We find that Americans' are moving from big states to small states. We also find that increase in income tax positively affect the inter - states migration for Origin states and negatively for Destination states. Our main and qualitative results are robust and consistent through the regressions.

Table 3.3: Basic Results – PPML Estimation –First Stage

M.POP ijt	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Wage-Ratio (ijt)	0.630 (0.237)	0.709 (0.171)	0.662 (0.211)	0.757 (0.155)	0.712 (0.171)	0.775 (0.144)	
GDP-Ratio (ijt)		-0.0229*** (0.000)			-0.0227*** (0.000)		-0.0171*** (0.000)
POP-Ratio (ijt)			-0.0273*** (0.003)			-0.0229*** (0.010)	
EMP-Ratio (ijt)				0.328** (0.034)	0.443*** (0.10)	0.0209** (0.41)	
EXP-Wage-Ratio (ijt)							0.062 (0.144)
R-Squared	0.937	0.9364	0.9369	0.9369	0.9369	0.9369	0.937
Observations	50897	50897	50897	50897	50897	50897	50897
Ori Time FE	YES	YES	YES	YES	YES	YES	YES
Dest Time FE	YES	YES	YES	YES	YES	YES	YES
PAIR FE	YES	YES	YES	YES	YES	YES	YES

P- values are in parenthesis. *** and ** indicate statistically significant at 1% and 5% respectively. The dependent variable is Migration as a proportion of population.

Table 3.4: Second Stage Estimation

PAIR FE	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LAND-Ratio(ij)	-0.000206***	-0.000205***	-0.000192***	-0.000206***	-0.000205***	-0.000192**	-0.000206***
	0.000	0.000	0.004	0.000	0.000	0.004	0.000
DT-Capital-Cities (ji)	-0.0445***	-0.0445***	-0.0444***	-0.0445***	-0.0445***	-0.0444***	-0.0444***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Constant	-0.089	-0.0791	-0.0803	-0.089	-0.0792	-0.0803	-0.0766
	0.68	0.714	0.71	0.68	0.714	0.71	0.712
R-Squared	0.5875	0.5888	0.5883	0.5875	0.5888	0.5883	0.5929
Observations	2550	2550	2550	2550	2550	2550	2550
PAIR FE	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LAND-Ratio (ij)	-0.000237***	-0.000236***	-0.000223**	-0.000237***	-0.000236***	-0.000223**	-0.000237***
	0.003	0.004	0.033	0.003	0.004	0.033	0.004
DT-Big-Cities (ji)	-0.0657***	-0.0656***	-0.0655***	-0.0657***	-0.0656***	-0.0655***	-0.0653***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Constant	0.299***	0.308***	0.306***	0.299***	0.308***	0.306***	0.307***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-Squared	0.6911	0.6925	0.913	0.6911	0.6925	0.6913	0.695
Observations	2550	2550	2550	2550	2550	2550	2550

P- values are just below the coefficients. *** indicates statistically significant at 1%. Origin State FE and Destination State FE are used in the second stage estimation.

Table 3.5: Basic Results: OLS Estimation – First stage

ln (M.POP) ijt	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Wage-Ratio (ijt)	0.747**	0.831***	0.772**	0.747**	0.831***	0.773**	
	0.019	0.009	0.015	0.018	0.009	0.015	
GDP-Ratio (ijt)		-0.0242***			-0.0242***		-0.0239***
		0.000			0.000		0.000
POP-Ratio (ijt)			-0.0218**			-0.0218**	
			0.017			0.017	
EMP-Ratio (ijt)				0.456**	0.448**	0.460**	
				0.026	0.028	0.025	
EXP-Wage-Ratio (ijt)							0.0880*
							0.056
Constant	-9.245***	-9.263***	-9.211***	-9.705***	-9.715***	-9.674***	-8.510***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-Squared	0.9165	0.9166	0.9165	0.9165	0.9166	0.9165	0.9166
Observations	50897	50897	50897	50897	50897	50897	50897
Ori Time FE	YES	YES	YES	YES	YES	YES	YES
Dest Time FE	YES	YES	YES	YES	YES	YES	YES
PAIR FE	YES	YES	YES	YES	YES	YES	YES

P- values are just below the coefficients. *** and ** indicate statistically significant at 1% and 5% respectively. The dependent variable is Log of Migration as a proportion of population.

Table 3.6: Second Stage Estimation

PAIR FE	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LAND-Ratio (ij)	-0.0000161*** 0.001	-0.0000161*** 0.001	-0.0000153*** 0.004	-0.0000161*** 0.001	-0.0000161*** 0.001	-0.0000153*** 0.004	-0.0000161*** 0.000
DT-Capi-City (ij)	-0.00310*** 0.000	-0.00310*** 0.000	-0.00309*** 0.000	-0.00310*** 0.000	-0.00310*** 0.000	-0.00309*** 0.000	-0.00309*** 0.000
Constant	0.0615*** 0.000	0.0615*** 0.000	0.0614*** 0.000	0.0615*** 0.000	0.0615*** 0.000	0.0614*** 0.000	0.0614*** 0.000
R-Squared	0.342	0.3404	0.3394	0.342	0.3404	0.3393	0.3413
Observations	2550	2550	2550	2550	2550	2550	2550
PAIR FE	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LAND- Ratio (ij)	-0.0000183*** 0.003	-0.0000183*** 0.003	-0.0000174** 0.022	-0.0000183*** 0.003	-0.0000183*** 0.003	-0.0000174** 0.022	-0.0000183** 0.003
DT-Big-Cities (ij)	-0.00455*** (0.000)	-0.00454*** (0.000)	-0.00454*** (0.000)	-0.00455*** (0.000)	-0.00454*** (0.000)	-0.00454*** (0.000)	-0.00453*** (0.000)
Constant	0.0881*** 0.000	0.0879*** 0.000	0.0878*** 0.000	0.0881*** 0.000	0.0879*** 0.000	0.0878*** 0.000	0.0877*** 0.000
R-Squared	0.5217	0.5181	0.5174	0.5217	0.5181	0.5174	0.5182
Observations	2550	2550	2550	2550	2550	2550	2550

P- values are just below the coefficients. *** and ** indicate statistically significant at 1% and 5%. Origin State FE and Destination State FE are used in the second stage estimation.

Table 3.7: Robustness Check – Different Dependent variable– First Stage

ln (M) ijt	OLS	OLS	OLS	OLS	PPML	PPML	PPML	PPML
Wage-Ratio (ijt)	0.831*** 0.009	0.772** 0.015	0.831*** 0.009	0.773** 0.015	0.831 0.152	0.772 0.185	0.997* 0.086	0.988* 0.102
GDP-Ratio (ijt)	-0.0242*** 0.000		-0.0242*** 0.000		-0.0242*** 0.000		-0.0263*** 0.000	
POP-Ratio (ijt)		-0.0218** 0.017		-0.0218** 0.017		-0.0217** 0.045		-0.0188* 0.077
EMP-Ratio(ijt)			0.448** 0.028	0.460** 0.025			0.522 0.198	0.553 0.232
R-Squared	0.9378	0.9378	0.9378	0.9378	0.9323	0.9321	0.9323	0.9322
Observations	50897	50897	50897	50897	50897	50897	50897	50897

P- values are in parenthesis. ***, ** and * indicate statistically significant at 1%, 5% and 10% respectively. All specifications in the Table includes Origin Time FE, Destination Time FE and PAIR FE. Log of Migration-POP is dependent variable for OLS estimation and Migration-POP is for PPML estimation.

Table 3.8: Robustness Check – Lag of Explanatory Variables

	(OLS)	(OLS)	(OLS)	(PPML)	(PPML)	(PPML)
Wage Ratio (ijt-1)	1.456***	1.544***	1.477***	1.328**	1.411***	1367**
	0.000	0.000	0.000	0.018	0.01	0.015
GDP Ratio (ijt-1)		-0.0257***			-0.0240***	
		0.000			0.000	
POP Ratio (ijt-1)			-0.0193**			-0.0143***
			0.045			0.010
R-Squared	0.9145	0.9146	0.9145	0.9342	0.9342	0.934
Observations	48349	48349	48349	48349	48349	48349

P- values are in parenthesis. ***, ** and * indicate statistically significant at 1%, 5% and 10% respectively. All specifications in the includes Origin Time FE, Destination Time FE and PAIR FE. Log of Migration-POP is dependent variable for OLS estimation and Migration-POP is for PPML estimation.

Table 3.9: Robustness Check – Estimation of Size variable controlling by Income Tax

	(OLS)	(OLS)	(PPML)	(PPML)
	ln(M.POP)	ln(M.POP)	M.POP	M.POP
WAGE (ijt)	0.858**	0.807**	0.825*	0.781
	0.022	0.032	0.096	0.122
GDP (ijt)	-0.0234***		-0.0219***	
	0.000		0.000	
POP (ijt)		-0.0210*		-0.0232***
		0.098		0.008
Income Tax (ijt)	-0.00000504	-0.00000583	-0.0000554	-0.0000578
	0.816	0.786	0.134	0.127
R-Squared	0.9214	0.9213	0.9396	0.9396
Observations	45221	45221	45231	45231

P- values are in parenthesis. ***, ** and * indicate statistically significant at 1%, 5% and 10% respectively. All specifications in the Table includes Origin Time FE, Destination Time FE and PAIR FE. Log of Migration-POP is dependent variable for OLS estimation and Migration-POP is for PPML estimation.

Table 3.10: Second stage Estimation – First State OLS – Origin State

OTFE	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
ln(PC-Income-Tax)$_{it}$	0.281***	0.231**	0.280***	0.236**	0.285***	0.234**	0.315***	0.260**	0.313**	0.265***	0.319***	0.264***
	(0.005)	(0.02)	(0.004)	(0.017)	(0.004)	(0.018)	0.002	0.011	0.002	0.009	0.002	0.01
Log PCI (it)		0.952***		0.825***		0.964***		1.041***		0.912***		1.054***
		0.000		0.000		0.000		0.000		0.000		0.000
Constant	-0.278***	-10.25***	-0.277***	-8.914***	-0.282***	-10.38***	-0.312***	-11.22***	-0.311**	-9.864***	-0.316***	-11.35***
	0.005	0.000	0.005	0.000	0.004	0.000	0.002	0.000	0.002	0.000	0.002	0.000
R-Squared	0.9736	0.9751	0.9714	0.9727	0.9708	0.9725	0.9636	0.9654	0.9608	0.9623	0.9596	0.9616
Observations	946	946	946	946	946	946	946	946	946	946	946	946
Origin FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

P- values are in parenthesis. *** and ** indicate statistically significant at 1% and 5% respectively.Dependent Variable is Origin State Time Fixed Effect (OTFE). Last 2 columns are not presented due to space limitation.

Table 3.11: Second Stage Estimation – Alternative Definition of Tax– First stage OLS – Origin State

OTFE	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
ln Income Tax GDP(it)	0.190**	0.177**	0.195**	0.184**	0.193**	0.180**	0.214***	0.200**	0.219***	0.206**	0.217***	0.203**
	0.016	0.023	0.013	0.018	0.015	0.021	0.009	0.012	0.007	0.009	0.008	0.011
Log PCI (it)		0.986***		0.859***		0.998***		1.079***		0.950***		1.092***
		0.000		0.000		0.000		0.000		0.000		0.000
Constant	-0.238**	-10.59***	-0.244**	-9.265***	-0.241**	-10.73***	-0.268***	-11.60***	-0.274***	-10.26***	-0.272***	-11.75***
	0.017	0.000	0.013	0.000	0.016	0.000	0.01	0.000	0.007	0.000	0.009	0.000
R-Squared	0.0973	0.9751	0.9713	0.9727	0.9706	0.9725	0.9635	0.9654	0.9607	0.9623	0.9594	0.9616
Observations	946	946	946	946	946	946	946	946	946	946	946	946
Origin State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

P- values are in parenthesis. *** and ** indicate statistically significant at 1% and 5% respectively. Dependent Variable is Origin State Time Fixed Effect (OTFE). Last two columns are not presented due to space.

Table 3.12: Second Stage Estimation –First Stage OLS – Destination State

DTFE	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
ln PC Income Tax (jt)	-0.317**	-0.366***	-0.311**	-0.366***	-0.316**	-0.364***	-0.329***	-0.371***	-0.322**	-0.370***	-0.328***	-0.368***
	0.012	0.007	0.014	0.007	0.012	0.008	0.01	0.007	0.011	0.007	0.01	0.007
Log PCI (jt)		0.365*		0.407*		0.354		0.316		0.358*		0.305
		0.1		0.065		0.111		0.159		0.108		0.175
Constant	0.320**	-3.475	0.312**	-3.912*	0.317**	-3.363	0.331***	-2.952	0.323**	-3.397	0.329***	-2.835
	0.011	0.126	0.013	0.083	0.011	0.139	0.009	0.198	0.011	0.135	0.009	0.217
R-Squared	0.9627	0.9629	0.967	0.9673	0.9667	0.9669	0.9624	0.9626	0.9668	0.967	0.9665	0.9666
Observations	946	946	946	946	946	946	946	946	946	946	946	946
Destination State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

P- values are in parenthesis. *** and ** indicate statistically significant at 1% and 5% respectively. Dependent Variable is Destination State Time Fixed Effect (DTFE).

Table 3.13: Second Stage Estimation – Alternative Definition of Tax –OLS in the First Stage – Destination State

DTFE	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
ln(Income Tax GDP$_{jt}$)	-0.310***	-0.327***	-0.308***	-0.327***	-0.308***	-0.325***	-0.316***	-0.331***	-0.314***	-0.331***	-0.315***	-0.329***
	0.006	0.004	0.006	0.004	0.006	0.004	0.005	0.004	0.005	0.004	0.005	0.004
Log PCI (jt)		0.326		0.368*		0.315		0.276		0.319		0.265
		0.126		0.082		0.139		0.199		0.136		0.218
Constant	0.393**	-3.015	0.389***	-3.452	0.390***	-2.906	0.401***	-2.486	0.397***	-2.932	0.398***	-2.372
	0.000	0.165	0.006	0.109	0.005	0.182	0.004	0.257	0.005	0.178	0.005	0.28
R-Squared	0.9628	0.963	0.9671	0.9674	0.9668	0.967	0.9626	0.9627	0.9669	0.9671	0.9666	0.9667
Observations	946	946	946	946	946	946	946	946	946	946	946	946
Destination State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

P- values are in parenthesis. *** and ** indicate statistically significant at 1% and 5% respectively. Dependent variable is Destination State Time Fixed Effect (DTFE)

Table 3.14: Second Stage Estimation – PPML in the First stage –Origin State

OTFE	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
Log PC Income Tax (it)	0.279***	0.213***	0.278***	0.218***	0.286***	0.218***	0.293***	0.225***	0.290***	0.229***	0.301***	0.231***
	0.000	0.005	0.000	0.004	0.000	0.004	0.000	0.003	0.000	0.003	0.000	0.003
Log PCI (it)		1.251***		1.133***		1.279***		1.288***		1.165***		1.318***
		0.000		0.000		0.000		0.000		0.000		0.000
Constant	-0.464***	-13.56***	-0.478***	-12.35***	-0.492***	-13.88***	-0.478***	-13.97***	-0.490***	-12.69***	-0.507***	-14.31***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-Squared	0.9282	0.9362	0.9384	0.9442	0.9405	0.9473	0.9219	0.9303	0.9343	0.9404	0.9347	0.942
Observations	946	946	946	946	946	946	946	946	946	946	946	946
Origin State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

P- values are in parenthesis. *** and ** indicate statistically significant at 1% and 5% respectively. Dependent Variable is Origin State Time Fixed Effect (OTFE).

Table 3.15: Second stage Estimation – Alternative Definition of Tax –PPML in the First Stage– Origin State

OTFE	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
lnIncmTxGDP_{it}	0.179***	0.162***	0.183***	0.168***	0.183**	0.166***	0.189***	0.171***	0.192***	0.176***	0.193***	0.176***
	0.005	0.007	0.003	0.005	0.004	0.006	0.003	0.004	0.002	0.003	0.002	0.004
Log PCI (it)		1.282***		1.165***		1.310***		1.321***		1.198***		1.351***
		0.000		0.000		0.000		0.000		0.000		0.000
Constant	- 0.411***	- 13.88***	- 0.431***	- 12.67***	- 0.438***	- 14.20***	- 0.424***	- 14.30***	- 0.442***	- 13.03***	- 0.451***	- 14.65***
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.9277	0.9361	0.938	0.9441	0.9401	0.9473	0.9213	0.9302	0.9338	0.9403	0.9419	0.9419
Observations	946	946	946	946	946	946	946	946	946	946	946	946
Origin State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

P- values are in parenthesis. *** and ** indicate statistically significant at 1% and 5% respectively. Dependent Variable is Origin State Time Fixed Effect

Table 3.16: Second Stage Estimation – – PPML in the First Stage – – Destination States

DTFE	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
ln PC Income Tax (jt)	- 0.231*	-0.226	-0.223	-0.225	- 0.232*	-0.225	- 0.236*	-0.228	- 0.227*	-0.226	- 0.237*	-0.227
	-0.096	-0.118	-0.11	-0.123	-0.096	-0.12	-0.09	-0.115	-0.1	-0.12	-0.089	-0.117
Log PCI (jt)		-0.038		0.011		-0.049		-0.058		-0.0063		-0.071
		-0.846		-0.954		-0.8		-0.765		-0.974		-0.716
constant	- 0.233*	0.158	- 0.286**	-0.401	- 0.280**	0.231	- 0.229*	0.373	- 0.283**	-0.217	- 0.275**	0.458
	-0.09	-0.937	-0.038	-0.84	-0.042	-0.908	-0.096	-0.852	-0.041	-0.913	-0.045	-0.819
R-Squared	0.9184	0.9184	0.9257	0.926	0.9266	0.9266	0.9182	0.918	0.9256	0.9256	0.9264	0.9265
Observations	946	946	946	946	946	946	946	946	946	946	946	946
Destination FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

P- values are in parenthesis. *** and ** indicate statistically significant at 1% and 5% respectively. Dependent Variable is Origin State Time Fixed Effect (OTFE).

Table 3.17: Second Stage Estimation – Alternative Definition of Tax – PPML in First Stage – Destination State

DTFE	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)	(5a)	(5b)	(6a)	(6b)
Log Income Tax GDP (jt)	- 0.208*	- 0.205*	- 0.205*	- 0.204*	- 0.208*	- 0.204*	- 0.211*	- 0.206*	- 0.207*	- 0.206*	- 0.211*	- 0.206*
	-0.073	-0.084	-0.08	-0.086	-0.074	-0.085	-0.07	-0.082	-0.076	-0.084	-0.07	-0.083
Log PCI (jt)		-0.062		-0.013		-0.073		-0.082		-0.03		-0.095
		-0.743		-0.947		-0.699		-0.663		-0.873		-0.616
Constant	-0.201	0.442	- 0.251*	-0.119	- 0.249*	0.513	-0.198	0.66	- 0.248*	0.0665	- 0.246*	0.743
	-0.165	-0.821	-0.086	-0.951	-0.087	-0.793	-0.172	-0.736	-0.09	-0.973	-0.091	-0.704
R-Squared	0.9184	0.9185	0.9257	0.9258	0.9267	0.9267	0.9182	0.9183	0.9257	0.9257	0.9265	0.9265
Observations	946	946	946	946	946	946	946	946	946	946	946	946
Destination FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

P- values are in parenthesis. *** and ** indicate statistically significant at 1% and 5% respectively. Dependent Variable is Origin State Time Fixed Effect (OTFE).

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