THE ROLES OF INTERNATIONAL TRADE AND IMMIGRATION ON U.S. LOCAL LABOR AND HOUSING MARKET DIFFERENTIATION

BY

CONG ZHANG

DISSERTATION

Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Economics
in the Graduate College of the
University of Illinois at Urbana-Champaign, 2016

Urbana, Illinois

Doctoral Committee:

Professor David Albouy, Chair
Professor Daniel McMillen
Professor Mark Borgschulte
Professor Eliza Forsythe

Abstract

This thesis identifies the effects of international trade and immigration on local labor and housing markets. Housing not only relates to individual welfare, but also affects the performances of local industries, such as construction, real estate, and mortgage financial service industries. Therefore, understanding the effects of international trade and immigration on housing is essential for governments to guide local development, for housing related industries to serve local economy, and for individuals to plan housing mortgage.

Chapter 1, "The Effects of Imports on Local Labor Market: A Decomposition", uses OECD STAN Bilateral Trade Database by Industry and End-use category to study the effects of import on U.S. local labor market outcomes. The results are comparable to Autor, Dorn, and Hanson (2013), and confirm that total import reduces local wages and employment rates more in more exposed areas. Since OECD also separates import volumes by their end-use categories, I could separately examine the effects of intermediate goods import and final goods import on local labor market. The decomposition exercise indicates intermediate import is the driving force of the negative effects of total import on non-manufacturing industries.

Chapter 2, "The Dynamic Effect of Imports on U.S. Local Jobs and Housing", highlights the link between import shocks and local housing price differentiation. In this chapter, I perform theoretical and empirical analyses to examine the dynamic effects of intermediate goods import on labor and housing markets across U.S. locations. I separate local industries into tradable and non-tradable sectors and build a two-sector spatial equilibrium model, where local housing and labor markets interact. Consistent with the model, I find that intermediate import reduces rents, housing prices, the employments and wages of both tradable and non-tradable sectors. The mechanism identified is that intermediate import first reduces the local labor demands of the two industry sectors which lead to a local wage decline. The decrease in local wage is followed by a reduction in local rent and housing price. Declining housing price and rent further reduce the local non-tradable labor demand because the non-tradable sector is tightly related with housing.

Chapter 3, "The Impacts of Immigration on Local Rent", separates immigrants according to their races and education levels, and explore their heterogeneous effects on metropolitan rental prices. Since the majority of new immigrants rent houses, the effect of immigration on rental prices is important for making immigration policies. The empirical results show that low-educated Hispanic immigrants lower rents, whereas other immigrants tend to live in places where local rents are already high. Further investigation suggests low educated Hispanic immigrants drive natives from renting a house to purchase a house, and thus have negative effect on local rents.

Acknowledgments

I would like to thank all the person who help and support me to finish my dissertation. Thanks my advisor, Professor David Albouy, for providing great suggestions and guidance on my thesis. He is a person who always has smart ideas. I am glad that I can follow his suggestions and learn from him. Thanks my committee members, Professor Daniel McMillen, Professor Mark Borgschulte, and Professor Eliza Forsythe, for their generous support and devotion. I also want to thank our department head, Professor Martin Perry, for helping me to prepare the job interviews, and for improving our department's doctoral program.

I also want to say thanks to my friends who enrich my life and share my emotion in UIUC. Last, I would like to thank my family for inspiring me to finish my Ph.D. Thanks my great parents for supporting me and taking care my baby. Thanks my husband, Bing Zuo, for encouraging me every time when I was upset during the Ph.D life, and for being there whenever I need. Thanks my lovely baby, Albert Zuo, for motivating me to be a better person.

Table of Contents

Chapter 1

The Effects of Imports on Local Labor Markets: A Decomposition

1.1 Introduction

Autor, Dorn and Hanson (2013) shows import could reduce local wages and employments because imported goods compete with domestic goods. However, we know import especially intermediate goods import could also substitute domestic labor force. Therefore, we might wonder whether import's labor substitution effect or its product competition effect dominates in labor markets.

In this chapter, I use a new trade data set to decompose total import into intermediate goods import and final goods import. Since intermediate goods import mainly substitutes domestic labor force while final goods import mainly competes with domestic final goods, I examine the two separately and show whether labor substitution and import competition have different influences on U.S. local labor markets.

The effects of intermediate goods import and final goods import are different in natural. The intermediate goods import includes goods which are imported and used as intermediate inputs in the production of final goods. Therefore, when the domestic firms use the imported intermediate goods in production, they could fire those domestic workers who originally produced the intermediate inputs. In this way, the intermediate goods import mainly substitute domestic labor force. In another way, the cheaper imported intermediate inputs would help domestic firms to reduce cost, and thus have positive output effect on domestic labor market. The final goods import includes goods which are imported and consumed directly by consumers. Therefore, the final goods import competes with domestic final goods production and reduce the domestic final goods' price. The price reduction could have contradictory effects on domestic firms. In one way, the price reduction would have negative effects on domestic firms because their goods are now cheaper. In the other way, the price competition would force domestic firms to increase productivity and so have positive effects on them.

Although both intermediate goods import and final goods import could have positive and negative effects on domestic labor market, they should affect different industries heterogeneously. Since those non-manufacturing industries like construction, mining, agriculture, and even services industries could use imported intermediate inputs in the production, the intermediate import would have effect on those non-manufacturing industries while the final import mainly compete with the manufacturing firms. Therefore, government and domestic firms could treat the shocks from intermediate import and final import separately.

The decomposition analysis uses import data from the OECD STAN Bilateral Trade Database by Industry and End-use category, County Business Pattern (CBP) and the local demographic data from Autor et al. (2013) to construct a balanced panel data. The OECD data separately reports intermediate goods import and total goods import, and thus facilitates the decomposition exercise. I then use local industry composition in the initial year from CBP to weight industry import values and create the local import measures. Merging the local import measures to the data from Autor et al. (2013), I can construct the balanced panel data with each commuting zone as one observation[1].

To make causal inferences, I adapt Autor et al. (2013)'s instrument variable strategy to address the concern that the local import measures and local market outcomes both correlate with some unobserved local demand shocks. This strategy uses other developed countries' import volumes as the instruments of U.S. import volumes. The identifying assumption is that other developed countries' import activities are not correlated with unobserved local demand shocks in the U.S.

Using the instrument variable strategy and the panel data estimation, I could begin the causal analysis. I first show OECD local total import reduces local wage and employment rate by a similar size as the Autor et al. (2013)'s local import measure. I then decompose total import into intermediate import and final import, and show intermediate import is the driving force for the negative effect of the total import on non-manufacturing firms. The final import affects local wage and employment rate either positively or insignificantly. Finally,

[1]Please refer to Autor, Dorn and Hanson (2013) for a commuting zone definition.

I show the effects of intermediate import and final import on manufacturing industries and non-manufacturing industries are differently. The intermediate import negatively affects the non-manufacturing industries, while the final import transfers employment from the manufacturing industries to the non-manufacturing industries.

The chapter contributes to the recent trade literature which studies the effects of international trade on local labor market (Autor, Dorn and Hanson (2013); Topalova (2007); Kovak (2013)). Using a different trade data set, the chapter confirms Autor et al. (2013)'s results are quite robust, and thus encourage more future research on this topic. By showing the effects of intermediate import and final import are different on local labor market, the decomposition exercise opens new windows for the further research onto this topic.

The decomposition exercise also adds new insights to the international outsourcing literature as the outputs of outsourced activities have to be imported back and used as inputs. While literature provides considerable evidence on international outsourcing's effects on U.S. national wage structures[2], little is known about its effect on U.S. local markets. My chapter thus fills the gap.

The chapter informs governments that the labor substitution effect from intermediate imports is the major negative shock on non-manufacturing firms resulting from international trade. Therefore, government could make different policies to deal with the shocks from intermediate import and final import. Since final import could even have positive effects on local non-manufacturing firms, government could focus on dealing with the negative shocks from intermediate import. For instance, government could allocate more resources to places which imported a lot intermediate goods.

The rest of the chapter proceeds as follows. The next section outlines the econometric model and instrumental variable strategy. Section 3 talks explains the data resources and the local import measures. Section 4 lists and analyzes the results. Section 5 concludes.

---

[2] Feenstra and Hanson (1996), (1999); Liu and Trefler (2008); Crino (2009); Ebenstein, Harrison, McMillan and Phillips (2009)

1.2 Empirical Strategy

In this section, I explain the econometric model and key identification strategy. I adapt the instrumental variable strategy from Autor et al. (2013) to address the endogeneity of local import measures. Using the instrumental variable strategy, I could show final good import and intermediate good import affects local labor markets differently.

1.2.1 Econometric Model

In this section, I outline the econometric model I use. The model is a balanced panel data model with each commuting zone as one observation. Each commuting zone has 2 periods: 1990-2000 and 2000-2007.

My study is conducted on U.S. commuting zones which are defined in Autor et al.(2013). The commuting zones cover all the 48 U.S. states (except Hawaii and Alaska), both rural and urban areas. Each commuting zone (CZ) is a cluster of counties that are tied together by residents' daily commuting behaviors.[3]

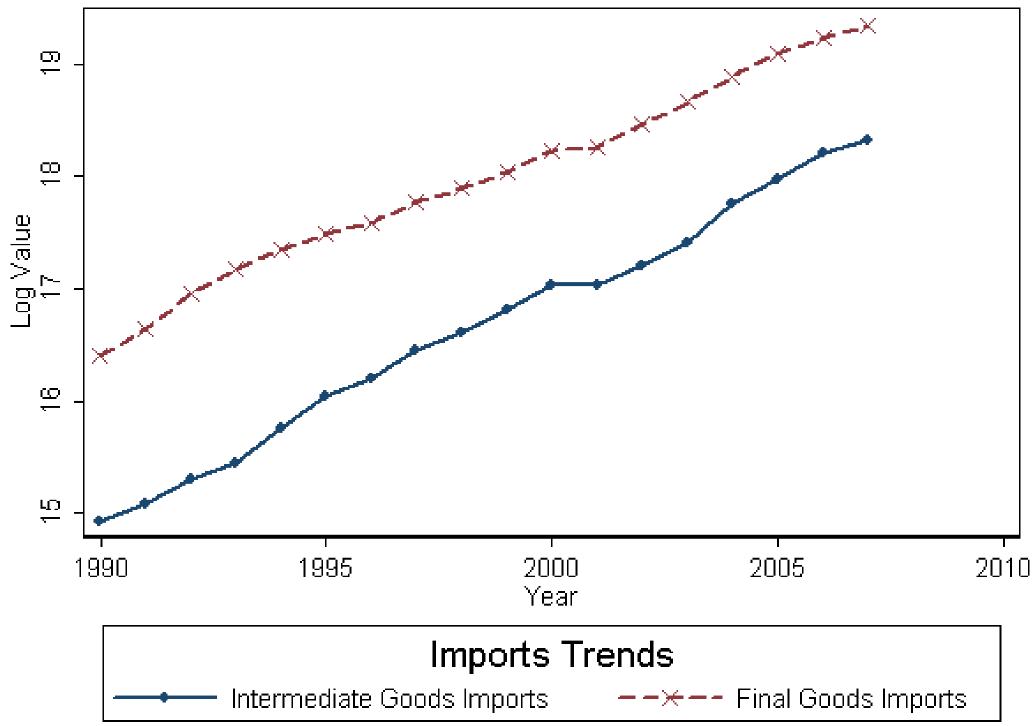
My panel data model is set the same as Autor et al. (2013)'s

$$\Delta A_{rt} = a_t + b_1 Import_{rt} + X'_{rt} b_2 + \epsilon_{rt} \tag{1}$$

where r denotes CZ, and X is a vector of local demographic variables including log value of manufacturing employment, log value of college-educated population, log value of foreign born population, log value of female population, log value of routine population, and an outsourcing index. The main explanatory variable $Import_{rt}$ can be local total import, local intermediate import, or local final import. The local import measures have the same structure $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry total import, intermediate import, or final import value in thousand US$ accordingly. L_i as total employment for industry i, L_{ri} as local employment for industry i, and L_r as total local employment. The dependent variable A_{rt} can be local wage, employment rate, unemployment rate, not-in-the-labor-force rate, and manufacturing and non-manufacturing industries'

[3]For details, please refer to Autor et al. (2013)'s online appendix.

Figure 1.1: Import Trends from China, 1990-2007



Notes: The figure shows the log values of intermediate goods import and final goods import from China to U.S in year 1990 to year 2007.

wages and employment rates.

1.2.2 Identification

This section presents the possible identifying threatens to the panel data regression, and explains the instrumental variable strategy used to address the endogenous problem.

The local import variables in the regression may be endogenous if imports correlate with some unobserved local demand shocks. For instance, if due to some unobserved local demand shocks, local industry compositions change in some places, those places would require more imports. If this is the case, the OLS estimates may identify the reverse causality.

As this chapter uses U.S. import from China to investigate import's effects, I adapt Autor et al. (2013)'s instrumental variable strategy to address the endogenous problem. The strategy uses other developed countries' import volumes as the instruments of U.S.

import volumes. The identifying assumption is that the increasing Chinese exports to the U.S. and the other developed countries are due to China's rising comparative advantage and falling trade costs. According to Figure 1.1 and 1.2, U.S. and other developed countries have imported increasing amounts from China since 1990 when China began to develop quickly. Because of the fast development of Chinese manufacturers and China's accession to the WTO, it is plausible that much of China's recent trade expansion has been driven by its internal productivity growth and reductions in trade barriers rather than by labor demand shocks in U.S. territories. Therefore, the instrument can identify the supply driven effects of U.S. import.

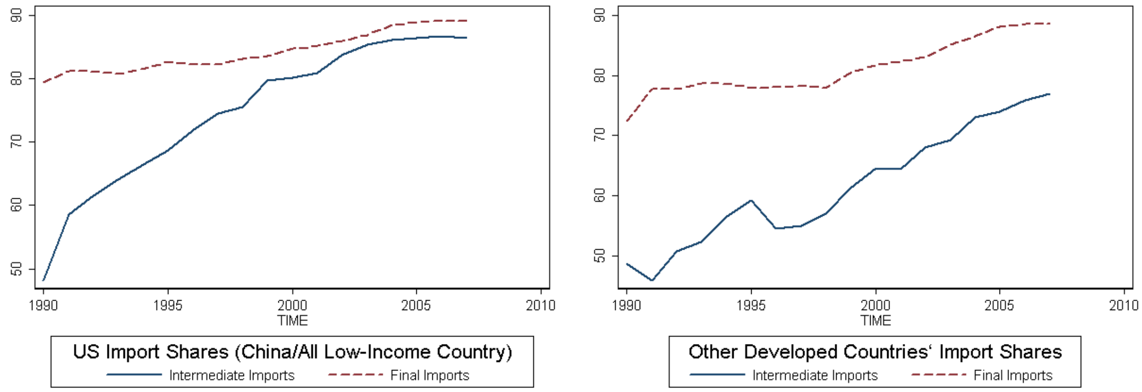
Following Autor et al. (2013), I use other developed countries' import from China as the instrument for U.S. import from China. In detail, I sum up the import volumes of Australia, Denmark, Finland, Germany, Japan, NewZealand, Spain and Switzerland by year and create $\Delta I\_oth_{it} = I\_oth_{it} - I\_oth_{i(t-1)}$. The instruments have the same structures as the local import measures. But I substitute ΔI_{it} using ΔI_oth_{it} in the instruments. In order to get strongly exogenous instrument variables, I also use the previous decade's employments to substitute the beginning period weights. That is, my instrument variables take the form $Import\_iv_{rt} = \frac{1}{L_{r(t-2)}} \sum_i a_{ri(t-2)} \Delta I\_oth_{it}$ with $a_{ri(t-2)} = \frac{L_{ri(t-2)}}{L_{i(t-2)}}$. Corresponding to the local total import, local intermediate import, and local final import measures, I have three instruments.

1.3 Data

This section compares my international trade database with other trade database, and explains my main local import measures. The OECD trade database I use provides total trade volumes and intermediate trade volumes separately, while other databases only provides total trade volumes.

The OECD database was newly released by OECD in the year 2011. It provides the total trade volumes and the intermediate goods trade volumes by industry sectors between countries. Therefore, I can easily decompose total import into intermediate import and final import using OECD data.

Figure 1.2: Import Shares from China, 1990-2007



Notes: The figure shows the import shares for U.S. and other developed countries. The import share is defined as $\frac{imports_{from-China}}{imports_{from-All-Low-Income-Countries}}$. The left panel's import values are the import values for U.S. The right panel's import values are sum of the import values for eight developed countries: Australia, Denmark, Finland, Germany, Japan, NewZealand, Spain, and Switzerland. The low income countries are defined by world bank in year 2012.

To compare my results with Autor et al. (2013), I compares U.S. total import values from China between OECD and UN Comtrade by year in Table 1.1 because the Autor et al. (2013) uses Comtrade trade database. We can see the two institutions have their own ways of recording import volumes. According to Comtrade, U.S. total import from China increased by 1156% from year 1990 to year 2007, while OECD reports U.S. total import from China increased by 1986%. However, we will see in the result section, the estimates of using Comtrade local total measure and OECD local total measure have similar magnitudes.

Compared with the Comtrade data, the OECD data facilitates the decomposition exercise. The Comtrade databases only provides total trade volumes, and therefore subject to certain drawbacks when measuring intermediate import volumes. Previous papers using the Comtrade database need to combine import data at the industry level and the initial year industry input-output matrix in order to measure the industry level intermediate import. Those papers need to assume the industry input-output matrix is kept constant as its initial year value. My analysis, therefore, escapes from such restrictive assumption by using the OECD data.

From Table 1.1, we can see intermediate import increased 2374% over my studying period. The increase is higher than the increase of the total import. Therefore, the effects of the intermediate import can be larger than the total import.

Table 1.1: Comparison—Yearly Value of Import with China for U.S. based on Comtrade and OECD Databases, 1990-2007

	Comtrade	**OECD Total**	**OECD Intermediate**	**OECD** $\frac{Intermediate}{Total}$
Year 1990				
Yearly Import Value in BN US$	26.3	16.3	3.63	0.223
Year 2000				
Yealy Import Value in BN US$	121.6	108.0	25.1	0.232
Year 2007				
Yearly Import Value in BN US$	330.0	340.0	89.8	0.264
Import Growth 1990-2007				
Percentage	1156%	1986%	2374%	

Notes: The Comtrade trade data is used by Autor et al. (2013). The comparison shows OECD and Comtrade have different records for trades. The difference is larger in the early year.

The only limitation of OECD data is that it divides the trade data only into industry sectors, not into individual industries as the UN Comtrade does. Table 1.2 compares the import values at the industry level between OECD and Comtrade. The mean total import values in the OECD are similarly to the ones in the Comtrade, but the variations are slightly smaller in the OECD. In Table 1.3, I compare the local total import measure with Autor et al. (2013)'s local import measure which uses the Comtrade data. The OECD local total import measure is still similar to the Comtrade local total import measure in mean, but smaller in standard deviation.

Table 1.2 also compares intermediate goods import and final goods import at the industry level. The intermediate import accounts for 50% of the total import on average. And for some industries, they only import intermediate goods so that their $\frac{intermediate}{total}$ ratios are equal to 1. Those industries are Basic Metals; Coke, Refined Petroleum Products and Nuclear Fuel; Extraction of Crude Petroleum and Natural Gas; Forestry, Logging, Mining of Coal, and Lignite and Extraction of Peat; and Mining of Metal Ores. Also, the increase of intermediate import is more dramatically than the increase of final import according to Figure 1.2. In Table 1.3, I also compare the local intermediate import and final import measures. The local final import is larger than the local intermediate import in both mean and standard deviation. However, the absolute values of $\frac{Local\_Intermediate}{Local\_Total}$ are not always less than one.

Therefore, the geographic distributions of local intermediate import measure and local total import measure are different.

From the OECD data archive, I extract the total import and intermediate import volumes between the U.S. and China, and between other developed countries and China for the years 1990, 2000, and 2007. Import data for the year 1980 is not available since China was not a big open country in that year.

Then I use County Business Pattern (CBP) and OECD to create the local import measures. I extract local industry employment share from CBP, and use the local industry shares to weigh the industry level import values from OECD. For each location, I sum up the weighted import values for all industries in the location as the local import measure. $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry total import, intermediate import, or final import value in thousand US$ accordingly. L_i as total employment for industry i, L_{ri} as local employment for industry i, and L_r as total local employment.

Based on the local intermediate import measure, I find locations in Texas, Ohio, and Michigan have large intermediate import. Those locations have a lot chemical manufacturing, structure metal manufacturing, fabricated metal manufacturing which heavily import intermediate inputs from China, but not much final goods from China.

Combining the local import variables with the local demographic, wage, and employment measures in Autor et al. (2013), I create a balanced panel data with each commuting zone as one observation. The panel data includes two time periods: 1990-2000 and 2000-2007, and 722 commuting zones in each time period. Any dependent variables in each period are the difference between the beginning year value and the end year value. For instance, the local average wage change for 1990-2000 period takes the form $\Delta log(wage_{r(1990-2000)}) = log(wage_{r2000}) - log(wage_{r1990})$. All the dependent variables are adjusted to their 10-year equivalent values.

1.4 Results

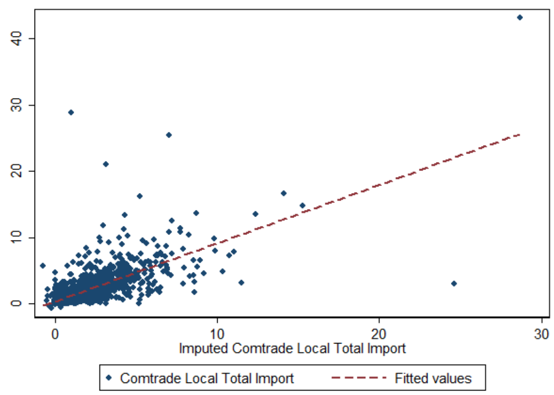
In this section, I show the main results. The results indicate the OECD total import measure and the Comtrade measure have similar negative effects on U.S. local labor markets so that the results in Autor et al. (2013) are quite robust. The decomposition of total import into intermediate goods import and final goods import shows the labor substitution effect from the intermediate import is the major cause of the negative effect on local non-manufacturing industries.

Let us first look at the first stage estimation of my 2SLS estimations. Figure 1.3 shows the scatter plots for the first stage estimation. We can see strong correlations between the local import measures and the imputed local import measures. The third panel of Table 1.4 shows the coefficients and F-statistics for the first stage estimations. The large coefficients and the F-statistics indicate the instruments are not weak instruments.

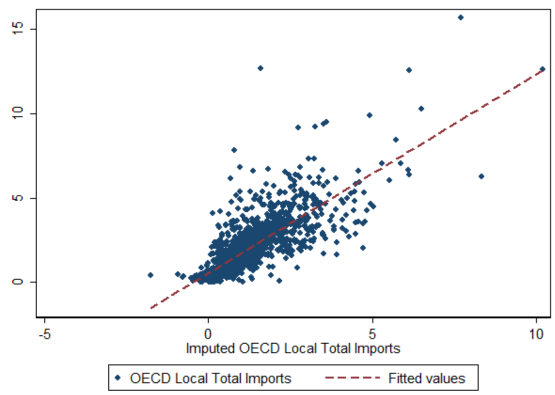
In Table 1.4, the top panel lists the OLS results of the local import measures on U.S. local employment rate. The OLS estimates of Comtrade and OECD total import measures have the same sign, but different significance levels. The fourth column shows the decomposition result. The intermediate import reduces local employment rate while the final import increases local employment rate.

The second panel of Table 1.4 uses the 2SLS instrumental variable strategy to address the endogenous bias. The first two columns compare the effects of Comtrade import and OECD total import. Both Comtrade and OECD total import measures reduce local employment rate, and the sizes of the effects are similar. Column 3 and 4 then decompose the OECD total import measure into intermediate import and final import. In column 3, I only use instrumental variable for the local intermediate import measure, and use the local final import measure as a control. In column 4, I use instrumental variables for both the local intermediate import and final import measures. The results show intermediate import still reduces local employment rate, but final import would insignificantly or positively affects local employment rate. This implies labor substitution effect from the intermediate import is the major reason that total import could reduce local employment rate. The import competition from final goods import induces either positive or zero net effect on local employment rate. Because the final import competes with only the domestic manufacturing firms, but not the local service firms, it moves workers from manufacturing firms to local service firms. As a result, the final import does not affect the local total employment rate. As the contrast, the intermediate import substitutes labor in both manufacturing and service firms so that

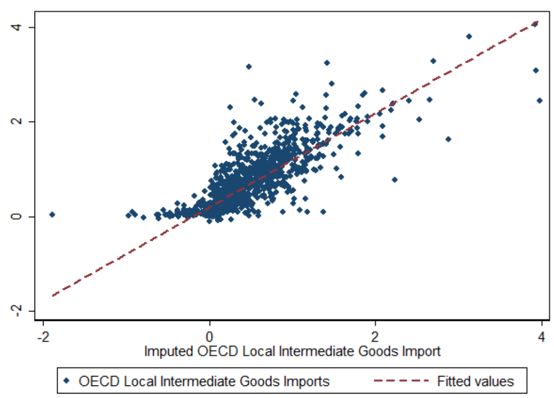
Figure 1.3: 2SLS First Stage Regression, 1990-2007



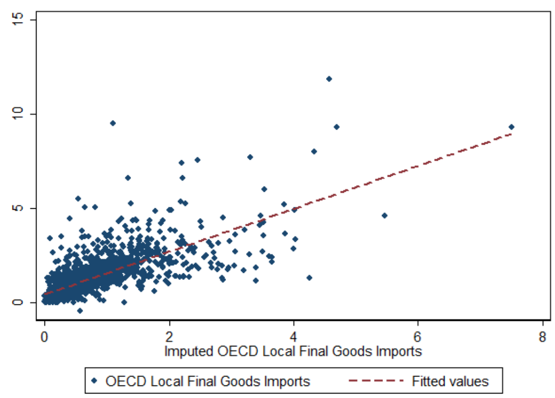
Comtrade Local Total Imports
F-stat: 47.64



OECD Local Total Imports
F-stat: 75.99



OECD Local Intermediate Imports
F-stat: 118.7



OECD Local Final Imports
F-stat: 133.5

Notes: The figure shows the 2SLS first stage scatter plots for the Comtrade local total import measure, the OECD local total import measure, the OECD local intermediate import measure, and the OECD local final import measure. All the four local import measures have the form $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry total import, intermediate import, or final import value in thousand US$ accordingly. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. The Comtrade local total import measure is used by Autor et al. (2013).

it has negative effect on local employment rate.

According to the 2SLS estimates, a $1000 per local worker increase in total import would decrease local employment rate by 0.616 percentage points, while a $1000 per local worker increase in intermediate import would decrease local employment rate by 2.116 percentage points. The estimated coefficient of intermediate import seems larger than the total import. However, since the standard deviation of local total import is larger than the local intermediate import, the standardized effects of the two imports measures are similar. One standard deviation of total import increase would decrease local employment rate by 0.319 percentage points, while one standard deviation of intermediate import increase would decrease local employment rate by 0.384 percentage points.

The bottom panel of Table 1.4 lists the reduced form results. The reduced form regressions directly use the instrumental variables as the explanatory variables, and the results are similar.

Table 1.5 and 1.6 estimate the effects of those import measures on local unemployment rate and not-in-the-labor-force rate. The Comtrade and OECD total import measures still have similar effects on local unemployment and not-in-the-labor-force rate. The total import measures increase both local unemployment rate and local not-in-the-labor-force rate. However, by comparing the sizes of the effects in the two tables, we can conclude a larger proportion of the displaced local labor force are voluntary unemployed. The decomposition exercises in column 3 and 4 in the two tables show the intermediate import still contributes more to the overall effect of import. According to the fourth columns, a $1000 per person increase in the intermediate import increases local not-in-the-labor-force rate by 2.051 percentage points[4].

Table 1.7 shows the induced local average wage changes. The effects of Comtrade and OECD total import measures on local wage are quite close. And the decomposition regressions in the last two columns confirm that the intermediate import is the major force to decrease local average wage. A 1000 US$ per person increase in the intermediate import reduces local average weekly wage by 3.575 log-points according to column 4.

In Table 1.8 to 1.11, the OECD total import measure affects the average wages and em-

[4] The mean local unemployment rate is 4.8% and the mean local not-in-the-labor-force rate is 24.76%.

ployment rates of manufacturing and non-manufacturing sectors similarly as the Comtrade total import measure. The evidence again indicates the results in Autor et al. (2013) are quite robust. The total import reduces manufacturing employment rate and non-manufacturing wage, and has negligible effects on non-manufacturing employment rate nor manufacturing wage. According to Autor et al. (2013), total import might force those who have lowest pay in manufacturing sector to lose their jobs, and so the average wage in manufacturing industries is not affected. In the non-manufacturing sector, the total import does not have employment effect but only wage reduction effect.

The third and fourth columns in Table 1.8 to 1.11 are the decomposition exercises. In the manufacturing sector, the effect of the final import dominates the effect of the intermediate import because the final import competes with the domestic manufacturing industries. The same as the total import, the final import reduces the manufacturing employment rate, and has no effect on manufacturing wage. And the intermediate import has insignificant employment effect but negative wage effect on manufacturing sector. In those manufacturing industries which import many intermediate inputs, the employment might decline due to the labor substitution effect from the intermediate import. However, since the manufacturing industries importing many intermediate inputs produce basic materials like metal and chemical, the other manufacturing industries which relies on those basic materials could benefit from the product effect from the intermediate import. As a result, the intermediate import does not affect the overall manufacturing employment. For the manufacturing wage, on the contrary of the final import, the intermediate import would not necessarily substitute labor with lowest pay. Therefore, the average manufacturing wage is reduced by the intermediate import.

In the non-manufacturing sector, the intermediate import and the final import still have heterogeneous effects. The final import increases non-manufacturing employment, and has no effect on non-manufacturing wage. Since the final import competes solely with the manufacturing industries, and forces manufacturing labor to move to the non-manufacturing sector, it could increase non-manufacturing employment. The result is consistent with the previous literature which documents import competition shrinks manufacturing sector and promotes service sector. The intermediate import reduces non-manufacturing employment, and has no effect on non-manufacturing wage. The employment result indicates the intermediate import also has labor substitution effect on non-manufacturing industries. The wage result implies it might also have output effect so that the productivity in non-manufacturing sector increases and keeps the non-manufacturing wage steady.

1.5 Conclusion

The findings in this chapter lead to two main conclusions. First, my chapter confirms the results in Autor et al. (2013) are quite robust. Since Autor et al. (2013) is the leading paper studying trade's effects on local labor markets, such confirmation would encourage more future research on this topic. Second, the decomposition of total import into intermediate import and final import indicates the labor substitution effect of intermediate import is the driving force of the overall negative effect of import on the non-manufacturing sector. Therefore, the decomposition exercise in this chapter could stimulate more future research on the effects of intermediate import.

The results lead to several policy implications. First, government should separately treat intermediate goods import and final goods import since the two impose different effects. The intermediate goods could substitute domestic labor force in both manufacturing and non-manufacturing sectors, while the final goods import mainly competes with domestic manufacturing industries. Second, since the geographic distributions of the intermediate import and final import are also different, government could allocate different types of resources to different locations accordingly.

Future research can continue studying the decomposition exercise. Researchers could divide local employment into occupation categories, and examine the effects of intermediate import and final import on different occupations. Researchers can also design analysis to further study the different mechanisms of intermediate import and final import on local labor markets.

Table 1.2: Summary Statistics Comparison—Value of Industry Level Import with China for U.S. based on Comtrade and OECD Databases, 1990-2007

	mean	**sd**	**min**	**p50**	**max**
Year 1990 (Values in BN US$)					
Comtrade Industry Total Import	12.888	2.6803	7.3119	12.896	20.347
OECD Industry Total Import	12.089	1.7502	8.3023	12.145	15.721
OECD Industry Intermediate Import	10.919	1.5534	7.1929	11.181	13.439
OECD Industry Final Import	11.414	2.7115	4.3041	11.951	15.679
OECD Industry $\frac{Intermediate}{Total}$	0.4804	0.3811	0.0404	0.3805	1
Year 2000 (Values in BN US$)					
Comtrade Industry Total Import	14.221	2.7058	7.7944	14.367	20.897
OECD Industry Total Import	13.729	2.3373	7.5229	13.995	16.951
OECD Industry Intermediate Import	12.641	2.1525	7.5229	13.076	15.336
OECD Industry Final Import	13.602	2.6666	5.6454	14.049	16.928
OECD Industry $\frac{Intermediate}{Total}$	0.5234	0.3693	0.0111	0.4789	1
Year 2007 (Values in BN US$)					
Comtrade Industry Total Import	14.613	3.1363	7.0648	14.714	23.589
OECD Industry Total Import	14.738	2.5186	9.1315	15.418	17.876
OECD Industry Intermediate Import	13.677	2.5213	6.6682	14.481	16.379
OECD Industry Final Import	14.690	2.6670	6.9207	15.048	17.844
OECD Industry $\frac{Intermediate}{Total}$	0.5538	0.3592	0.0020	0.5600	1
Pooled-Year (Values in BN US$)					
Comtrade Industry Total Import	14.015	2.9559	7.0648	14.125	23.589
OECD Industry Total Import	13.537	2.4589	7.5229	13.416	17.876
OECD Industry Intermediate Import	12.432	2.3823	6.6682	12.653	16.379
OECD Industry Final Import	13.236	2.9724	4.3041	13.689	17.844
OECD Industry $\frac{Intermediate}{Total}$	0.5197	0.3662	0.0020	0.4714	1

Notes: The Comtrade trade data is used by Autor et al. (2013). The OECD measures are used for my decomposition analysis. Since the maximum values of OECD Industry $\frac{Intermediate}{Total}$ are 1 for all years, some industries having only intermediate imports in my studying periods. There industries are Basic Metals; Coke, Refined Petroleum Products and Nuclear Fuel; Extraction of Crude Petroleum and Natural Gas; Forestry, Logging, Mining of Coal, and Lignite and Extraction of Peat; and Mining of Metal Ores.

Table 1.3: Summary Statistics Comparison—Value of Local New Import with China for U.S. based on Comtrade and OECD Databases, 1990-2007

	mean	**sd**	**min**	**p50**	**max**
$\frac{\Delta Imports}{Worker}$ **in Thousand US$**					
Comtrade Local Total Import	1.9056	2.5830	-0.6289	1.1790	43.085
OECD Local Total Import	1.9547	1.6783	-0.0107	1.4965	15.680
OECD Local Intermediate Import	0.6181	0.5884	-0.0991	0.3829	4.0663
OECD Local Final Import	1.3356	1.1599	0.0025	1.0653	11.874
OECD $\frac{Local\_Intermediate}{Local\_Total}$	0.2889	0.3711	-8.7860	0.2889	9.2269
$\frac{\Delta Imputed\_Imports}{Pre-Worker}$ **in Thousand US$**					
Comtrade Imputed Local Total Import	1.7546	2.0845	-0.7233	1.1157	28.655
OECD Imputed Local Total Import	1.1941	1.1125	-1.7725	0.8856	10.207
OECD Imputed Local Intermediate Import	0.4168	0.4811	-1.8974	0.2709	3.9835
OECD Imputed Local Final Import	0.7773	0.7342	-0.0004	0.5518	7.5071
OECD Imputed $\frac{Local\_Intermediate}{Local\_Total}$	0.3540	1.4739	-37.029	0.3499	22.695

Notes: The local import measures all have the same structure. $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry total import, intermediate import, or final import value in thousand US$ accordingly. L_i as total employment for industry i, L_{ri} as local employment for industry i, and L_r as total local employment. Some of the ratios $\frac{Local\_Intermediate}{Local\_Total}$ have absolute values larger than 1. This indicates in the local level, the intermediate import value is not always smaller than the total import value. The Comtrade local measures are used by Autor et al. (2013).

Table 1.4: The Effects of New Imports from China on Changes of Employment Rate in Commuting Zones, 1990-2007

Dependent Variable: 10-year Changes of Local Employment Rate (in % pts)				
VARIABLE $\frac{\Delta Imports}{Worker}$	(1)	(2)	(3)	(4)
		OLS		
Comtrade Local Total Import	-0.115			
	(0.086)			
OECD Local Total Import		-0.446***		
		(0.077)		
OECD Local Intermediate Import				-4.244***
				(1.093)
OECD Local Final Import				0.723**
				(0.285)
		2SLS		
Comtrade Local Total Import	-0.774***			
	(0.176)			
OECD Local Total Import		-0.616***		
		(0.153)		
OECD Local Intermediate Import			-3.376***	-2.116**
			(0.661)	(0.938)
OECD Local Final Import			0.491**	-0.113
			(0.192)	(0.382)
		2SLS First Stage		
	Comtrade Local Total	OECD Local Total	OECD Local Intermediate	OECD Local Final
Imputed Comtrade Local Total Import	0.631***			
	(0.090)			
F-Stat	47.643			
Imputed OECD Local Total Import		1.128***		
		(0.103)		
F-Stat		75.994		
Imputed OECD Local Intermediate Import			0.669***	0.449***
			(0.052)	(0.138)
Imputed OECD Local Final Import			0.061	1.072***
			(0.037)	(0.128)
F-Stat			118.7	133.5
		Reduced Form		
Imputed Comtrade Local Total Import	-0.489***			
	(0.076)			
Imputed OECD Local Total Import		-0.696***		
		(0.141)		
Imputed OECD Local Intermediate Import				-1.468***
				(0.440)
Imputed OECD Local Final Import				-0.251
				(0.331)
Instrumented for Final	N/A	N/A	No	Yes
Observation	1,444	1,444	1,444	1,444

Notes: The explanatory local import measures have the same form $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry total import, intermediate import, or final import value in thousand US$ accordingly. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. Column 3 uses local final import measure simply as a control variable, while column 4 uses instrument variables for both the local intermediate and final import measures. The Comtrade Local Total Import measure is used in Autor et al. (2013). The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.
*** p<0.01, ** p<0.05, * p<0.1

Table 1.5: The Effects of New Imports from China on Changes of Unemployment Rate in Commuting Zones, 1990-2007, 2SLS Estimates

Dependent Variable: 10-year Changes of Local Unemployment Rate (in % pts)

VARIABLE $\frac{\Delta Imports}{Worker}$	(1)	(2)	(3)	(4)
Comtrade Local Total Import	0.221***			
	(0.057)			
OECD Local Total Import		0.177**		
		(0.085)		
OECD Local Intermediate Import			0.617*	0.065
			(0.330)	(0.349)
OECD Local Final Import			-0.050	0.215
			(0.111)	(0.157)
Instrumented for Final	N/A	N/A	No	Yes
Observation	1,444	1,444	1,444	1,444

Notes: The explanatory local import measures have the same form $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry total import, intermediate import, or final import value in thousand US$ accordingly. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. Column 3 uses local final import measure simply as a control variable, while column 4 uses instrument variables for both the local intermediate and final import measures. The Comtrade Local Total Import measure is used in Autor et al. (2013). The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.
*** p<0.01, ** p<0.05, * p<0.1

Table 1.6: The Effects of New Imports from China on Changes of Not-in-the-Labor-Force Rate in Commuting Zones, 1990-2007, 2SLS Estimates

Dependent Variable: 10-year Changes of Local Not-in-the-Labor-Force Rate (in % pts)

VARIABLE $\frac{\Delta Imports}{Worker}$	(1)	(2)	(3)	(4)
Comtrade Local Total Import	0.553***			
	(0.150)			
OECD Local Total Import		0.439***		
		(0.144)		
OECD Local Intermediate Import			2.759***	2.051***
			(0.542)	(0.743)
OECD Local Final Import			-0.441**	-0.101
			(0.178)	(0.341)
Instrumented for Final	N/A	N/A	No	Yes
Observation	1,444	1,444	1,444	1,444

Notes: The explanatory local import measures have the same form $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry total import, intermediate import, or final import value in thousand US$ accordingly. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. Column 3 uses local final import measure simply as a control variable, while column 4 uses instrument variables for both the local intermediate and final import measures. The Comtrade Local Total Import measure is used in Autor et al. (2013). The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.
*** p<0.01, ** p<0.05, * p<0.1

Table 1.7: The Effects of New Imports from China on Changes of Average Weekly Wage in Commuting Zones, 1990-2007, 2SLS Estimates

Dependent Variable: 10-year Changes of Local Average Weekly Wage (in log-pts)				
VARIABLE $\frac{\Delta Imports}{Worker}$	(1)	(2)	(3)	(4)
Comtrade Local Total Import	-0.759***			
	(0.253)			
OECD Local Total Import		-0.794***		
		(0.299)		
OECD Local Intermediate Import			-5.215***	-3.575***
			(1.575)	(1.219)
OECD Local Final Import			0.926**	0.139
			(0.468)	(0.558)
Instrumented for Final	N/A	N/A	No	Yes
Observation	1,444	1,444	1,444	1,444

Notes: The explanatory local import measures have the same form $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry total import, intermediate import, or final import value in thousand US$ accordingly. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. Column 3 uses local final import measure simply as a control variable, while column 4 uses instrument variables for both the local intermediate and final import measures. The Comtrade Local Total Import measure is used in Autor et al. (2013). The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.

*** p<0.01, ** p<0.05, * p<0.1

Table 1.8: The Effects of New Imports from China on Changes of Local Employment Rate in Manufacturing Industries, 1990-2007, 2SLS Estimates

Dependent Variable: 10-year Changes of Manufacturing Employment Rate (in log-pts)

VARIABLE $\frac{\Delta Imports}{Worker}$	(1)	(2)	(3)	(4)
Comtrade Local Total Import	-0.596***			
	(0.0988)			
OECD Local Total Import		-0.660***		
		(0.150)		
OECD Local Intermediate Import			-2.307***	-0.120
			(0.595)	(0.909)
OECD Local Final Import			0.208	-0.840**
			(0.166)	(0.364)
Instrumented for Final	N/A	N/A	No	Yes

Notes: The explanatory local import measures have the same form $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry total import, intermediate import, or final import value in thousand US$ accordingly. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. Column 3 uses local final import measure simply as a control variable, while column 4 uses instrument variables for both the local intermediate and final import measures. The Comtrade Local Total Import measure is used in Autor et al. (2013). The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 1.9: The Effects of New Imports from China on Changes of Local Employment Rate in Non-Manufacturing Industries, 1990-2007, 2SLS Estimates

Dependent Variable: 10-year Changes of Non-Manufacturing Employment Rate (in log-pts)

VARIABLE $\frac{\Delta Imports}{Worker}$	(1)	(2)	(3)	(4)
Comtrade Local Total Import	-0.178			
	(0.137)			
OECD Local Total Import		0.043		
		(0.127)		
OECD Local Intermediate Import			-1.069**	-1.995***
			(0.545)	(0.553)
OECD Local Final Import			0.283*	0.727***
			(0.166)	(0.218)
Instrumented for Final	N/A	N/A	No	Yes

Notes: The explanatory local import measures have the same form $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry total import, intermediate import, or final import value in thousand US$ accordingly. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. Column 3 uses local final import measure simply as a control variable, while column 4 uses instrument variables for both the local intermediate and final import measures. The Comtrade Local Total Import measure is used in Autor et al. (2013). The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.
*** p<0.01, ** p<0.05, * p<0.1

Table 1.10: The Effects of New Imports from China on Changes of Local Average Weekly Wage in Manufacturing Industries, 1990-2007, 2SLS Estimates

Dependent Variable: 10-year Changes of Manufacturing Weekly Wage (in log-pts)

VARIABLE $\frac{\Delta Imports}{Worker}$	(1)	(2)	(3)	(4)
Comtrade Local Total Import	0.150			
	(0.482)			
OECD Local Total Import		-0.351		
		(0.786)		
OECD Local Intermediate Import			-7.076*	-6.065**
			(4.104)	(3.064)
OECD Local Final Import			2.051**	1.566
			(0.845)	(0.972)
Instrumented for Final	N/A	N/A	No	Yes

Notes: The explanatory local import measures have the same form $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry total import, intermediate import, or final import value in thousand US$ accordingly. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. Column 3 uses local final import measure simply as a control variable, while column 4 uses instrument variables for both the local intermediate and final import measures. The Comtrade Local Total Import measure is used in Autor et al. (2013). The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.

*** p<0.01, ** p<0.05, * p<0.1

Table 1.11: The Effects of New Imports from China on Changes of Local Average Weekly Wage in Non-Manufacturing Industries, 1990-2007, 2SLS Estimates

Dependent Variable: 10-year Changes of Non-Manufacturing Weekly Wage (in log-pts)

VARIABLE $\frac{\Delta Imports}{Worker}$	(1)	(2)	(3)	(4)
Comtrade Local Total Import	-0.761***			
	(0.137)			
OECD Local Total Import		-0.584*		
		(0.302)		
OECD Local Intermediate Import			-2.885**	-0.857
			(1.392)	(1.299)
OECD Local Final Import			0.480	-0.492
			(0.449)	(0.622)
Instrumented for Final	N/A	N/A	No	Yes

Notes: The explanatory local import measures have the same form $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry total import, intermediate import, or final import value in thousand US$ accordingly. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. Column 3 uses local final import measure simply as a control variable, while column 4 uses instrument variables for both the local intermediate and final import measures. The Comtrade Local Total Import measure is used in Autor et al. (2013). The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.
*** p<0.01, ** p<0.05, * p<0.1

Chapter 2

The Dynamic Effect of Imports on U.S. Local Jobs and Housing

2.1 Introduction

As shown by Autor, Dorn and Hanson (2013), Topalova (2007), and Kovak (2013), import competition causes declines in local industry wages and employment rates. However, we have also seen that in areas which have large employments in industries vulnerable to imports, like Detroit, local rent and housing prices largely decline. Also, since local housing and labor markets are mutually affected (Roback, 1982; Mian and Sufi, 2014; Charles and Notowidigdo, 2013), we might wonder whether import dynamically affects local labor and housing markets.

This chapter performs theoretical and empirical analyses to investigate the dynamic effect of intermediate imports on local wages, employments, rents, and housing prices. The dynamic effect begins with the intermediate import shock on local industries and spreads to local housing market. The changing rents and housing prices further impose a secondary effect on local industries like construction, banking, and real estate.

My chapter focuses on intermediate imports instead of total imports because intermediate imports and final imports affect local market differently (Zhang, 2015). While final goods imports only affect industries producing the similar final goods, intermediate imports also affect industries using the imported inputs. Also, according to Feenstra and Hanson (1996, 1999), Egger and Falkinger (2006), and Crino (2009), intermediate imports could be a measure of the international outsourcing process. Therefore, by studying intermediate imports, I could also add insights to the outsourcing literature.

To analyze the dynamic effect closely, I classify industries into tradable and non-tradable sectors, as the two sectors have a different relationship with housing, and, therefore, play a different role in the dynamic. The tradable sector includes custom services, wholesale, and manufacturing industries. The non-tradable sector contains construction and all other service industries like real estate, personal care, and mortgage financial services.

The two sectors are modeled separately in a two-sector spatial equilibrium model. The model combines the specific factor model and the Rosen-Roback spatial model. The labor demands and supplies of the two sectors follow the framework used in the specific factor model. The Rosen-Roback spatial model is needed for the analysis on local housing markets.

I obtain labor demand functions for the two sectors by solving their cost-minimization problems. Both sectors use local labor, capital, and imported intermediate inputs to produce. But tradable sector relies more on imported intermediate inputs. As a result, both sectors' labor demand would be reduced by an intermediate import shock, but the local labor demand for the tradable sector is reduced more.

I solve local labor supply function by optimizing a representative worker's labor choice between tradable and non-tradable sectors. Following Casas (1984), I assume workers move imperfectly across tradable and non-tradable sectors. This assumption allows the intermediate shock to affect the two sectors heterogeneously which is supported by my empirical analysis. With this assumption, some of the displaced workers from the tradable sector move to the non-tradable sector following the intermediate import shock. The cross-sector labor movement increases labor supply in the non-tradable sector and decreases labor supply in the tradable sector.

To obtain local housing demand function, I assume the representative worker consumes a composite of tradable goods and housing to optimize his utility. The solution of the consumption choice problem shows that the housing demand is a function of the wages and employments of both sectors. Therefore, the local wage and employment declines can reduce the housing price. In general, the representative worker consumes a composite of tradable good and a composite of non-tradable good. The non-tradable good price as a function of local rent is then affected by the local wage and employment declines.

Local housing supply is assumed as a function of local housing price and housing construction cost following Saiz (2010). I use the non-tradable sector's wage to approximate the housing construction cost and express the local housing supply as a function of housing price and non-tradable wage.

I then solve the spatial equilibrium using conditions that local housing supply equates local housing demand and the marginal resident is indifferent between staying and migrating. The equilibrium shows that the local wages and employments of the tradable and non-tradable sectors, the local housing price, the local rent, and the local housing supply can all be affected by the intermediate import shock.

The equilibrium also suggests that the intermediate import shock affects local jobs and housing dynamically. The labor demands of both sectors are directly reduced by intermediate imports with tradable sector being affected more. At the same time, the housing supply slightly increases because the construction cost decline. Subsequently, the labor supplies of both sectors are affected because workers move from the tradable sector to the non-tradable sector. Following the reduction of local wages, local housing demand declines. The housing supply and demand changes then reduce the housing prices and rents. As a consequence of the housing sector reduction, labor demand further declines in the non-tradable sector.

Based on the model, I create a local intermediate import measure which uses the initial period local industry compositions to weigh the national industry import values. The places with higher local import measures are subjected to higher import shocks because of larger initial employments in industries vulnerable to imports. The local intermediate import measure and the equilibrium equations are then used to empirically examine intermediate import's local dynamic effect.

My empirical analysis uses data from the U.S. Census, the OECD Bilateral Trade database, and the County Business Patterns (CBP). The geographic units in the analysis are commuting zones which cover the whole U.S. territory except Alaska and Hawaii States[1]. Local average wages and employment rates of the two sectors, housing prices, rents, housing stocks are measured using the U.S. census. The industry level total import values and intermediate import values are extracted from the OECD. My local import measures weigh the OECD national industry import values using local industry employment shares from the CBP. All the variables are collapsed into the commuting zone level and merged with the local demographic controls from Autor et al. (2013). The final data set is a balanced panel data with each commuting zone as one observation.

[1]Please refer to Autor, Dorn and Hanson (2013) for a commuting zone definition.

Using a panel data model, I could examine intermediate imports' dynamic effect. The local labor and housing market outcomes are the dependent variables. The main explanatory variable is the local intermediate import measure. The full control variables in Autor et al. (2013) are included in the regression specification. Those controls are log values of local manufacturing employment, college-educated population, foreign born population, female population, routine population, and a local outsourcing index.

To formally study intermediate imports' dynamic, I adapt Autor et al. (2013)'s instrumental variable strategy to deal with the concern that the local intermediate import measure and the local market outcomes correlate with some common unobserved local demand shocks. This strategy uses other developed countries' import volume as an instrument of U.S. import volume. The identifying assumption is that other developed countries' import activities are not correlated with unobserved local demand shocks in the U.S.

Consistent with my model's predictions, the empirical analysis shows that the increase of intermediate import reduces the wages and employments of both tradable and non-tradable sectors, the local housing price, and the local rent. The reduced housing price and rent further decrease the non-tradable labor demand.

With the reduced-form instrumental variable estimations, I then calibrate my theoretical structural model in order to fully understand the dynamic. The calibration indicates the intermediate import directly substitute labor force in both tradable and non-tradable sector, but it also impose positive product effects on both sectors by reducing the production cost. The calibration also confirms that the intermediate import affects local labor and housing market dynamically.

To my knowledge, my study is the first to examine the effect of trade on local housing markets. According to Glaeser, Gyourko, Morales and Nathanson (2014) and Ferreira, Fernando and Gyourko (2012), housing is local in natural and housing price trends show heterogeneous patterns in different locations. However, the reasons behind the heterogeneous patterns are still unclear. Thanks to the recent trade papers like Autor et al. (2013), Topalova (2007), and Kovak (2013) which make local trade measurements available, I could study the effect of intermediate import on local housing markets. The study then adds new knowledge to understand the heterogeneous housing price and rent trends across U.S. areas.

The study contributes to both trade and urban literature by combining the specific factor model with the spatial equilibrium model. Rosen (1979) and Roback (1982) spatial models consider only closed economy, whereas the local trade specific factor models by Autor et al. (2013) and Kovak (2013) only study trade's local labor market effects. My combined model facilitates the study of intermediate imports' dynamic effect on local labor and housing markets and shows local housing could amplify the trade-induced damage on local labor market.

By studying housing's reaction to trades, the chapter also sheds lights on the trade-induced welfare analysis. Although the welfare effect is an important concern in the trade literature, few studies have measured the welfare effect appropriately owing to ignorance of the local housing market. Since changes in housing prices further alter labor demand, and housing expenditure is the largest consumer expenditure, any welfare analysis is incomplete without considering housing market changes.

My chapter, which focuses on intermediate imports, adds new insights to the international outsourcing literature as the outputs of outsourced activities have to be imported back and used as inputs. The research on international outsourcing (Chongvilaivan and Hur, 2011; Wang, Gwebu, and Wang, 2008; Chang and Gurbaxani, 2012) shows outsourcing is beneficial to firms because it saves cost and improves service quality. In this sense, intermediate imports should impose a positive effect on the local economy in the long run. Nevertheless, as the chapter shows, intermediate imports reduce local employment and exacerbates local wage inequality in the short or medium run.

This study provides trade policy guidance for governments by identifying more affected industries and places, thereby allowing effective allocation of resources. Moreover, since housing plays a considerable role in the import-induced dynamic, governments can try to encounter the employment decline by promoting housing demand. The chapter also informs local housing-related industries, such as construction, home decorating, and mortgage financial service industries, that imports can negatively affect them. This allows them to formulate appropriate hedging strategies by forecasting the impact of future import shocks.

The rest of the chapter proceeds as follows. The next section builds the two-sector spatial equilibrium model and gives testable predictions. Section 3 outlines the empirical method and the identifying strategy. Section 4 summarizes the data resources. The results are listed and analyzed in section 5. Section 6 concludes.

2.2 Theoretical Framework

In this section, I develop a two-sector spatial model and derive my main explanatory variable—the local import measure. The model adds spatial elements into the classical factor specific model, and better explains trade's dynamic effect.

2.2.1 Local Labor Market

This section models labor market demand and supply equilibrium conditions, which are then used to derive the final spatial equilibrium.

Local Labor Demand

In order to separately model the tradable and non-tradable sectors, two demand functions are derived in this section. Based on the two demand functions, I also derive the local import measure.

I begin modeling labor demand by setting up firms' production functions. Consider region r with two sectors, and each sector has several industries. Industries in both sectors use local labor L and imported intermediate goods I to produce. The non-tradable sector also needs local land K to produce. To make the model simple, technology T is assumed to be the same across regions but may differ across sectors. The CES production function for any industry i in tradable sector 1 is thus

$$Y_{1i} = T_{1i}(L_{1i}^{\rho_1} + I_i^{\rho_1})^{\frac{1}{\rho_1}}$$

The CES production function for any industry i in non-tradable sector 2 is

$$Y_{2i} = T_{2i}(L_{2i}^{\rho_2} + I_i^{\rho_2} + K_i^{\rho_2})^{\frac{1}{\rho_2}}$$

The region subscript r is suppressed here, and the time subscript t is suppressed from then on in this section. Industries in non-tradable sector rely heavily on local land which implies the elasticity of substitution in sector 1 is larger than in sector 2, i.e. $\rho_1 < \rho_2$.

By assuming that goods and all the inputs markets are perfect competitive, I use the cost minimization conditions and the input market clearing conditions to get the log-linearized labor demand functions for the two sectors and the land rent function[2]

$$\hat{W}_{1r} = b_{1L}\hat{L}_{1r} + b_{1I}IMP_r \tag{1}$$

$$\hat{W}_{2r} = b_{2L}\hat{L}_{2r} + b_{2P}\hat{P}_r + b_{2I}IMP_r \tag{2}$$

$$\hat{R}_r = b_{3L}\hat{L}_{2r} + b_{3P}\hat{P}_r + b_{3I}IMP_r \tag{3}$$

Where P_r is the price for local non-tradable good, R_r is the price for land, and IMP_r is the local import measure. The local tradable good's price is normalized to 1^3. The local land is assumed to be fixed.

From the demand functions, my local import exposure is defined as

$$IMP_r = \frac{\sum_i a_{ri}\hat{I}_i}{L_r}$$

Where $a_{ri} = \frac{L_{ri}}{L_i}$, I_i is industry intermediate import value, and L_r is local employment. Within the a_{ri} ratio, L_i is total employment for industry i, and L_{ri} is local employment for industry i. Intuitively, the local import measure treats local labor markets as sub-economies subject to different import shocks according to their initial industry compositions. Using the initial local industry employment shares as the weights is natural since a place with a lot industries vulnerable to import initially would be affected more by future imports.

From the derivation of the demand functions (1) and (2), we know the inverse labor demand elasticities $b_{1L} < 0$, $b_{2L} < 0$. And the local import's direct effects on the two sectors satisfy $b_{1I} < b_{2I} < 0$ because $\rho_1 < \rho_2$. This leads to the following lemma

[2]See Appendix A for the derivation.

[3]Because I focus on intermediate import instead of total import, I can get rid of the effect of final import on the tradable goods' price. Therefore, the tradable goods' price can be normalized to 1.

LEMMA: If labor supply or intermediate import increases, the wages of tradable and non-tradable sectors decrease. The intermediate import directly reduces the tradable wage larger than the non-tradable wage.

Local Labor Supply

I adapt Casas (1984)'s strategy to introduce imperfect sector mobility as a constant, and solve the labor supply function in this section. The imperfect sector mobility allows labor movement between the two sectors after the import shock.

For simplicity, the model follows Casas (1984) to assume the elasticity of labor mobility across sectors as a non-negative constant ϵ, so I can write down the labor supply function as[4] $\frac{L_{1r}}{L_{2r}} = (\frac{W_{1r}}{a_2 W_{2r}})^{\epsilon}$. This labor supply function can be derived by considering a representative worker's utility maximization problem[5]. The worker consumes goods G and supplies labor L_1, L_2 in the two sectors

$$U(G_r, L_{1r}, L_{2r}) = V(G_r) - a_2 L_{1r}^{1+\frac{1}{\epsilon}} - L_{2r}^{1+\frac{1}{\epsilon}}$$

$$\text{st.} \qquad G_r = W_{1r} L_{1r} + W_{2r} L_{2r}$$ [6]

Solving for L_{1r} and L_{2r}, we can get the local labor supply function. Under this setting, the representative workers would supply labor to both sectors whenever $\epsilon \neq \infty$. Since all locations have employments in both tradable and non-tradable sectors, the representative worker's labor supply setting makes sense.

Then log-linearizing the labor supply function gives a relation of sector wages and employments

$$\hat{L}_{1r} - \hat{L}_{2r} = \epsilon(\hat{W}_{1r} - \hat{W}_{2r}) \tag{4}$$

When ϵ is infinite, workers can move freely across the two groups. If wages are different

[4]This is a simplified version of Casas's specification.

[5]In the case of an individual worker's utility maximization problem, we can refer to Casas (1984) for the derivation and interpretation.

[6]I will specific G_r later when modeling housing/goods demand.

across sectors, local workers would all choose to work in the sector having higher wage. When ϵ is zero, workers are totally immobile across sectors. Therefore, the intermediate import imposes homogeneous effects on the two sectors' employment under this case. When $0 < \epsilon < \infty$, workers can change sectors with friction, and thus the intermediate import affects the two sectors' employment differently.

Combining labor supply function (4) and labor demand functions (1) and (2), I can solve the labor market equilibrium

PROPOSITION 1: The wages and employments in both sectors would decrease when intermediate import increases. If the increase of intermediate import reduces the tradable wage more than the non-tradable wage, it also reduces the tradable employment more than the non-tradable employment.

The effects of intermediate imports on the wages and employments of the two sectors depend on the elasticity of labor mobility ϵ. If $\epsilon = 0$ and workers cannot move across sectors, the wages and employments of the two sectors would not be further affected. Under this situation, the magnitudes of labor demand elasticities b_{1L} and b_{2L} determine which sector would be penalized more. When $\epsilon = \infty$, intermediate imports affect the wages and employments of the two sectors homogeneously. In reality $0 < \epsilon < \infty$ so that import can impose heterogeneous effects on the two sectors. Under this situation, we know from equation (3) that $\frac{d\Delta L_{1r}}{dIMP_r} < \frac{d\Delta L_{2r}}{dIMP_r}$ whenever $\frac{d\Delta W_{1r}}{dIMP_r} < \frac{d\Delta W_{2r}}{dIMP_r}$[7].

2.2.2 Local Housing Market

This section models the effect of intermediate imports on housing, and in general on any non-tradable goods' prices. By deriving and equating the local housing demand and supply functions, I solve the local housing price and housing supply equations.

Housing prices, or any local non-tradable goods' prices in general are set through representative worker's consumption problem. Considering again the representative worker's

[7] Any log-linearized variable $\hat{z} = \Delta log(z) \simeq \frac{\Delta z}{z_{(t-1)}}$

utility maximization problem, I now specify the consumption G. The representative worker cares about the consumption of a composite of tradable good C and housing H, i.e.

$$U(C_r, H_r, L_{1r}, L_{2r}) = V(C_r, H_r) - a_2 L_{1r}^{1+\frac{1}{\epsilon}} - L_{2r}^{1+\frac{1}{\epsilon}}$$
$$= log(C_r) + a_1 log(H_r) - a_2 L_{1r}^{1+\frac{1}{\epsilon}} - L_{2r}^{1+\frac{1}{\epsilon}}$$

$$\text{st.} \quad C_r + P_r^h H_r = W_{1r}L_{1r} + W_{2r}L_{2r}$$

Then solving the first order conditions for C_r, H_r, I get the optimal H_r^*. Log-linearizing H_r^* gives the local housing demand equation (a)

$$\hat{H}_r^D = \theta_{wr}(\hat{W}_{1r} + \hat{L}_{1r}) + (1 - \theta_{wr})(\hat{W}_{2r} + \hat{L}_{2r}) - \hat{P}_r^h \tag{a}$$

Where $0 < \theta_{wr} = \frac{W_{1r}L_{1r}}{W_{1r}L_{1r}+W_{2r}L_{2r}} < 1$ is the wage share from working in tradable sector.

Following Saiz (2010), the log-linearized housing supply function is set to

$$\hat{H}_r^S = \eta_r \hat{R}_r + \zeta_r \hat{CC}_r \tag{b}$$

Where $\eta > 0$ is the housing supply elasticity, and CC is the construction cost.

Assuming $\hat{CC}_r = \gamma_{1r}\hat{W}_{2L} + \gamma_{2r}IMP_r$, and equating the housing supply function (b) with the housing demand function (a), I solve local housing price as

$$\hat{P}_r^h = \frac{1}{1+\eta_r}(\theta_{wr}(\hat{W_{1r}} + \hat{L_{1r}}) + (1 - \theta_{wr} - \zeta_r\gamma_{1r})\hat{W}_{2r} + (1 - \theta_{wr})\hat{L}_{2r} - \zeta_r\gamma_{2r}IMP_r) \tag{5}$$

and local housing supply as

$$\hat{H}_r^S = \frac{1}{1+\eta_r}(\eta_r\theta_{wr}(\hat{W_{1r}} + \hat{L_{1r}}) + (\eta_r - \eta_r\theta_{wr} + \zeta_r\gamma_{1r})\hat{W}_{2r} + (1 - \theta_{wr})\hat{L}_{2r} + \zeta_r\gamma_{2r}IMP_r) \tag{6}$$

In general, the representative worker consumes a composite of tradable good and a composite of non-tradable good. The P_r^h now is the same as the price of the non-tradable good P_r.

PROPOSITION 2: Since the increase of intermediate import has negative effects on wage or employment in at least one sector, it also decreases the local housing price P_r^h, or the non-tradable price P_r in general. The increase of intermediate import has ambiguous effect on local housing supply H_r^S.

According to equation (5),

$$\begin{aligned}\frac{d\Delta P_r^h}{dIMP_r} =& \frac{1}{1+\eta_r}[\theta_{wr}(\frac{d\Delta W_{1r}}{dIMP_r} + \frac{d\Delta L_{1r}}{dIMP_r}) \\ &+ (1-\theta_{wr}-\zeta_r\gamma_{1r})\frac{d\Delta W_{2r}}{dIMP_r} + (1-\theta_{wr})\frac{d\Delta L_{2r}}{dIMP_r} - \zeta_r\gamma_{2r}]\end{aligned}$$

$\frac{1}{1+\eta_r}$ is positive as η_r is the housing supply elasticity. When one of $\frac{d\Delta W_{1r}}{dIMP_r}$, $\frac{d\Delta W_{2r}}{dIMP_r}$, $\frac{d\Delta L_{1r}}{dIMP_r}$, and $\frac{d\Delta L_{2r}}{dIMP_r}$ is negative, the only term in the bracket that could be positive is $(1-\theta_{wr}-\zeta_r\gamma_{1r})\frac{d\Delta W_{2r}}{dIMP_r}$. However, $1-\theta_{wr}-\zeta_r\gamma_{1r}$ is almost positive since $\gamma_{1r} \leq 1$[8]. Therefore, the intermediate import would reduce local housing price or local non-tradable good's price in general.

According to equation (6),

$$\begin{aligned}\frac{d\Delta H_r^S}{dIMP_r} =& \frac{1}{1+\eta_r}[\eta_r\theta_{wr}(\frac{d\Delta W_{1r}}{dIMP_r} + \frac{d\Delta L_{1r}}{dIMP_r}) \\ &+ (\eta_r-\eta_r\theta_{wr}+\zeta_r\gamma_{1r})\frac{d\Delta W_{2r}}{dIMP_r} + (1-\theta_{wr})\frac{d\Delta L_{2r}}{dIMP_r} + \zeta_r\gamma_{2r}]\end{aligned}$$

$\frac{1}{1+\eta_r}$ is positive as η_r is the housing supply elasticity. The $\zeta_r\gamma_{2r}$ term is positive, while the other terms in the bracket are negative. Therefore, the intermediate import has ambiguous effect on local housing supply because one of $\frac{d\Delta W_{1r}}{dIMP_r}$, $\frac{d\Delta W_{2r}}{dIMP_r}$, $\frac{d\Delta L_{1r}}{dIMP_r}$, and $\frac{d\Delta L_{2r}}{dIMP_r}$ is negative.

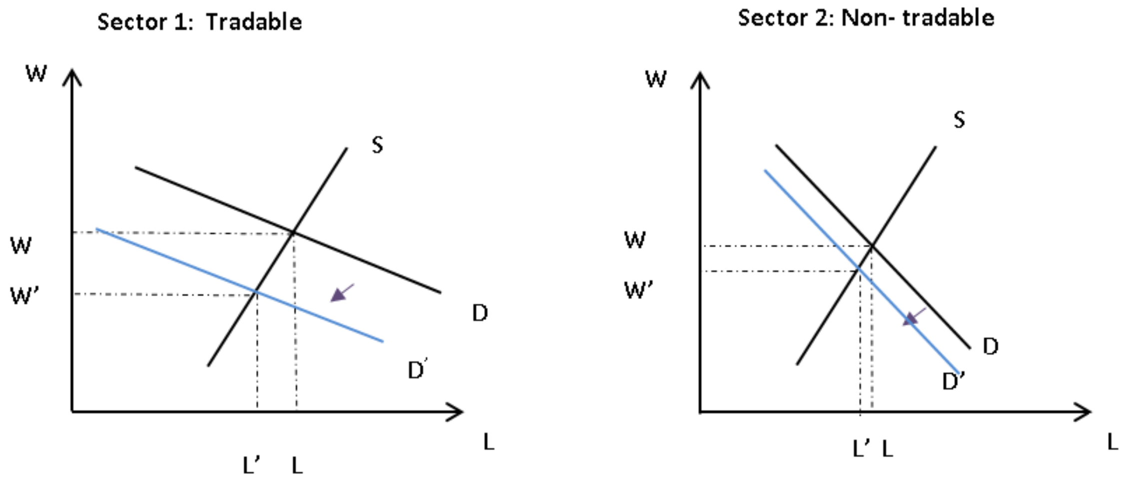
2.2.3 Spatial Equilibrium

Combing the labor and housing market equilibrium conditions, I solve the spatial equilibrium in this section. The equilibrium predicts that intermediate imports would impose a dynamic effect on local market. The predictions are tested in the following empirical session.

The spatial equilibrium condition is derived by considering residents' location choices. Any resident in location r need to choose to stay or migrate after the intermediate import shock. In the equilibrium, the marginal resident will be indifferent between stay and mi-

[8]The W_{2L} is the wage for the whole non-tradable sector so that it is reasonable that $\gamma_{1r} \leq 1$.

Figure 2.1: The Labor Substitution Effects of Intermediate Import on the Tradable and Non-tradable Sectors



Notes: The intermediate imports first reduce labor demands of tradable and non-tradeable sectors by substituting local labor force who originally produced the intermediate inputs. And the tradable sector experiences a larger labor demand decline because this sector relies more on the imported intermediate inputs. In the figure, the non-tradable sector has more elastic labor demand, while the two sectors have the same labor supply elasticity. But other situations about the demand and supply elasticities could apply.

grate. By normalizing the outside utility to be a constant $\bar{U}$, I can write down the marginal resident's equilibrium condition as

$$U(C_r^*, H_r^*, L_{1r}, L_{2r}) = \bar{U}$$

Substituting the optimal consumption decisions C_r^* and H_r^* into the condition, and log-linearizing the resulting equation, I get

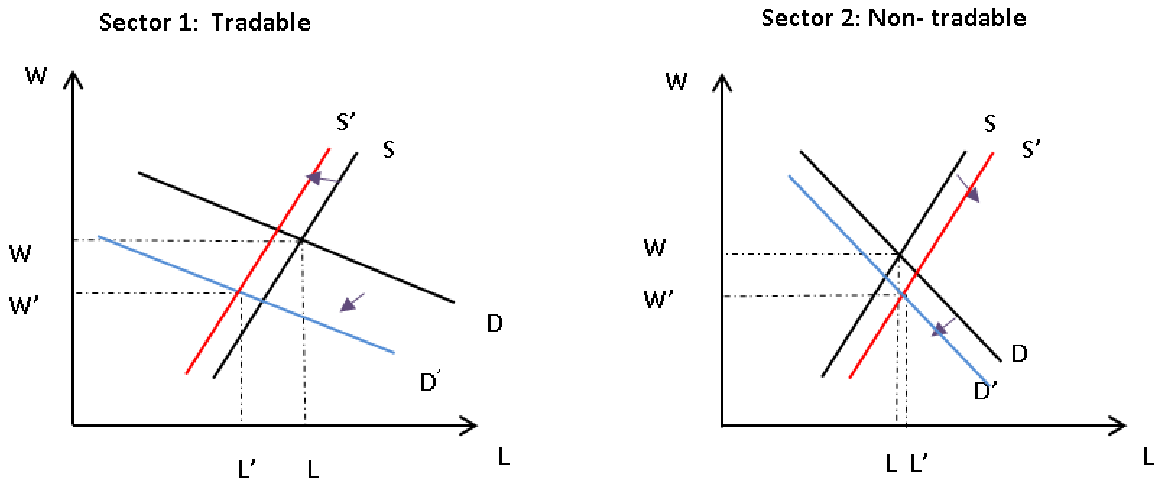
$$F_2(\hat{W}_{1r}, \hat{W}_{2r}, \hat{L}_{1r}, \hat{L}_{2r}, \hat{P}_r, IMP_r) = 0 \tag{7}$$

This leads to

PROPOSITION 3: The local housing prices and rent reductions induced by the intermediate import further decreases local wage and employment.

Position 1 to 3 then predicts that intermediate imports have the following dynamic effect.

Figure 2.2: The Labor Movement following the Labor Demand Changes in the Two Sectors

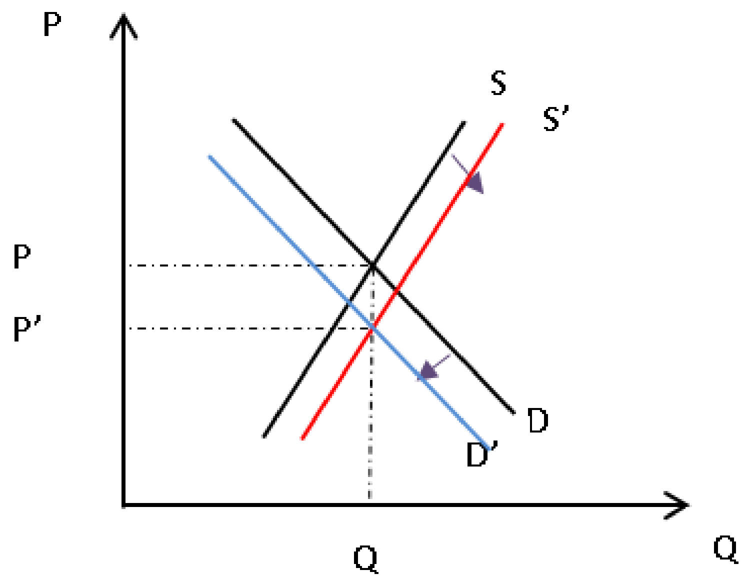


Notes: Since demand is reduced more in the tradable sector at the first step, some tradable workers move to the non-tradable sector. This would decrease labor supply in the tradable sector and increase labor supply in the non-tradable sector. In the figure, the non-tradable sector has more elastic labor demand, while the two sectors have the same labor supply elasticity. But other situations about the demand and supply elasticities could apply.

Intermediate imports would first reduce labor demands in the tradable and non-tradable sectors with tradable sector incurring a larger reduction. Subsequently, labor moves from tradable sector to non-tradable sector. The imperfect labor movement reduces labor supply in the tradable sector and increase labor supply in the non-tradable sector. Next, the housing price and rent are reduced because of the decreased local employment, wage and production cost. Finally, the labor market is further affected by the housing price and rent decline.

Figure 2.1 to 2.4 show the intuition of this model. As Figure 2.1 shows the labor demands of tradable and non-tradable sectors decrease in the first step. As the labor demand declines larger in the tradable sector, some workers move from the tradable sector to the non-tradable sector in the next step. The labor movement would increase labor supply in the non-tradable sector and decrease labor supply in the tradable sector as in Figure 2.2. At the same time, the demand of non-tradable goods including housing decreases because of the local wage decline. The supply of non-tradable goods including housing could increase due to the reduction of inputs prices. The supply and demand changes of the non-tradable goods reduce local non-tradable goods' prices but have an ambiguous effect on local non-tradable goods' quantities as in Figure 2.3. Followed by the non-tradable goods' prices reduction, the labor demand in

Figure 2.3: The Effects of Intermediate Import on Housing and on Non-tradable Goods in General



Notes: As wages of both sectors decrease, local demand on housing and other non-tradable goods would reduce because residents' purchasing power decreases. In the same time, the local supply of housing and other non-tradable goods could increase since the intermediate inputs' prices decrease in production processes. The demand and supply changes would bring down the prices of local non-tradable goods including housing but have an ambiguous effect on the quantities of local non-tradable goods including housing.

the non-tradable sector further moves down in Figure 2.4. Therefore, intermediate imports dynamically reduce the wages and employments of the two sectors, rents, and housing prices. Intermediate imports' impact on the non-tradable employment and housing stock could go either direction.

Equation (1), (2), (4), (5), and (7) form a system of equation with 5 equations and 5 unknowns $\hat{L}_{1r}$, $\hat{L}_{2r}$, $\hat{W}_{1r}$, $\hat{W}_{2r}$, and $\hat{P}_r^h$. The solution to the system of equation determines the reduced form dynamic effect of local intermediate imports (IMP_r)

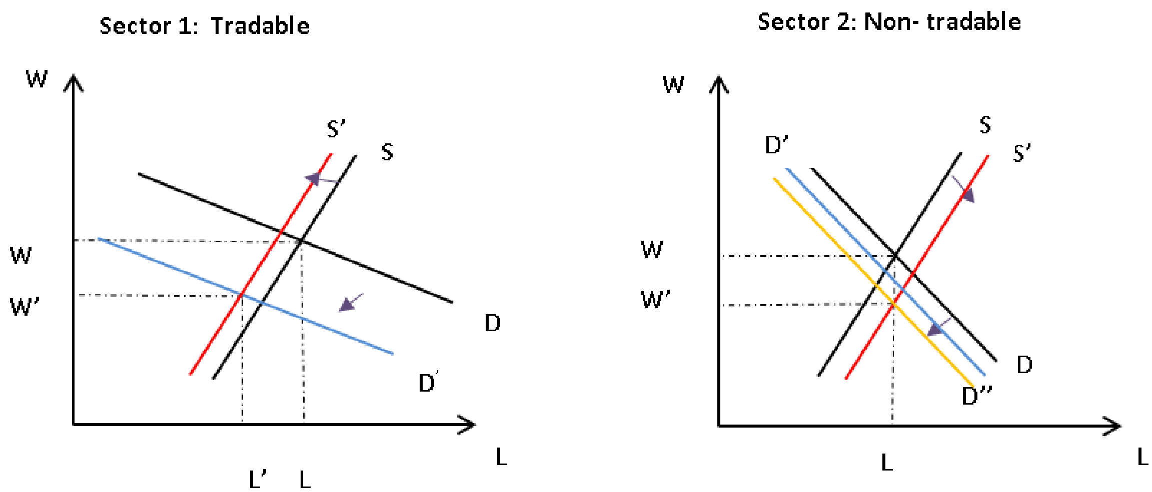
$$\Delta W_{1r} = \beta_0^1 + \beta_1^1 IMP_r + \epsilon_r^1$$

$$\Delta W_{2r} = \beta_0^2 + \beta_1^2 IMP_r + \epsilon_r^2$$

$$\Delta L_{1r} = \beta_0^3 + \beta_1^3 IMP_r + \epsilon_r^3$$

$$\Delta L_{2r} = \beta_0^4 + \beta_1^4 IMP_r + \epsilon_r^4$$

Figure 2.4: The Secondary Effects of the Induced Housing Changes on the Non-tradable Sector



Notes: The declines of local housing price and non-tradable price in general can further reduce the labor demand of local non-tradable sector. In the figure, the non-tradable sector has more elastic labor demand, while the two sectors have the same labor supply elasticity. But other situations about the demand and supply elasticities could apply.

$$\Delta P_r^h = \beta_0^5 + \beta_1^5 IMP_r + \epsilon_r^5$$

From equation (3), I could have the local rent equation

$$\Delta R_r = \beta_0^6 + \beta_1^6 IMP_r + \epsilon_r^6$$

And I can also write down the housing supply equation from equation (6)[9]

$$\Delta H_r^S = \beta_0^7 + \beta_1^7 IMP_r + \epsilon_r^7$$

Here all the reduced-form equations use the change of log-valued variables as the dependent variables since I log-linearize all the equations.

In the following sections, I use the above equations to empirically examine intermediate imports' effects on local labor and housing markets.

[9]As non-tradable goods' supply is hard to measure, I only study intermediate imports' effect on local housing supply.

2.3 Empirical Approach

To serve the empirical analysis, I explain the key identification strategy and important variable definitions in this section. I adapt the instrumental variable strategy from Autor et al. (2013) to address the endogeneity of local intermediate import shocks. The local housing prices and rents are measured following the procedure in Albouy and Lue (forthcoming).

2.3.1 Econometric Model

In this section, I outline the econometric model I use. The model is a panel data model with each commuting zone as one observation.

My study is conducted on U.S. commuting zones which are defined in Autor et al.(2013). The commuting zones divide the American labor market into 722 areas. Each commuting zone (CZ) is a cluster of counties that are tied together by residents' daily commuting behaviors.[10] Therefore, CZ captures the economic notion that employers and workers interact within their local markets. And it is also a good geographic unit for housing studies since local housing demand is affected by residents' commuting behaviors. Since I use the Census data, which provides no county level measures, CZ is the best geographic unit for this study. Unlike states or PUMAs, CZs offer me enough observations. And Compared with Metropolitan Statistical Areas, which only cover urban areas, CZs cover both urban and rural areas.

Based on the reduced-form solution in the theoretical model, my basic commuting zone level regression is set to

$$\Delta A_{rt} = \alpha_t^1 + \beta_1^1 Import_{rt} + X'_{rt}\beta_2^1 + \epsilon_{rt}^1 \qquad (I)$$

where r denotes CZ, and X is a vector of the local demographic variables. The main explanatory variable $Import_{rt}$ is the local intermediate goods import measure. I also use a local final goods import measure in all the regressions. The local intermediate and final import measures have the same structure as the theoretical model suggests $Import_{rt} =$

[10] For details, please refer to Autor et al. (2013)'s online appendix.

$\frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry intermediate goods import or final goods import value. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. The weights $a_{ri(t-1)}$ are the beginning period employment shares. The dependent variable A_{rt} can be local sector wages, employments, housing prices, rents, or housing stocks. Note this is a reduced form regression which only identifies the net effects of imports.

The coefficient of interest are both β_1^2 and β_3^2 in (II) when studying the secondary effects. When local housing price and rent increase, local non-tradable industries like real estate, mortgage banking and construction should perform better and expand their business. Therefore, I expect $\beta_3^2 > 0$. When $\beta_3^2 > 0$, intermediate imports could impose a secondary negative effect on the local non-tradable sector by reducing local housing price and rent. The magnitude of β_3^2, however, is not the size of the secondary effect.

2.3.2 Identification

This section presents the possible identifying threatens to regression (I) and (II), and explains the instrument strategies used to address the endogenous problems.

The import variable in regression (I) and (II) may be endogenous if import correlates with any unobserved local demand shocks. If this is the case, the OLS estimates may underestimate the true impact, as U.S. local market outcomes and import may both positively correlate with the unobserved demand shocks. For instance, if due to some unobserved local demand shocks, local industry compositions change in some places, those places would require more imports.

As this chapter uses U.S. import data from China to investigate import's dynamic effect, I can adapt Autor et al. (2013)'s instrument strategy to address the endogenous problem. The strategy uses other developed countries' import volumes as the instruments of U.S. import volumes. The identifying assumption is that the increasing Chinese exports to the U.S. and other developed countries are due to China's rising comparative advantage and falling trade costs. Because of the fast development of Chinese manufacturers and China's accession to the WTO, it is plausible that much of China's recent trade expansion has been driven by its internal productivity growth and reductions in trade barriers rather than by labor demand shocks in U.S. territories. Therefore, the instrument can identify the supply driven effects of U.S. import.

To construct the instrument, I sum up the import volumes of Australia, Denmark, Finland, Germany, Japan, NewZealand, Spain and Switzerland by year and create $\Delta I\_oth_{it} = I\_oth_{it} - I\_oth_{i(t-1)}$. The instrument has the same structure as the local intermediate import measure. But I substitute ΔI_{it} using ΔI_oth_{it} in the instrument. In order to get strongly exogenous instrument variable, I also use the previous decade's employments to substitute the beginning period weights. That is, my instrument variable takes the form $Import\_iv_{rt} = \frac{1}{L_{r(t-2)}} \sum_i a_{ri(t-2)} \Delta I\_oth_{it}$ with $a_{ri(t-2)} = \frac{L_{ri(t-2)}}{L_{i(t-2)}}$.

2.3.3 Housing price and Rental Fee

Except using local median housing price and rent, I also use a hedonic model to create local housing price and rent indice in this section. The hedonic model accounts for housing characters like number of rooms, square foot, etc., and, therefore, creates better housing measures.

The hedonic model is based on Albouy & Lue (forthcoming). The following linear model is fitted for each census year using samples of homeowners and renters separately.

$$log(P_h) = X_h'\beta + \gamma CZ + \epsilon_h$$

Where X_h is a vector of detailed housing characters including number of rooms and bedrooms, house age, and kitchen facility, etc., and CZ are 722 commuting zone dummies. The regression does not include an constant in order to create indice for all 722 commuting zones.

The estimated coefficients of CZ dummies γ are defined as the CZ-level hedonic housing prices or rents. Intuitively, a particular CZ's housing price measures its housing market relative performance to the national housing market. For instance, if a CZ's housing price is negative, its housing price is lower than the national housing price. The hedonic housing price (rent) is essentially a standardized housing price (rent), which uses the national average housing price (rent) as the base. The changes of hedonic and median housing prices and rents are then used as the dependent variables in regression (I).

2.4 Data

In order to study intermediate imports' dynamic at the CZ level, I merge all my data and collapse the final data into the CZ level in this section. The data used includes the U.S. census, the OECD Trade, the county Business Pattern (CBP), and the local demographic variables from Autor et al. (2013).

The CZ housing prices, rents, and wages and employments of the two industry sectors are all extracted from the U.S. Census. The 5% 1980, 1990, and 2000 Census samples, and the 2006, 2007 and 2008 American Community Survey (ACS) samples are used. I combine the three ACS samples and treat the combined data as the 2007 data since the sample size of ACS is much smaller than the 5% 10-year census.

The CZ-level housing prices and rental fees are constructed using the Census data. Housing prices are created based on reported house values, while rental fees are based on monthly gross rents. House values and rents are adjusted to 2008 dollar values using census inflation rates. The summary statistics for housing prices and rental fees by year are listed in Table 2.1. The standard deviation of hedonic housing price increases across time, which implies housing price inequality across CZ increases. Since U.S. import to China also increases in the same period, we may expect import plays a role in housing price heterogeneity across locations.

To measure the wages and employments of the tradable and non-tradable sectors, I first classify industries into the two sectors according to the final goods import data from OECD. The industries which show up in the final good import data are classified into the tradable sector, while the local service and construction industries are in the non-tradable sector. Because custom service is now not a local industry, I group it into the tradable sector. As a robust check, I put the custom service back into the service sector, the results do not change. The tradable sector includes all the manufacturing industries, the wholesale industries, and the custom service. The non-tradable sector includes high skilled services like banking and real estate, and also low skilled services like haircut and restaurant.

Then I use the Census data to measure the local wages and employment of the two industry sectors. When measuring weekly wages and employments, I exclude people in the military and people with no positive work week. Weekly wage is measured using real working week as denominator, and annual wage as nominator. All of the wage variables are also adjusted to 2008 dollar values. The log values of weekly wages and employments for the tradable and non-tradable sectors are provided in Table 2.2. On average, the wage is higher in the tradable sector than in the non-tradable sector. Local workers are largely employed in the non-tradable sector.

I extract the total import and intermediate import values from the OECD STAN Bilateral Trade Database by Industry and End-use category. The data was newly released by OECD in the year 2011. It provides the total goods trade volume and the intermediate goods trade volume by industry sectors between countries. From the OECD data, I extract the import data between the U.S. and China, and between other developed countries and China for the years 1990 to 2007. Data for the year 1980 is not available since China was not a big open country before year 1990.

OECD data allows me to directly measure intermediate import so that I could focus on studying the effects of intermediate import. Previous papers need to combine total imports data at the national level and the initial year industry input-output matrix to measure the industry level intermediate imports. Those papers need to assume the industry input-output matrix is kept constant as its initial year value. My analysis, therefore, escapes from such restrictive assumption.

The ratio between the local intermediate import and the local total import measures $\frac{Intermediate}{Total}$ in Table 2.2 explain the use of intermediate import instead of the total import. The absolute value of the ratio is not always less than 1 which implies that the intermediate import could contribute more to the overall effect of the total import than the final goods import[11].

The only limitation of using OECD data is that it divides the trade data only into

[11] Refer to Chapter I for further comparison between the effects of final goods import and intermediate goods import

industry sectors, not into individual industries as the UN Comtrade does. This may reduce the variation of my import variables among CZs. I compare my local total import measure with Autor et al. (2013)'s measure since Autor et al. (2013) uses the Comtrade data. The local total import measure has standard deviation 1.678 and mean 1.955. Autor et al (2013)'s standard deviation and mean are 2.583 and 1.906. Therefore, although the standard deviations of the Autor et al (2013)'s measure are slightly larger, the means of the two measures are similar. Thus it should be fine to use OECD data.

According to OECD data, the top 5% U.S. industries that import intermediate goods from China are the Basic Metals industry, the Chemicals and Chemical Products industry, the Electrical Machinery and Apparatus industry, the Fabricated Metal Products industry, the Machinery and Equipment industry, the Office, Accounting and Computing Machine industry, the Radio, Television and Communication Equipment industry, and the Rubber and Plastics Products industry. We might expect locations with larger employments in those industries to be affected more by intermediate import shocks.

Then I combine the OECD import values with the CBP industry employment counts and create the local import measure. The OECD data uses the 3^{rd} Revision of the International Standard Industry Classification (ISIC Rev.3) to classify industries, while the CBP either use the American SIC system or the NAICS system depending on the data year. Therefore, a crosswalk is needed to combine the two data sets. Since NAICS systems can be easily adjusted to the SIC87 system using crosswalks from the Census, this chapter uses a crosswalk between SIC87 and ISIC Rev.3 provided by UNSD[12]. The local intermediate and final import variables are then calculated using the industry import volumes from OECD and the CZ industry employments from CBP for each studying period.

The created CZ import measures show sufficient variations. According to Table 2.2, the two-period pooled standard deviations of local intermediate and final imports are 0.588 and 1.159 separately. While some areas experience mild intermediate import shocks, other places face severe shocks (4.066). However, places facing high shocks in the first period do not always experience the same degrees of shocks in the next period. Places that experience high intermediate import shocks in both periods include several CZs in New York, Michigan

[12] United Nations Statistics Division. http://unstats.un.org/unsd/cr/registry/regdnld.asp

and California.

I finalize my data and create variables by matching the local import measures with the Census data and the demographic variables from Autor et al. (2013) by year and CZ. The final data includes two time periods: 1990-2000 and 2000-2007, and 722 commuting zones in each time period. According to the model, any dependent variables in each period are the difference between the beginning year value and the end year value. For instance, the local average wage change for 1990-2000 period takes the form $\Delta log(wage_{r(1990-2000)}) = log(wage_{r2000}) - log(wage_{r1990})$. All the dependent variables are adjusted to their 10-year equivalent values.

2.5 Results

The result section shows that intermediate imports negatively affect the wages and employments of both tradable and non-tradable sectors, housing prices, and rents. And the induced housing price and rent declines can impose a further negative effect on non-tradable sector. The results are consistent with the spatial equilibrium model, and thus confirm intermediate imports' dynamic effect on local markets.

2.5.1 Local Labor Market

This section displays imports' effects on local labor market outcomes. The results indicate that the intermediate import reduces the wages and employments of both tradable and non-tradable sectors. And the effects are not affected by how tradable and non-tradable sectors are classified.

Table 2.3 shows the effects of intermediate import on the wages and employments of the two sectors. The estimations are based on regression equation (1). In the table, tradable sector includes manufacturing industries, wholesale industries, and custom service industries whose final products can be traded nationally or internationally. The non-tradable sector includes the other service industries, the construction industries, and the retail industries whose final products are exchanged locally. According to the 2SLS estimations, the intermediate import reduces the wages and the employments of both the tradable and the non-tradable sectors.

The mechanism for the effects is outlined in the model. As Figure 2.1, 2.2 and 2.4 show, the intermediate goods import first reduces the labor demands of both sectors because non-tradable industries using the imported intermediate inputs are also directly affected. Next, workers move from tradable sector to non-tradable sector because the wage of tradable sector is reduced more in the first step. This would increase labor supply of non-tradable sector and decrease labor supply in the tradable sector. At the same time, labor demand in the non-tradable sector is further reduced because intermediate import can impose a large negative effect on the price of local non-tradable goods including housing as shown in next section.

From the table, we can compare the effects of the intermediate import on the two sectors. The tradable and non-tradable wages are reduced by 0.079 log-points and 0.058 log-points for a $1000 per worker increase in the intermediate import. And the tradable and non-tradable employments are reduced by 0.165 log-points and 0.096 log-points for a $1000 per worker increase in the intermediate import.

The comparison tells that the intermediate import and the local labor force are substitutes and the substitution in the tradable sector is larger. When local firms use imported intermediate goods to produce, they can fire the workers who originally produced those intermediate inputs. As a result of such labor substitution effects, the intermediate import could affect both tradable and non-tradable sectors. However, the tradable sector could rely more on the imported goods since the tradable sector includes manufacturing and wholesale industries. Therefore, the intermediate import would affect the tradable sector more than the non-tradable sector.

Table 2.4 reclassify industries and examine the effects of intermediate imports on the new sectors. The first two columns are tradable industries, while the last three columns are non-tradable industries. We can see the effects in the first two columns are identical. The service sector now includes custom services. The intermediate imports reduce the wage and employment of the service sector which implies the prices of non-tradable goods other than housing are also affected. According to column 4, the wage and employment of the construction sector is also reduced, and the employment decline in the construction sector is the largest among all the industries. The results in this table indicate intermediate imports could affect both tradable and non-tradable sectors no matter how the sectors are classified.

The final import has small positive effects on the wages and employments of the tradable and non-tradable sectors. The final import moves workers from the tradable sector into the non-tradable sector, and thus increases the employment in the non-tradable sector. The non-tradable wage is increased because the final import reduces the tradable goods' price. As a result, residents have more budgets for the non-tradable goods. Therefore, the final import could have positive effect on the non-tradable sector. For the tradable sector, the final import could increase the average wage because the final import competition excludes the lowest paid tradable workers. The final import could eventually have slightly positive effect on the tradable employment due to its long-run productivity effect.

2.5.2 Local Housing Market

This section examines the effects of intermediate import on local housing market. The empirical results in this section show that the intermediate import reduces local housing price and rent.

Intermediate import's effects on local housing price and rent are unclear. Intuitively, local housing prices and rents can be affected by intermediate imports negatively through several channels. First, the decline of local wage and employment can lower workers' housing demand or their ability to get financing. Next, cheaper construction cost could raise local housing supply which then reduces local housing prices and rents. In addition, some marginal residents may move to other more desirable cities, which also reduces local housing demand. However, intermediate imports can also affect local housing price positively. The intermediate import can reduce local goods' price, therefore make local housing more attractive. The net effect of intermediate imports thus is determined by the relative size of the negative and the positive effects.

Table 2.5 uses equation (I) to formally test intermediate imports' effects on housing prices and rental prices. Column 1 and 2 use the hedonic rental prices and housing price as dependent variables, whereas column 3 and 4 use the median rent and housing price as dependent variables. According to the OLS estimates, the intermediate import reduces all four price measures. In the 2SLS estimates, the sizes and significant levels of the effects reduce. The hedonic housing price is reduced by 0.3 log-points and the median housing prices is reduced by 0.311 log-points by a $1000 per worker increase in the intermediate import. The median rent is reduced by 0.053 log-points by a $1000 per worker increase in the intermediate import. However, when individual housing characteristics are considered, intermediate imports have no effect on the hedonic rent.

Next, I show the effects of intermediate imports on local housing stocks in Table 2.6. To measure local housing stock, I sum up the occupied units and the vacant units for each locations. Column 1 examines the effects of intermediate import on total housing stock, column 2 examines the effect on house units for rent, and column 3 studies the effect on house units for sale. We can see the intermediate import barely affects local housing stocks. Only the house units for sale is slightly reduced. The housing price, rent and housing stock patterns are consistent with the theoretical model's predictions that intermediate import increases local housing supply and reduces local housing demand.

The fourth column of Table 2.6 examines the effect of intermediate imports on local population. The result indicates intermediate imports do not affect local net migration. Therefore, housing price and rent are mainly affected through the wage, employment, and construction cost channels instead of the migration channel.

Table 2.7 and 2.8 add the Wharton land regulation index in Gyourko et al. (2008) as an additional control in the housing price, rent, and housing stocks regressions. Places having higher Wharton Regulation Index are expected to have lower housing supply. Therefore, the land regulation index could control for local housing supply which would for sure affect local housing price and rent. The comparison between the two tables and the original estimations in Table 2.5 and 2.6 further confirms intermediate imports' negative effects on housing prices and rents.

Similarly, Table 2.9 and 2.10 use the local housing supply elasticity in Saiz (2010) as an additional control. The housing supply elasticity accounts for local geographic restrictions as well as the Wharton Land Regulation Index. Thereby, the supply elasticity contains more information than the Wharton Regulation Index, and so could better controls for local housing supply. The estimates are also consistent with the baseline estimates, and so further confirm intermediate imports' can reduce local housing prices and rents.

Finally, I show the standardized effects of intermediate imports in Table 2.11. The table is based on the coefficients in the baseline Tables 2.3, 2.5, and 2.6. One standard deviation increase of the local intermediate import reduces tradable wage and non-tradable wage by 0.566 and 0.559 log-points. The tradable and non-tradable employment are reduced by 0.131 and 0.073 log-points for one standard deviation increase in the local intermediate import measure. Therefore, intermediate imports affect the tradable sector slightly larger than the non-tradable sector. The hedonic and median housing prices are decreased by 0.832 and 0.765 log-points by one standard deviation increase in the local intermediate import measure. And one standard deviation increase of the local intermediate import reduces median rent by 0.253 log-points. And thus the intermediate import reduces housing prices more than rents. The house units for sale is reduced slightly by 0.043 log-points for one standard deviation increase of the local intermediate import measure.

2.5.3 Structural Model Calibration

In this section, I show the reduced housing market could impose a secondary negative effect on local non-tradable industries, and fully explain the intermediate import's dynamic by calibrating my structural model using the above reduced-form estimates.

In the structural model, I have parameter set (b_{1L}, b_{1I}, b_{2L}, b_{2P}, b_{2I}, b_{3L}, b_{3P}, b_{3I}, ϵ, η, θ_w, ζ, γ_1, γ_2, a_1, a_2), while I have (β_1^1, β_1^2, β_1^3, β_1^4, β_1^5, β_1^6, β_1^7) in the reduced-form model. The structural parameters are more than the reduced-form parameters.

Fully solving the structural model gives the employment parameters β_1^3 and β_1^4 in the reduced-form equations

$$\beta_1^3 = \frac{A_4 B_1 + A_2 B_2}{A_1 A_4 + A_2 A_3}$$

$$\beta_1^4 = \frac{A_3 B_1 - A_1 B_2}{A_2 A_3 + A_1 A_4}$$

Where $A_1 = C_1 - (1 + b_{1L})[(1 + a_1)\theta_w - \frac{a_1\theta_w}{1+\eta}] - \frac{b_{2P}(1+b_{1L})\theta_w[(1+a_1)(1-\theta_w) - \frac{a_1(1-\theta_w-\zeta\gamma_1)}{1+\eta}]}{1+\eta-(1-\theta_w-\zeta\gamma_2)b_{3P}}$ with $C_1 = a_2(1 + \frac{1}{\epsilon})9.208^{(1+\frac{1}{\epsilon})}$, $A_2 = C_2 - (1 + b_{2L})(1 + a_1)(1 - \theta_w) + \frac{a_1[(1+b_{2L})(1-\theta_w) - b_{2L}\zeta\gamma_1]}{1+\eta} -$

$\frac{b_{2P}[(1-\theta_w)(1+b_{2L})-\zeta\gamma_1][(1+a_1)(1-\theta_w)-\frac{a_1(1-\theta_w-\zeta\gamma_1)}{1+\eta}]}{1+\eta-(1-\theta_w-\zeta\gamma_2)b_{3P}}$ with $C_2 = (1+\frac{1}{\epsilon})10.472^{(1+\frac{1}{\epsilon})}$, $A_3 = 1 - b_{1L}\epsilon + \frac{b_{2P}\theta_w(1+b_{1L})\epsilon}{1+\eta-(1-\theta_w-\zeta\gamma_2)b_{3P}}$, $A_4 = 1 - b_{2L}\epsilon - \frac{b_{2P}[(1+b_{2L})(1-\theta_w)-\zeta\gamma_1]\epsilon}{1+\eta-(1-\theta_w-\zeta\gamma_2)b_{3P}}$, $B_1 = \frac{1}{1+\eta-(1-\theta_w-\zeta\gamma_2)b_{3P}}\{b_{2P}[b_{1I}\theta_w - \zeta\gamma_2 + b_{2I}(1-\theta_w-\zeta\gamma_1)][(1+a_1)(1-\theta_w)-\frac{a_1(1-\theta_w-\zeta\gamma_1)}{1+\eta}]\}$, and $B_2 = \frac{-1}{1+\eta-(1-\theta_w-\zeta\gamma_2)b_{3P}}\{b_{2P}[b_{1I}\theta_w - \zeta\gamma_2 + b_{2I}(1-\theta_w-\zeta\gamma_1)]\} + b_{1I} - b_{2I}$.

Substituting the two employment parameters into the other equations, I can write down the housing price parameter β_1^5, the wage parameter β_1^1 and β_1^2, the rent parameter β_1^6, and the housing supply parameter β_1^7 in the reduced-form model as

$$\beta_1^5 = \frac{\theta_w(1+b_{1L})\beta_1^3 + \theta_w b_{1I} - \zeta\gamma_2 + (1-\theta_w-\zeta\gamma_1)b_{2I} + [(1-\theta_w)(1+b_{2L})-\zeta\gamma_1]\beta_1^4}{(1+\eta)-(1-\theta_w-\zeta\gamma_2)b_{3P}}$$

$$\beta_1^1 = b_{1L}\beta_1^3 + b_{2I}$$

$$\beta_1^2 = b_{2L}\beta_1^4 + b_{2I} + b_{2P}\beta_1^5$$

$$\beta_1^6 = b_{3L}\beta_1^4 + b_{3I} + b_{3P}\beta_1^5$$

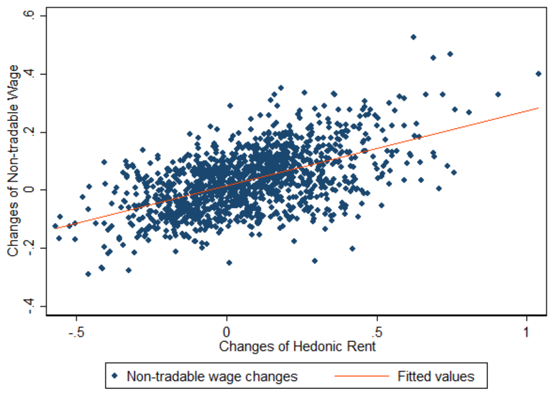
$$\beta_1^7 = \eta\beta_1^5 + \zeta\gamma_1\beta_1^2 + \zeta\gamma_2$$

To pin down the structural parameters from the estimated β's, I use the mean housing supply elasticity estimated in Saiz (2010) to set $\eta = 1.75$, and use the mean wage bill share for tradable sector from my data to set $\theta_w = 0.241$. Following the estimation in Rafael Dix-Carneiro (2014) about the sector mobility cost, I set the elasticity of mobility parameter ϵ to be between 1.4 and 2.7. The utility parameters a_1 and a_2 are set to be between 0.1 to 0.5. To determine b_{3L}, b_{3I}, and b_{3P}, I regress local rent on local non-tradable employment, local housing price, and local intermediate import measure. The regression indicates $b_{3L} = 0.073$, $b_{3I} = -0.011$, and $b_{3P} = 0.229$.

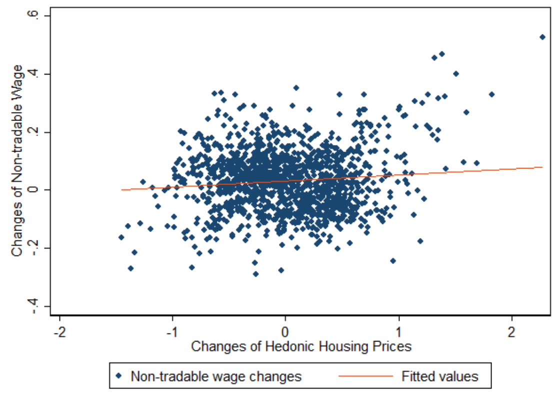
Using these values, I calibrate the model and obtain values of the structural parameters b_{1L}, b_{1I}, b_{2L}, b_{2I}, b_{2P}, $\zeta\gamma_1$, and $\zeta\gamma_2$ as there is no extra value to separately measure ζ, γ_1, γ_2. The means of calibrated b_{1L}, b_{1I}, b_{2L}, b_{2I}, b_{2P}, $\zeta\gamma_1$, and $\zeta\gamma_2$ are -0.162, -0.359, -0.579, -0.105, 0.044, -0.292, and 0.476 separately.

According to the negative signs of b_{1L} and b_{2L}, the employment and wage are negative related in firms' labor demand functions. According to b_{1I} and b_{2I}, the direct labor substitu-

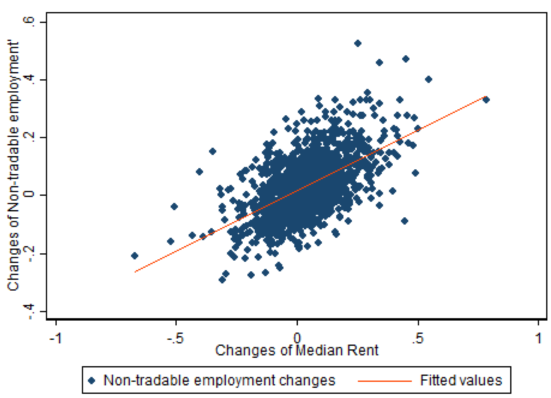
Figure 2.5: The Relations between Housing and Local Non-tradable Wage, 1990-2007



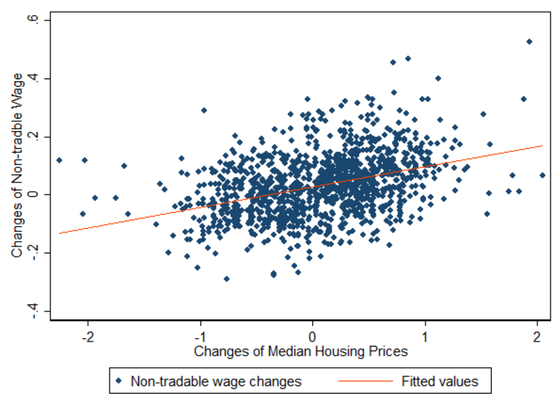
Panel A: Hedonic Rent



Panel B: Hedonic Housing Price



Panel C: Median Rent



Panel D: Median Housing Price

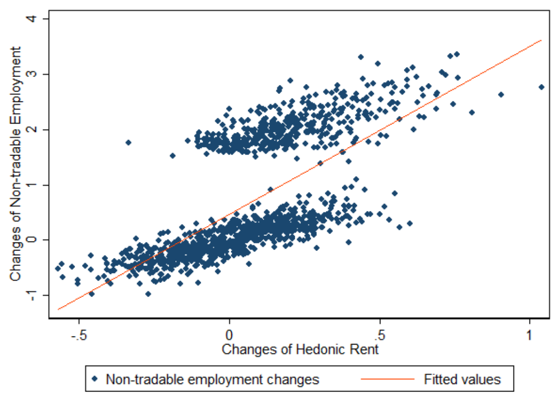
Notes: Panel A shows the relations between the hedonic rent change and the non-tradable wage change. Panel B shows the relations between the hedonic housing price change and the non-tradable wage change, while Panel C shows the relations between the median rent change and the non-tradable wage change. Panel D shows the relation between the median housing price change and the non-tradable wage change. All the housing price, rent, and wage measures are log valued.

tion effect of the intermediate import is larger in the tradable sector than in the non-tradable sector. The results are consistent with the theoretical model's assumption that $\rho_1 < \rho_2$.

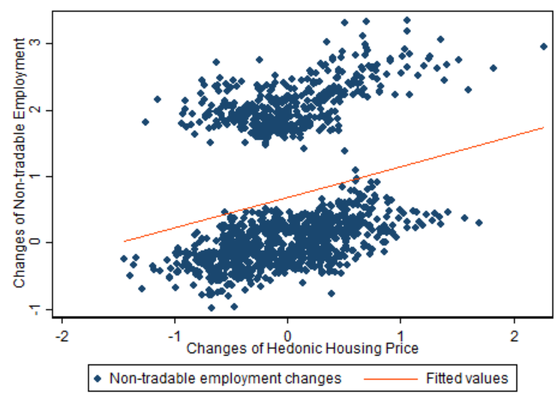
The $\zeta\gamma_2$ is positive which indicates the intermediate import imposes direct negative effect on local housing price, or local non-tradable goods' price in general according to equation (5). The positive $\zeta\gamma_2$ also indicates the intermediate import could increase local housing or non-tradable goods' supply by reducing production costs in the non-tradable sector according to equation (6). Therefore, the intermediate import also has a positive output effect in the non-tradable sector. The output effect also highly possibly exists in the tradable sector as the previous literature demonstrates. Comparing the calibrated direct labor substitution coefficients b_{1L} and b_{2L} with the reduced-form estimation coefficients β_1^1 and β_1^2, we see the overall wage reductions are much smaller than the direct labor substitution wage reductions in both sectors. This implies the intermediate import could have positive output effect in both tradable and non-tradable sectors by reducing the production costs.

Table 2.12 shows the detailed calibration results. For all the calibrations, the signs of b_{1L}, b_{1I}, b_{2L}, b_{2I}, and $\zeta\gamma_2$ stay the same. The sign of $\zeta\gamma_1$ randomly changes, but is negative in most of the cases. Therefore, the non-tradable goods' supply is negative affected by this sector's average wage because the wage is an approximation of production cost in the theoretical model. The b_{2P} is positive when the utility parameters are small, but becomes negative when the utility parameters increase to 0.4 and 0.5. When residents care more about consumption in non-tradable sector (a_1 increase) and they gain less dis-utility by working in the non-tradable sector (a_2 increase), the relation between the non-tradable goods' price and this sector's wage could become negative. In either cases, the induced housing market decline can further affects local non-tradable sector. And since the b_{2P} is positive on average, the induced housing price decline can cause local non-tradable wage to further decrease in my analysis. The result is consistent with Figure 2.5 and 2.6. In the figure, the non-tradable wage is positive correlated with all local housing price and rent measures. The housing prices and rents, however, do not have a particular relation with non-tradable employment in the figure.

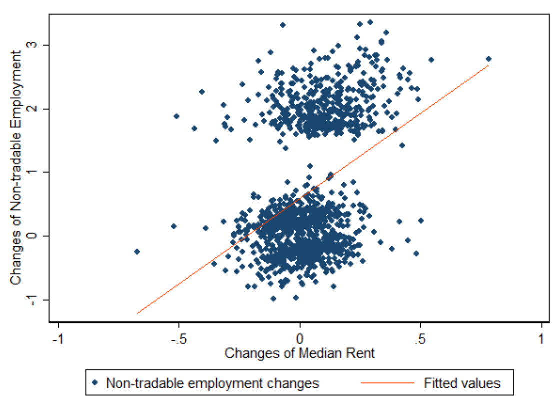
Figure 2.6: The Relations between Housing and Local Non-tradable Employment, 1990-2007



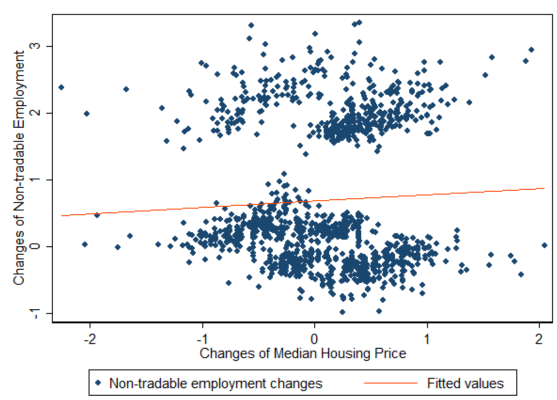
Panel A: Hedonic Rent



Panel B: Hedonic Housing Price



Panel C: Median Rent



Panel D: Median Housing Price

Notes: Panel A shows the relations between the hedonic rent change and the non-tradable employment change. Panel B shows the relations between the hedonic housing price change and the non-tradable employment change, while Panel C shows the relations between the median rent change and the non-tradable employment change. Panel D shows the relation between the median housing price change and the non-tradable employment change. All the housing price, rent, and employment measures are log valued.

2.6 Conclusion

The findings in this article lead to two main conclusions. First, U.S. intermediate imports from China penalizes both tradable and non-tradable sectors. The second conclusion follows directly. Intermediate imports' effects on housing cannot be ignored when studying its local impact because intermediate imports affects local labor and housing market dynamically.

This chapter contributes to trade, housing, and labor literature. Following the literature (Autor et al., 2013; Topalova, 2007; Kovak, 2013) studying trade's local effects, the chapter shows intermediate imports affects U.S. labor and housing market heterogeneously. Places with more initial employments in industries vulnerable to imports are affected more. This chapter also provides new insight to the housing literature by first showing trade shocks can help explain housing price differentiation across U.S. locations.

This chapter provides several policy implications. First, local governments should take local housing markets into account when announcing trade policy. In certain circumstances, promoting local housing demand to indirectly deal with trade induced job loss can be more efficient. At other times, however, the announced trade policy on labor markets could be offset by its effect on the housing market. Second, policy makers should try to specify heterogeneous policies for different industries since trade affects industries differently. Third, government could reallocate resources to areas which are more vulnerable to import shocks during transition periods. Since resources are limited, concentrating on specific places can be more effective than spreading resources thinly everywhere.

The chapter opens great possibilities for future research. The local welfare change resulting from imports is left to examine. Since renters like rent decline, while house owners hate housing price reduction, the welfare changes for the two types of residents should be different. Therefore, the local labor market outcomes need to be re-estimated separately for the two types of residents before beginning the welfare analysis. In addition, future research can add credible skill-biased-technology measures to the framework. In this way, it can show the relative importance of imports and skill-biased-technology in affecting labor and housing markets, and contributes to the Trade-SBTC-Wage debate.

Table 2.1: Summary statistics of Median and Hedonic Housing Prices and Rents, 1980-2007

variable	mean	sd	min	p50	max
Year 1980					
Hedonic rent	0.009	0.160	-0.399	-0.009	0.611
Hedonic house	-0.121	0.171	-0.530	-0.122	0.597
Median rent (in US$)	6.375	0.159	5.848	6.367	6.878
Median house (in US$)	11.965	0.239	11.49	11.96	12.93
Year 1990					
Hedonic rent	0.117	0.216	-0.501	0.077	0.998
Hedonic house	0.472	0.369	-0.227	0.416	2.249
Median rent (in US$)	6.319	0.206	5.698	6.291	7.141
Median house (in US$)	11.31	0.365	10.58	11.21	13.08
Year 2000					
Hedonic rent	0.236	0.223	-0.260	0.203	1.169
Hedonic house	0.279	0.371	-0.477	0.238	1.929
Median rent (in US$)	6.332	0.204	5.835	6.299	7.204
Median house (in US$)	11.48	0.357	10.65	11.48	13.02
Year 2007					
Hedonic rent	0.268	0.222	-0.362	0.235	1.102
Hedonic house	0.230	0.448	-0.599	0.189	1.865
Median rent (in US$)	6.417	0.214	5.800	6.394	7.206
Median house (in US$)	11.72	0.462	10.82	11.56	13.44
Pooled Year					
Hedonic rent	0.158	0.231	-0.501	0.128	1.169
Hedonic house	0.215	0.414	-0.599	0.151	2.249
Median rent (in US$)	6.361	0.201	5.698	6.345	7.206
Median house (in US$)	11.62	0.441	10.58	11.61	13.44

Notes: The table shows summary statistics for the hedonic and median housing prices and rents by year. The hedonic housing prices and rents are calculated based on hedonic regression models which account for housing characteristics. A negative value of hedonic housing price or rent indicates the housing price or rent is lower than the national average.

Table 2.2: Summary Statistics: Local Import Measures, Wages and Employments, 1990-2007

	mean	**sd**	**min**	**p50**	**max**
Local Import Measures ($\frac{\Delta Import}{Worker}$)					
Intermediate Imports (in Thousand US$)	0.618	0.588	-0.099	0.383	4.066
Final Imports (in Thousand US$)	1.336	1.159	0.003	1.065	11.87
Total Imports (in Thousand US$)	1.955	1.678	-0.011	1.497	15.68
$\frac{Intermediate}{Total}$	0.289	0.371	-8.786	0.289	9.227
Sector Wages and Employment (in log-pts)					
Tradable Wage (in US$)	6.478	0.163	5.997	6.466	7.280
Tradable Employment	9.208	1.879	3.437	9.321	15.23
Non-Tradable Wage (in US$)	6.309	0.116	6.022	6.292	6.912
Non-Tradable Employment	10.18	1.755	5.326	10.11	16.47

Notes: The main explanatory variable is the local intermediate import measure defined as $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry intermediate import value in thousand US$. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. The other local import measures are defined analogously by substituting the industry intermediate import I_i using corresponding industry import values. The $\frac{Intermediate}{Total}$ measure is the ratio between the local intermediate import and the local total import measure. The absolute value of the ratio is not always less than 1 which implies that the local intermediate import measure contains additional information compared with the local total import measure. The local log weekly wages and log employments for the tradable and non-tradable sectors are dependent variables. The tradable sector includes manufacturing, wholesale, and custom service industries. And the non-tradable sector includes local service, retail, and construction industries.

Table 2.3: The Effects of Intermediate Import on the Wages and Employments of the Tradable and Non-tradable Sectors, 1990-2007

Dependent Variable: 10-year Changes of Weekly Wage or Employment (in log-pts)

	Tradable Sector		**Non-tradable Sector**	
	Wage	Employment	Wage	Employment
Local Import ($\frac{\Delta Import}{Worker}$)				
		OLS		
Intermediate	-0.069***	-0.058	-0.068***	-0.082***
	(0.022)	(0.044)	(0.018)	(0.029)
Final	0.019***	0.002	0.016***	0.027***
	(0.006)	(0.012)	(0.005)	(0.007)
		2SLS		
Intermediate	-0.079***	-0.165***	-0.058***	-0.096**
	(0.029)	(0.051)	(0.019)	(0.039)
Final	0.022***	0.031**	0.013***	0.031***
	(0.007)	(0.015)	(0.005)	(0.009)
		2SLS First Stage		
		Intermediate	Final	
Imputed Intermediate		0.669***	0.449***	
		(0.052)	(0.138)	
Imputed Final		0.061	1.072***	
		(0.037)	(0.128)	
F-Stat		118.7	133.5	
Observations	1,444	1,444	1,444	1,444
Controls	Yes	Yes	Yes	Yes

Notes: The table shows the effects of intermediate import on the local average weekly wages and employments of tradable and non-tradable sectors. The main explanatory variable is the local intermediate import measure defined as $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry intermediate import value in thousand US\$. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. The local final import measured defined analogously is included as a control in the regression. The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.

*** p<0.01, ** p<0.05, * p<0.1

Table 2.4: The Effects of Intermediate Import on the Wages and Employments of other Industry Sectors, 1990-2007, 2SLS Estimates

Dependent Variable: 10-year Changes of Weekly Wage or Employment (in log-pts)					
SECTORS	**Manufacture**	**Manufacture+WholeSale**	**Service**	**Construct**	**Service+Construction**
	10-year Changes of Weekly Wage (in log-pts)				
Local Import ($\frac{\Delta Import}{Worker}$)					
Intermediate	-0.082**	-0.082***	-0.049**	-0.049**	-0.056***
	(0.035)	(0.021)	(0.022)	(0.023)	(0.021)
Final	0.023***	0.022***	0.012**	0.014**	0.014**
	(0.008)	(0.006)	(0.006)	(0.007)	(0.005)
	10-year Changes of Employment (in log-pts)				
Intermediate	-0.192***	-0.186***	-0.065*	-0.290***	-0.094**
	(0.059)	(0.049)	(0.034)	(0.079)	(0.038)
Final	0.029	0.039***	0.024***	0.075***	0.031***
	(0.018)	(0.011)	(0.009)	(0.023)	(0.009)
Observations	1,444	1,444	1,444	1,444	1,444
Controls	Yes	Yes	Yes	Yes	Yes

Notes: The table reports the effects of intermediate imports on other industry sectors. The Manufacture and Manufacture+WholeSale are tradable sectors, while the Service, Construct, and Service+Construction are non-tradable sectors. The Service sector includes all the local service industries including the custom services. The main explanatory variable is the local intermediate import measure defined as $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry intermediate import value in thousand US\$. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. The local final import measured defined analogously is included as a control in the regression. The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.
*** p<0.01, ** p<0.05, * p<0.1

Table 2.5: The Effects of Intermediate Import on Local Housing Prices and Rents, 1990-2007

Dependent Variable: 10-year Changes of Local Prices (in log-pts)

	(1) Hedonic Rent	(2) Hedonic House	(3) Median Rent	(4) Median House
Local Import ($\frac{\Delta Import}{Worker}$)				
		OLS		
Intermediate	-0.055**	-0.403***	-0.076***	-0.452***
	(0.024)	(0.099)	(0.027)	(0.116)
Final	-0.002	0.091***	0.004	0.102***
	(0.008)	(0.024)	(0.008)	(0.029)
		2SLS		
Intermediate	-0.029	-0.300***	-0.053*	-0.311***
	(0.025)	(0.101)	(0.030)	(0.115)
Final	-0.011	0.038	-0.003	0.043
	(0.011)	(0.031)	(0.012)	(0.038)
Observations	1,444	1,444	1,444	1,444
Controls	Yes	Yes	Yes	Yes

Notes: The table shows the effects of intermediate imports on hedonic and median local housing prices and rents. The hedonic housing prices and rents are measured using a hedonic regressions accounting for individual housing characteristics. The median housing prices and rents are the median housing and rent values in commuting zones. The main explanatory variable is the local intermediate import measure defined as $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry intermediate import value in thousand US$. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. The local final import measured defined analogously is included as a control in the regression. The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.

*** p<0.01, ** p<0.05, * p<0.1

Table 2.6: The Effects of Intermediate Import on Local Housing Stocks and Population, 1990-2007

Dependent Variable: 10-year Changes of Local House Units or Population (in log-pts)

	(1)	(2)	(3)	(4)
	All House Stock	House For Rent	House For Sale	Population
Local Import ($\frac{\Delta Import}{Worker}$)				
		OLS		
Intermediate	-0.035**	-0.001	-0.051***	-0.018
	(0.015)	(0.019)	(0.017)	(0.017)
Final	0.015**	0.005	0.018***	0.009
	(0.006)	(0.008)	(0.006)	(0.007)
		2SLS		
Intermediate	-0.038	-0.024	-0.054*	-0.019
	(0.025)	(0.023)	(0.031)	(0.028)
Final	0.006	0.009	0.006	0.0004
	(0.008)	(0.009)	(0.009)	(0.009)
Observations	1,444	1,444	1,444	1,444
Controls	Yes	Yes	Yes	Yes

Notes: The table shows the effects of intermediate imports on the total housing stock, the stock of housing for rent, the stock of housing for sale, and local population size. Housing stocks are defined as the sums of the occupied units and the vacant units in each commuting zone. The main explanatory variable is the local intermediate import measure defined as $Import_{rt} = \frac{1}{L_{r(t-1)}} \sum_i a_{ri(t-1)} \Delta I_{it}$ with $a_{ri(t-1)} = \frac{L_{ri(t-1)}}{L_{i(t-1)}}$. I_i is industry intermediate import value in thousand US\$. L_i is total employment for industry i, L_{ri} is local employment for industry i, and L_r is total local employment. The local final import measured defined analogously is included as a control in the regression. The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.
*** p<0.01, ** p<0.05, * p<0.1

Table 2.7: The Effects of Intermediate Import on Local Housing Prices and Rents, 1990-2007, 2SLS Estimates with Land Regulation Index as an Additional Control

Dependent Variable: 10-year Changes of Local Prices (in log-pts)

	(1) Hedonic Rent	(2) Hedonic House	(3) Median Rent	(4) Median House
$(\frac{\Delta Import}{Worker})$				
Intermediate	-0.033	-0.311***	-0.055**	-0.322***
	(0.024)	(0.096)	(0.028)	(0.108)
Final	-0.009	0.044	-0.002	0.049
	(0.011)	(0.031)	(0.012)	(0.037)
WRLURI	0.011*	0.044**	0.011*	0.057***
	(0.005)	(0.017)	(0.006)	(0.017)
Observations	986	986	986	986
Controls	Yes	Yes	Yes	Yes

Notes: The table shows the effects of intermediate imports on hedonic and median local housing prices and rents with controlling for the Wharton Land Use regulation Index (WRLURI). Since the WRLURI is not available for some of commuting zones, the observations decline. The hedonic housing prices and rents are measured using a hedonic regressions accounting for individual housing characteristics. The median housing prices and rents are the median housing and rent values in commuting zones. The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population. *** p<0.01, ** p<0.05, * p<0.1

Table 2.8: The Effects of Intermediate Import on Local Housing Stocks, 1990-2007, 2SLS Estimates with Land Regulation Index as an Additional Control

Dependent Variable: 10-year Changes of Local House Units (in log-pts)

	(1) log(All House Stock)	(2) log(House For Rent)	(3) log(House For Sale)
$(\frac{\Delta Import}{Worker})$			
Intermediate	-0.048*	-0.033	-0.065**
	(0.025)	(0.023)	(0.029)
Final	0.008	0.011	0.009
	(0.008)	(0.009)	(0.009)
WRLURI	0.002	-0.001	0.002
	(0.010)	(0.013)	(0.010)
Observations	986	986	986
Controls	Yes	Yes	Yes

Notes: The table shows the effects of intermediate imports on the total housing stock, the stock of housing for rent, and the stock of housing for sale with controlling for the Wharton Land Use regulation Index (WRLURI). Since the WRLURI is not available for some of commuting zones, the observations decline. Housing stocks are defined as the sums of the occupied units and the vacant units. The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 2.9: The Effects of Intermediate Import on Local Housing Prices and Rents, 1990-2007, 2SLS Estimates with Housing Supply Elasticity as an Additional Control

Dependent Variable: 10-year Changes of Local Prices (in log-pts)

	(1) Hedonic Rent	(2) Hedonic House	(3) Median Rent	(4) Median House
$(\frac{\Delta Import}{Worker})$				
Intermediate	-0.002	-0.425***	-0.028	-0.380**
	(0.037)	(0.121)	(0.044)	(0.159)
Final	-0.022	0.058	-0.011	0.058
	(0.018)	(0.041)	(0.021)	(0.063)
Supply Elasticity	-0.020**	-0.065***	-0.018**	-0.056**
	(0.008)	(0.024)	(0.007)	(0.022)
Observations	232	232	232	232
Controls	Yes	Yes	Yes	Yes

Notes: The table shows the effects of intermediate imports on hedonic and median local housing prices and rents with controlling for local housing supply elasticity in Saiz (2010). Since local supply elasticity is only available for large Metropolitan areas, the observations largely decline. The hedonic housing prices and rents are measured using a hedonic regressions accounting for individual housing characteristics. The median housing prices and rents are the median housing and rent values in commuting zones. The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 2.10: The Effects of Intermediate Import on Local Housing Stocks, 1990-2007, 2SLS Estimates with Housing Supply Elasticity as an Additional Control

Dependent Variable: 10-year Changes of Local House Units (in log-pts)

	(1) log(All House Stock)	(2) log(House For Rent)	(3) log(House For Sale)
$(\frac{\Delta Import}{Worker})$			
Intermediate	-0.057	-0.031	-0.099**
	(0.037)	(0.039)	(0.047)
Final	0.006	0.011	0.013
	(0.013)	(0.013)	(0.016)
Supply Elasticity	0.026*	0.034**	0.024*
	(0.013)	(0.017)	(0.012)
Observations	232	232	232
Controls	Yes	Yes	Yes

Notes: The table shows the effects of intermediate imports on the total housing stock, the stock of housing for rent, and the stock of housing for sale with controlling for the local housing supply elasticity in Saiz (2010). Since the housing supply elasticity is only available for large Metropolitan areas, the observations largely decline. Housing stocks are defined as the sums of the occupied units and the vacant units. The full control variable set in Autor et al. (2013) including time dummies is used. Robust standard errors in parentheses are clustered on state. All models are weighted by start of period commuting zone share of national population.
*** p<0.01, ** p<0.05, * p<0.1

Table 2.11: The Standardized Coefficients of the Baseline Estimates

	Tradable Wage	**Tradable Employment**	**Non-tradable Wage**	**Non-tradable Employment**
Intermediate Imports	-0.566	-0.131	-0.559	-0.073
	Hedonic Rent	**Hedonic House**	**Median Rent**	**Median House**
Intermediate Imports		-0.832	-0.253	-0.765
	log(All House Stock)	**log(House For Rent)**	**log(House For Sale)**	
Intermediate Imports			-0.043	

Notes: The table lists the standardized coefficients for Table 2.3, Table 2.5, and Table 2.6.

Table 2.12: The Calibration of the Structural Model

Structural Parameters	b_{1L}	b_{1I}	b_{2L}	b_{2I}	b_{2P}	$\zeta\gamma_1$	$\zeta\gamma_2$
			Utility Parameter a_1=a_2=0.1				
Mobility Elasticity ϵ							
1.4	-0.117	-0.347	-0.920	-0.095	0.155	-0.893	0.436
1.7	-0.088	-0.332	-0.614	-0.099	0.092	-0.041	0.496
2.1	-0.004	-0.294	-0.509	-0.082	0.102	-0.263	0.478
2.4	-0.294	-0.468	-1.039	-0.126	0.112	-0.577	0.452
			Utility Parameter a_1=a_2=0.2				
Mobility Elasticity ϵ							
1.4	-0.118	-0.375	-1.132	-0.105	0.217	-0.389	0.471
1.7	-0.036	-0.349	-0.892	-0.094	0.167	-0.418	0.475
2.1	-0.132	-0.398	-0.914	-0.098	0.167	-0.835	0.437
2.4	-0.209	-0.447	-0.791	-0.110	0.117	0.294	0.523
			Utility Parameter a_1=a_2=0.3				
Mobility Elasticity ϵ							
1.4	-0.118	-0.356	-0.692	-0.102	0.099	-0.010	0.499
1.7	-0.334	-0.414	-0.441	-0.114	0.015	0.605	0.546
2.1	-0.084	-0.337	-0.562	-0.088	0.080	-0.279	0.496
2.4	-0.120	-0.452	-1.066	-0.102	0.204	-0.783	0.446
			Utility Parameter a_1=a_2=0.4				
Mobility Elasticity ϵ							
1.4	-0.250	-0.284	-0.059	-0.120	-0.184	-0.347	0.467
1.7	-0.215	-0.295	-0.142	-0.116	-0.143	-0.392	0.465
2.1	-0.202	-0.391	-0.608	-0.122	0.005	-0.292	0.456
2.4	-0.147	-0.373	-0.461	-0.096	0.057	-0.999	0.418
			Utility Parameter a_1=a_2=0.5				
Mobility Elasticity ϵ							
1.4	-0.151	-0.307	-0.436	-0.103	-0.005	-0.643	0.449
1.7	-0.052	-0.339	-0.616	-0.085	0.137	0.344	0.523
2.1	-0.052	-0.260	-0.157	-0.092	-0.041	-0.437	0.462
2.4	-0.296	-0.411	-0.593	-0.127	-0.036	-0.396	0.466

Notes: The table lists the calibrated structural parameters using the estimates in the Tables 2.3, 2.5, and 2.6. To pin down the structural parameters from the estimated reduced-form β's, I use the mean housing supply elasticity estimated in Saiz (2010) to set $\eta = 1.75$, and use the mean wage bill share for tradable sector from my data to set $\theta_w = 0.241$. Following the estimation in Rafael Dix-Carneiro (2014) about the sector mobility cost, I set the elasticity of mobility parameter ϵ between 1.4 to 2.7. The utility parameters a_1 and a_2 are set to be between 0.1 to 0.5. To determine b_{3L}, b_{3I}, and b_{3P}, I regress local rent on local non-tradable employment, local housing price, and local intermediate import measure. The regression indicates $b_{3L} = 0.073$, $b_{3I} = -0.011$, and $b_{3P} = 0.229$.

Chapter 3

The heterogeneous effects of Immigration on Local Rents

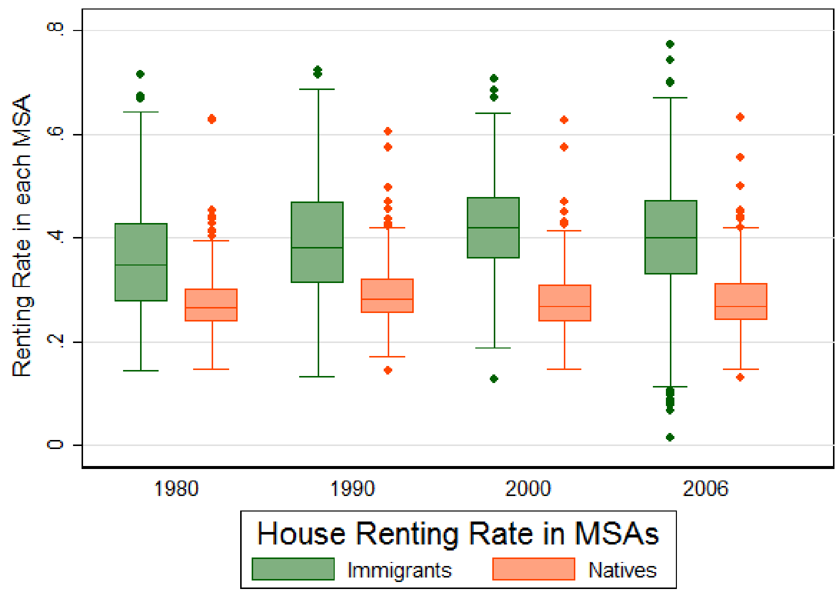
3.1 Introduction

Immigration has been criticized for taking job opportunities away from natives (Borjas, 2003, 2006; Card, 1990, 2001; Ottaviano and Peri, 2005, 2006). And we would also expect housing prices and rents to change if a lot immigrants enter the countries. Intuitively, more immigrants would increase housing demand, and thus bid up housing prices and rents. However, the price and wage reduction effects from immigration (Borjas, 2006; Cortes, 2008) might reduce local house demand. Therefore, it is unclear which direction the effect of immigration on U.S. local housing market goes.

Since new immigrants mainly rent houses as Figure 3.1 shows, this chapter examines the heterogeneous effects or relations of immigrants on metropolitan rental prices. By separating immigrants by their education levels and races, I could show immigrants with different backgrounds have different effects or relations with local rental prices. Places with great high educated immigrants or Asian immigrants always have higher rental prices, while places with a lot low educated immigrants or Hispanic immigrants have lower rental prices. If we believe the correlations based on a 2SLS estimates are causal for low-educated Hispanic immigrants, this chapter suggests low-educated Hispanic immigrants might have negative externality on natives.

To study the relations, the chapter uses U.S. Census data to construct a panel data with each metropolitan area as one observation. In total, 304 MSAs are included in the study. Metropolitan rental prices are measured using a hedonic regression with consideration of individual housing characteristics. The main explanatory variables are total immigrant inflow, high-educated immigrant inflow, low-educated immigrant inflow, Asian immigrant

Figure 3.1: The Comparison of Local Renting Rate between Immigrants and Natives, 1980-2006



Notes: The figure shows the box plots of local house renting rate for immigrants and natives. The local renting rate is defined as $\frac{pop\_rent}{pop\_rent+pop\_own}$ where the *pop* is immigrant population and native population accordingly. Each dot in the figure stands for one metropolitan area.

inflow, high-educated Asian immigrant inflow, low-educated Asian immigrant inflow, Hispanic immigrant inflow, high-educated Hispanic immigrant inflow, or low-educated Hispanic immigrant inflow.

Both OLS and 2SLS regression methods are used to examine the relations between immigration and metropolitan rental prices. The instrument used in the 2SLS method is adopted from Card (2001), Saiz (2006), Cortes (2008), and Ottaviano and Peri (2012). The instrument is created by projecting the yearly national immigrants counts into locations using the initial year local immigrant shares. The identifying assumption is that immigrants tend to enter places with a lot of previous immigrants from the same countries.

The identification strategy, however, only works for Hispanic, especially low-educated Hispanic immigrants based on descriptive data analyses. Use the Census data, I show the distribution maps of those immigrant groups. These maps tell that both high-educated and low-educated Asian immigrants tend to live in big cities or college towns where local rents are high, while Hispanic, especially low-educated Hispanic immigrants live in both urban and suburban ares where a lot previous Hispanic immigrants live. Therefore, the cultural tie instrument can only address reversal problem for Hispanic, especially low-educated Hispanic immigrants.

According to the estimates, immigration as a whole has negligible effect on local rents when local land use regulation and natural amenities are considered. However, if we separate immigrants by their education levels, those with at least one year college education positively correlate with local rents, while those with at most high school degree negatively correlate with local rents. When immigrants are divided by their races, Asian immigrants tend to live in places where local rents are high, while Hispanic, especially low-educated Hispanic immigrants reduce local rents.

The heterogeneous patterns inform government could treat immigrants differently. Whereas Hispanic immigrants substitute low educated natives in labor market, they also make local rents and possibly housing prices lower for natives. Therefore, Hispanic immigrants do not necessarily reduce natives' welfare. Although Asian immigrants largely enter high housing demand areas, they do not always take the same jobs away from natives. Therefore, government can focus on housing market regulation when dealing with Asian immigrants, and focus on labor market governance when treating Hispanic immigrants.

The chapter contributes to the traditional immigration literature which relates immigration with natives' labor market performance. Borjas (2003, 2006), Card (1990, 2001), and Ottaviano & Peri (2005, 2006) use different methods and different geographic units to show immigration could have small negative effects on natives' wage and employment rate. Those papers suggest immigrants and natives only substitute each other in the labor market when they are within the same education level. My chapter, therefore, adds knowledge to the immigration literature by also dividing immigrants according to their education level and examining their effects on local housing market separately.

The chapter also contributes to the recent immigration and urban literature. Saiz (2006) demonstrates immigration can impose positive effect on local housing prices and rents because immigrant inflow increases local housing demand. However, it does not consider that immigrants with different backgrounds may affect local housing marker heterogeneously. Ottaviano & Peri (2012) studies the effects of high educated and low educated immigrants on local housing prices and rents separately. It shows that only high educated immigrants can bid up local median housing prices and rents. It, however, does not control for individual housing characteristics nor local land regulation or natural amenities. Cortes (2008) shows that low-educated immigrants could reduce the prices of non-tradable goods other than housing at the state level. My chapter which examines the heterogeneous effects of immigrants on local housing market more carefully, and thus contributes to the growing literature.

The rest of the chapter proceeds as follows. The next section shows the data resource, immigration distribution maps, immigrants' house ownership patterns, and metropolitan rental price differences. Section 3 explains the empirical methods. Section 4 summaries and analyzes the results. The last section concludes.

3.2 Data

In this section, I explain my data resources and show the immigration patterns. I use the U.S. Census data to show the distributions of immigrants by their education levels and by their race. I also show immigrants' house ownership patterns.

3.2.1 Data Resource

I explain my data resources in this section. The data I use include the U.S. Census, the Wharton Land Use Regulation Index, and the Natural Amenity Scale Database.

My main data is U.S. Census data from IPUMS. Data in year 1980, 1990 and 2000 are from 10-year Census, while data in year 2005, 2006 and 2007 are from American Community Service (ACS). The data in ACS are combined together and used as data in year 2006 to enlarge the sample size in ACS. 1970 10-year Census data is also used when constructing instrument variables and pre-period control variables. Rents, immigrant counts, immigrant demographic measures, native counts, and native demographic measures are all extracted from the Census.

I also use two other data sets in the chapter. I use Wharton Land Use Regulation

Index in Gyourko, Saiz and Summers (2008) to control for MSAs' land regulation because land regulation policies would for sure affect local rent. I measure local natural amenities using the Economic Research Service Natural Amenities Scale Database in Department of Agriculture. Local natural amenities like average temperature, humility, and topology are also important determinants of local housing demand.

Combining those data sets together, I get a panel data with each metropolitan area as one observation. Each metropolitan area has four periods 1980, 1990, 2000, and 2006 in the panel data. The dependent variable is local rent. And the main explanatory variables are local immigrant inflow, local high-educated immigrant inflow, local low-educated immigrant inflow, local Asian immigrant inflow, local Hispanic immigrant inflow, local high-educated Asian immigrant inflow, local low-educated Asian immigrant inflow, local high-educated Hispanic immigrant inflow, local low-educated Hispanic immigrant inflow.

3.2.2 Data Patterns

I show immigrant distribution maps across U.S. metropolitan areas and local rent differences in this section. Immigrants distribute unevenly across U.S. MSAs. High-educated and low-educated immigrants have different preferences over locations. Asian and Hispanic immigrants also have different location choices.

First, let me show what the favorite MSAs for immigrants are. In Figure 3.2, I show the distribution map for MSAs' immigrant shares. The immigrant share is defined as local total immigrant counts divided by local total population counts. And the map shows the average share over year 1980, 1990, 2000, and 2006. According to the map, MSAs in California, Washington, New York, Florida, New Mexico, Nevada, and Texas are the most popular U.S. places for immigrants.

When I separate immigrants by their education levels, the distribution patterns for high-educated and low-educated immigrants are different. As Figure 3.3 shows high-educated immigrants prefers large MSAs like New York, Chicago, San Francisco, Las Vegas, Washington D.C., Houston, and etc. For low-educated immigrants, western areas and Florida are their favorite living locations as Figure 3.4 indicates.

The preferred living locations also diverse for Asian and Hispanic immigrants. According to Figure 3.5 and 3.8, Asian immigrants are more concentrated than Hispanic immigrants. Asian immigrants prefer to move into large cities in the west and east coasts, while Hispanic immigrants like both urban and suburban areas in western states and Florida state[1].

Figure 3.6 and 3.7 compare the distributions of high-educated and low-educated Asian immigrants. There is no big difference between the two maps. Both high-educated and low-educated Asian immigrants like big cities. Therefore, we would see a positive correlation between Asian immigrant share and local rent.

Figure 3.9 and 3.10 compare the location preferences for high-educated and low-educated Hispanic immigrants. While high-educated Hispanic immigrants prefer western coast and Florida state, low-educated Hispanic immigrants evenly distribute across areas where there are a lot of Hispanic population. This may imply Hispanic immigrants, especially low-educated Hispanic immigrants put a large weight on culture ties when making location decisions.

In Table 3.1, I display the correlations of these immigrant shares. From the low correlations between Asian and Hispanic immigration shares, we can confirm that the Asian immigrants and Hispanic immigrants have different preferences over U.S. locations. Within the Asian or Hispanic race group, high-educated and low-educated immigrants have high correlation coefficients, so they do share certain cultural tie.

Table 3.1: The Correlations of Local Immigration Shares, 1980-2006

	Local Immigration Shares ($\frac{F}{POP}$)			
	Correlation between Asian and Hispanic Immi			0.361
	OneYearCollege Asian Immi	HighSchool Asian Immi	OneYearCollege Hispanic Immi	HighSchool Hispanic Immi
OneYearCollege Asian Immi	1			
HighSchool Asian Immi	0.795	1		
OneYearCollege Hispanic Immi	0.422	0.380	1	
HighSchool Hispanic Immi	0.319	0.318	0.802	1

Notes: The table lists the correlations of the local immigration shares between Asian and Hispanic immigrants. The correlations are pooled correlations for year 1980, 1990, 2000, and 2006. The yearly immigration shares are defined as $\frac{F_t}{POP_t}$, where the F is local foreign born count, and the POP is local total population. The Asian immigrants are immigrants from China, Japan, or Korea. The Hispanic immigrants include immigrants from Mexico, Central America, Caribbean, and South America. The OneYearCollege are immigrants with at least one-year of college education, while HighSchool are immigrants with at most high school degree.

Now let us compare the above immigration distribution maps with the rent distribution

[1]See Appendix B for more detailed distributions of the Asian and Hispanic immigrants

maps in Figure 3.11 and 3.12. There is an obvious positive correlation between the share of Asian immigrants and the local rent. Such positive correlation exists for both high-educated and low-educated Asian immigrants. The correlation between the share of Hispanic immigrants and the local rent is less obvious because Hispanic immigrants settle in both high rent urban areas and low rent suburbans.

3.3 Methods

In this section, I show the econometric model, identification method, and the measurements of my local rental prices and immigrant inflows. Both OLS and 2SLS panel data models are used in this study. The measurement of local rental price follows Albouy and Lue (forthcoming), while the measurements of immigrant inflows follow Ottaviano & Peri (2012).

3.3.1 Econometric Model

This section specifies the econometric model and explains the instrument used in the 2SLS estimation. The empirical model is a panel data model with each metropolitan area as one observation. The instrumental variable strategy is adopted from Card (2001), Saiz (2006), and Ottaviano & Peri (2012).

My study is conducted on U.S. metropolitan areas. In total, 304 PMSAs are included in the analysis. Each PMSA has three periods 1980-1990, 1990-2000, and 2000-2006. Therefore, I have 912 observations in each panel data regression.

The panel data model is used to study the impact of immigration on local rental prices. The 10-year change of local log rents are used as the dependent variable. The main explanatory variable are local immigrant inflows. Following Ottaviano & Peri (2007), I define immigrant inflow as $\frac{\Delta F_t}{POP_{(t-1)}}$, where $\Delta F_t = F_t - F_{(t-1)}$, F is local foreign-born count, and POP is local total population count. The F can be total immigrant count, high-educated immigrant count, low-educated immigrant count, Asian immigrant count, high-educated Asian immigrant count, low-educated Asian immigrant count, Hispanic immigrant count, high-educated Hispanic immigrant count, or low-educated Hispanic immigrant count. Table 3.2

lists the summary statistics of these immigrant inflow variables. On average, U.S. attracts more low-educated immigrants than high-educated immigrants. And Hispanic countries are still the main original countries for U.S. immigrants.

The regression equation is

$$\Delta log(Rent_{rt}) = \alpha_t + \beta_1 \frac{\Delta F_t}{POP_{(t-1)}} + \beta_2 \frac{\Delta N_t}{POP_{t-1}} + X'_{rt}\beta_3 + \epsilon_{rt} \quad (1)$$

Where *Rent* is local rent, X is control variable vector, and β_t are time dummies. The control variable vector X includes land use regulation index, natural amenity score, pre-period work population percentage, pre-period male percentage, pre-period low-educated population percentage, pre-period employment rate, and pre-period average income.

The problem of the OLS estimation of equation (1) is that immigrants' location choices are not exogenous. It is possible that Asian or high-educated immigrants prefer to moving into high-rent places, while Hispanic or low educated immigrants tend to enter low-rent places. If this is the case, there exists reverse causality.

To show the estimated effects of Hispanic, especially low-educated Hispanic immigrants are possibly causal, I adapt instrumental variable strategy from Card (2001), Saiz (2006), Cortes(2008), and Ottaviano and Peri (2012). The instrument uses year 1970 local immigrant shares and current year national immigrant counts to predict current year local immigrant counts

$$\sum_c \frac{F_{cr1970}}{F_{c1970}} F_{ct}$$

Where c denotes immigrants' original country and r denotes PMSA. The identifying assumption is that immigrants tend to enter places where a lot of previous immigrants with the same nationalities live. That is, immigrants make location choices based on culture ties. According to the Figure 3.6, 3.7, 3.9, and 3.10, the instrument strategy could address the reverse causality for Hispanic, especially low-educated Hispanic immigrants since there is clear pattern that they live in both urban and rural Hispanic centers. For the Asian immigrants, the instrument variable strategy is weaker because they only lives in the high price urban areas.

I also check immigrants' effects on natives' house renting rates to see whether immigrants would drive natives from renting to buying a house. The regression equation is similar

$$\Delta Renting\_Rate_{rt} = \alpha_t + \beta_1 \frac{\Delta F_t}{POP_{t-1}} + \beta_2 \frac{\Delta N_t}{POP_{t-1}} + X'_{rt}\beta_3 + \epsilon_{rt} \tag{2}$$

Where $Renting\_Rate_{rt} = \frac{N\_rent_{rt}}{N\_rent_{rt} + N\_own_{rt}}$ is the renting rate for natives (N) at time t in location r.

3.3.2 Local Rental Prices

Except using local median rent, I also use a hedonic model to measure the local rent in this section. The hedonic model accounts for housing characters like number of rooms, square foot, etc., and, therefore, creates a better rent measure.

The hedonic model is based on Albouy & Lue (forthcoming). The following linear model is fitted for each census year.

$$log(R_h) = X'_h\beta + \gamma PMSA + \epsilon_h$$

Where X_h is a vector of detailed housing characters including number of rooms and bedrooms, house age, and kitchen facility, etc.

The estimated coefficients of PMSA dummies γ are defined as the PMSA-level hedonic rental prices. Intuitively, a particular PMSA's rent measures its housing market relative performance to the national housing market. For instance, if a PMSA's rent is negative, its rent is lower than the national rent. The hedonic rent is essentially a standardized rent, which uses the national average rent as the base. The hedonic and median rents are then used as the dependent variables in regression (1).

3.4 Results

In this section, I show the regression results and explain the insights from the empirical analysis. Asian immigrants tend to live in college towns and big cities where local rents are high. In contrast, Hispanic, especially low-educated Hispanic immigrants prefer to move in places where a lot of previous immigrants live. And as a result of the Hispanic immigrant inflow, those places experience local rent declines. The possible reason might be that the Hispanic immigrants make natives to switch from renting a house to buying a house.

I first replicate the results in Ottiviano & Peri (2012) using local median rent as the dependent variable. Table 3.3 lists the results. Column 1 uses the same control variable specification as Ottiviano & Peri (2012). The results are consistent with their findings. Then I add Wharton Land Use Regulation index as an additional control in column 2, Wharton Land Use Regulation index together with local natural amenities in column 3, and Wharton Land Use Regulation index together with local natural amenity score in column 4. The results slightly change. In column 2 to 4 only high-educated immigrant inflow has positive correlation with local median rent. But it hard to say it is high-educated immigrant inflow that raises local median rent. We see in Figure 3.3 that the high-educated immigrants only live in big cities. Therefore, it is highly possible that in places where rents are high, there are more good job opportunities so that more high-educated immigrants are attracted into those places.

Table 3.4 repeats the exercise in Table 3.3, but uses local hedonic rent as the dependent variable. The high-educated immigrant inflow still has positive correlation with local hedonic rent. However, the low-educated immigrant inflow now negatively correlates with local hedonic rent. Since low-educated immigrants work mainly in service sectors, there are job opportunities for them everywhere. Therefore, low-educated immigrants are not attracted by job opportunities into low hedonic rent areas. Would the low-educated immigrants be attracted into low rent areas because they can only afford the low rent? According to Figure 3.4, this is not the case. The low-educated immigrants are distributed into both high rent and low rent areas. And a large amount of the low-educated immigrants are Hispanic immigrants. Therefore, I would say the culture tie instrumental variable estimations here demonstrate that a large inflow of low-educated immigrants could reduce local rent.

Table 3.5 puts the high-educated and low-educated immigrant inflows in a single regression to check the robustness of the estimates. In Ottiviano & Peri (2012)'s specification, the effects of high-educated and low-educated immigrants are estimated separately in two different regressions. This table then puts the two immigrant inflows in one regression and uses the specification in column 4 of Table 3.4 to check the robustness. The estimates are similar to Table 3.4, and thus confirm the negative effect of low-educated immigrants on local rent. A one percentage increase in the new low-educated immigrants could decrease local hedonic rent by 0.958% relative to the national average rent.

Next, I examine how immigrants from different countries would affect local rent in Table 3.6. The table uses Asian and Hispanic immigrant inflows in a single regression, and includes both Wharton Land Use Regulation index and local natural amenity score as controls. According to the OLS estimates, the Asian immigrant inflow is positive correlated with the local rent, and the Hispanic immigrant inflow is negatively correlated with the local rent. The Asian immigrants, however, only live in college towns or big cities according to Figure 3.5. Therefore, the 2SLS cultural tie instrument could not address the reverse causality problem for Asian immigrant. We only know Asian immigrant inflow is positive correlated with local rent. For Hispainc immigrants, they live in both urban and suburban areas. And the places where a lot Hispanic immigrants live are traditional Hispanic culture centers according to Figure 3.8. Therefore, the 2SLS specification indicates that a 1% increase in new Hispanic immigrants could reduce local hedonic rent by 1.295%.

I then further separate Asian and Hispanic immigrants into high-educated and low-educated groups, and investigate their effects on local hedonic rent. Table 3.7 lists the first stage estimations. The own corresponding instruments largely explain the immigrant inflow measures. The OLS and 2SLS results are listed in Table 3.8. Both high-educated and low-educated Asian immigrant inflows positively correlate with local rent in the OLS estimates. The high-educated Hispanic immigrant inflow is positively correlated with local rent, while the low-educated Hispanic immigrant inflow negative correlates with local rent according to the OLS estimates. Looking at the distribution maps in Figure 3.6 and 3.7, we know the high-educated and low-educated Asian immigrants prefer similar places. And the two Asian groups both live in college towns or big cities where local rents are high. As a result, the 2SLS estimates for Asian immigrant groups could not be interpreted as causal effects. The 2SLS cultural tie instrumental variable strategy for Hispanic. especially low-educated Hispanic immigrant groups could address the reverse causality problem according to the distribution maps 3.9 and 3.10. A 1% increase in new low-educated Hispanic immigrants would reduce local hedonic rent by 0.952%. The size of the effect is comparable to the effect of low-educated immigrants in Table 3.5.

To further check the causal effect of Hispanic immigrants on local rent, four analysis are done. First, I add two location dummies to the estimations. The Asian Location Dummy sets PMSAs in California, New York, New Jersey, and Washington State as 1. And the Hispanic Location Dummy set PMSAs in California,New York, Texas, Florida, New Mexico, Arizona, and Washington States as 1. The two location dummies would not only indicate the places where a lot Asian and Hispanic live, but also consider the West Coast amenities. The results are showed in Table 3.9. The OLS and 2SLS are still similar as the benchmark estimations in Table 3.8. And the Asian Location Dummy is not significant in any estimation. The Hispanic Location Dummy is slightly negative. But with the consideration of Hispanic Location Dummy, we still see low-educated Hispanic has negative relation with local rent.

Second, I exclude non-metropolitan areas from the estimation. The estimations with only metropolitan areas are showed in Table 3.10. The results have similar patterns as the benchmark estimations. We still see high-educated Hispanic increases local rent, and low-educated Hispanic reduces local rent in the 2SLS estimations.

Third, I include only metropolitan and metropolitan-adjacent areas in the estimations. The results are listed in Table 3.11. The estimations are also similar to the benchmark estimations. The two tables indicate low-educated Hispanic immigrants do not live particular in rural areas. They also have negative effects on metropolitan areas based on the 2SLS estimations.

Finally, I separate U.S. locations based on their yearly average housing price into high-price and low-price areas, and estimate the correlations separately in high-price and low-price areas. The results are listed in Table 3.12. In the high-price areas, the OLS estimates are similar to the benchmark estimates. The 2SLS estimate is slightly different. The high-educated Asian is now positive correlated with local rent, while the high-educated Hispanic is not positive correlated with local rent here. However, the low-educated Hispanic immigrants still reduce local rent in the high-price areas. In the low-price areas, the high-educated Hispanic has no significant relation with local rent in neither OLS nor 2SLS estimation.

Nevertheless, the low-educated Hispanic is still negative related to local rent in both OLS and 2SLS estimations. The results in this table then indicate there is no evidence that low-educated Hispanic immigrants live only in metropolitan areas where local rent are relatively lower than the other metropolitan areas.

In general, low-educated Hispanic work in low-end service industries according to the data. There is no evidence that those jobs only exist in rural or low-price areas. And in fact, those jobs are popular in big cities where people tend to consume more local services. Therefore, all the four tables confirm the low-educated Hispanic immigrants could reduce local rent.

Table 3.13 examines the relation between natives' house renting rates and immigrant inflows to examine the possible reason for Hispanic, especially low-educated Hispanic immigrants to reduce local rent. The Hispanic, especially the low-educated Hispanic immigrants reduce natives' renting rates. The switching effect is larger on high-educated natives than on low-educated natives. Therefore, the low-educated Hispanic immigrants make natives to switch from renting a house to buying a house, and so reduce local renting demand.

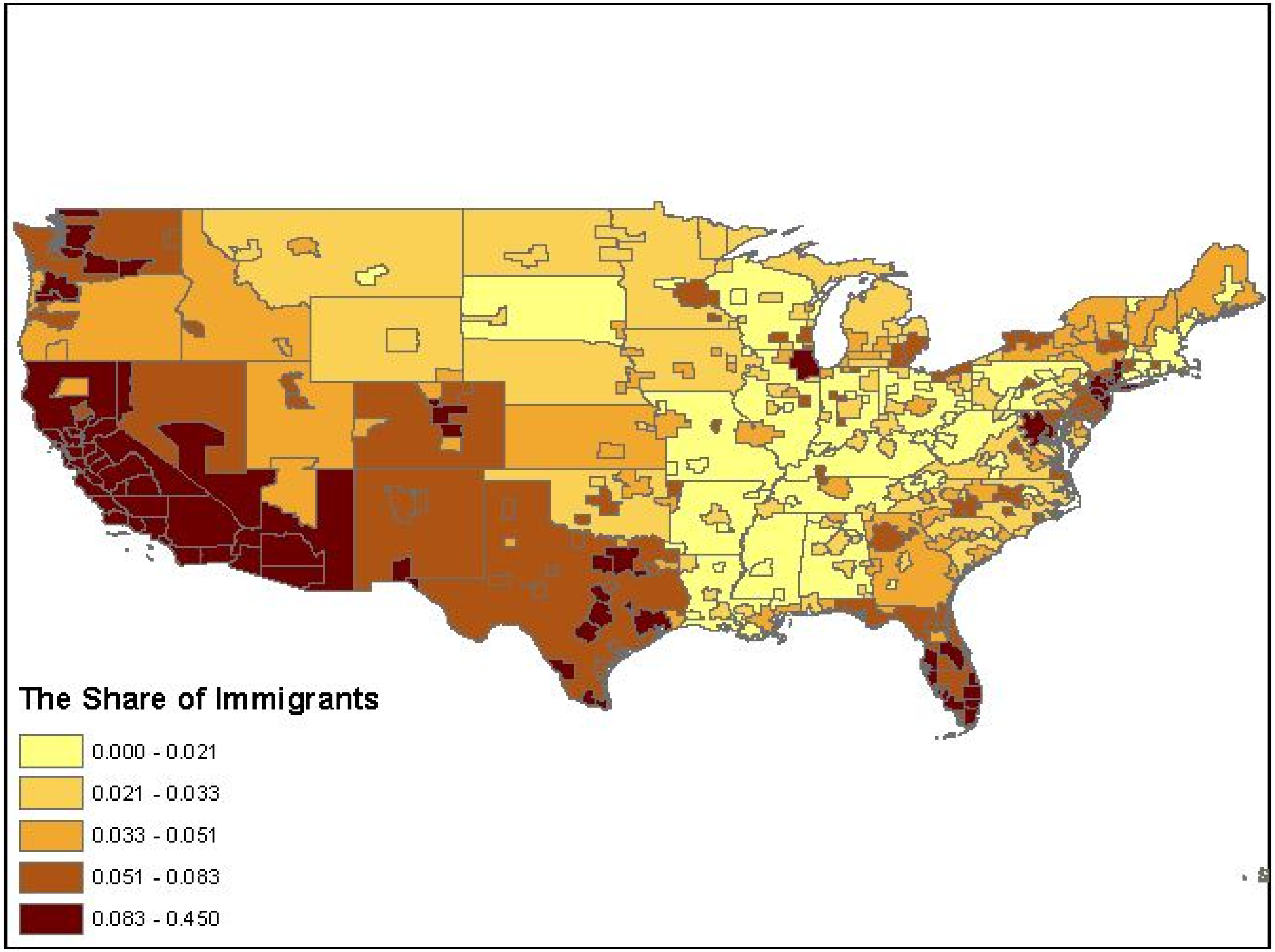
3.5 Conclusion

The chapter examines the heterogeneous correlations or effects of different immigrants on the rents of U.S. metropolitan areas. It finds that high-educated and low-educated Asian immigrants prefer to living in college towns and big cities where local rents are high. The Hispanic immigrants, however, distributed more evenly to places where a lot previous Hispanic immigrants settled down. Based on such evidence, this chapter uses cultural tie instrumental variable strategy used in Card (2001), Saiz (2006), cortes(2008), and Ottaviano & Peri (2012) to identify the causal relations between Hispanic immigrants and local rent. The results indicate Hispanic, especially low-educated Hispanic immigrants would reduce local rent by driving local natives to switch from renting a house to buying a house.

The chapter contributes to the immigration literature in several ways. The classical immigration literature focuses on immigrants' labor substitution effects in the labor market. This chapter thus contributes to the classical literature by examining immigration's effects in housing market. The chapter also contributes to the recent immigration and housing literature (Saiz, 2006, 2010; Ottaviano & Peri, 2012) by investigating the different effects of Asian and Hispanic immigrants on housing market. The results in this chapter are also consistent with Cortes (2008) which points out the low-educated immigrants would reduce other non-tradable goods' prices because housing is one of the non-tradable goods.

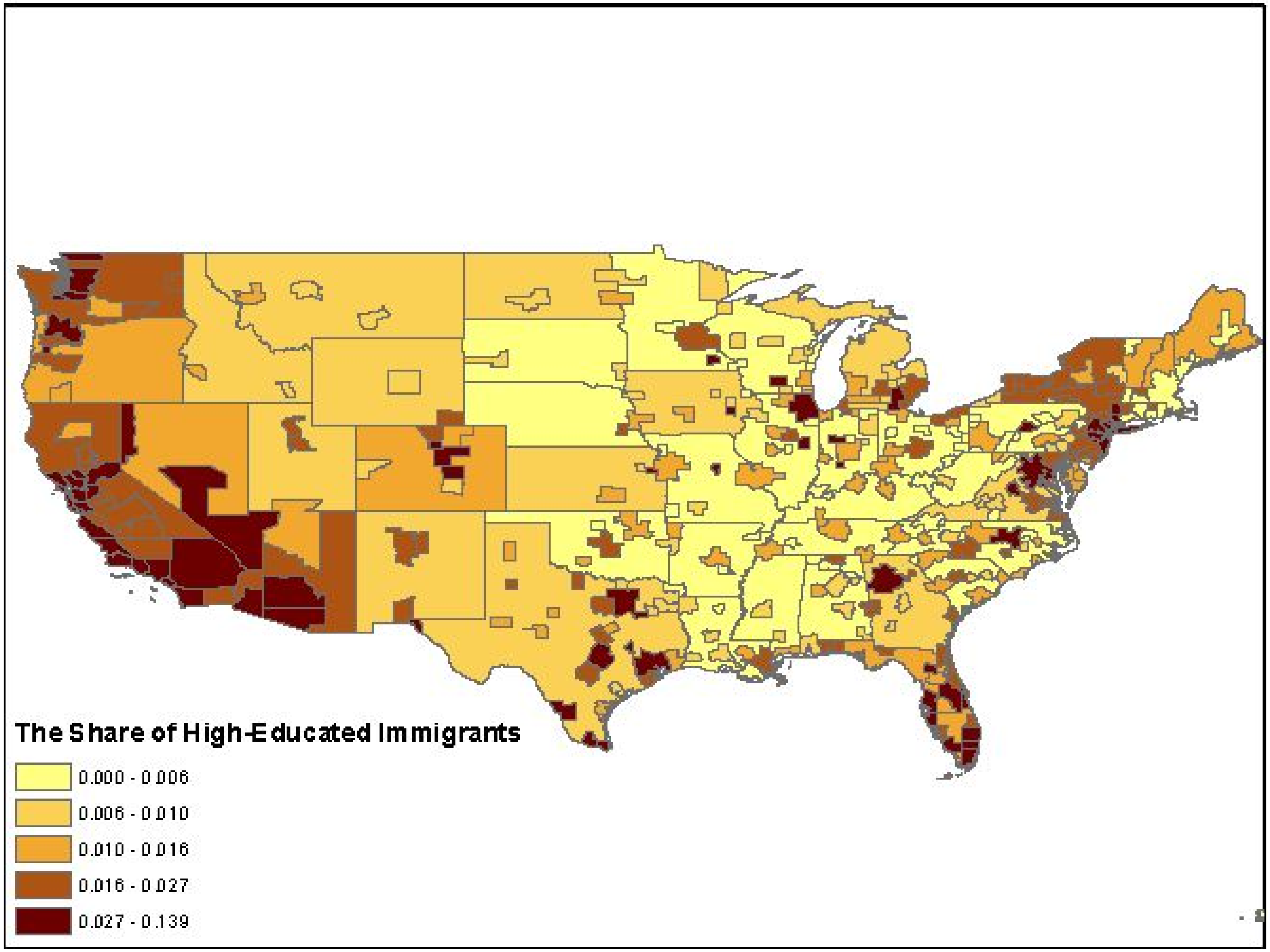
The results in the chapter can help U.S. government to have better understanding of immigration's effects and make wiser immigration policies. While low-educated immigrants reduce local average wage, they also reduce local rental prices. Therefore, low-educated immigrants do not necessary reduce natives' welfare because housing is now more affordable to them. Considering low-educated immigrants' negative effects on local rent, U.S. government might not need to make tough immigration policies to restrict low-educated immigrants to enter the country.

Figure 3.2: The Distribution Map of Total Immigrants, 1980-2006



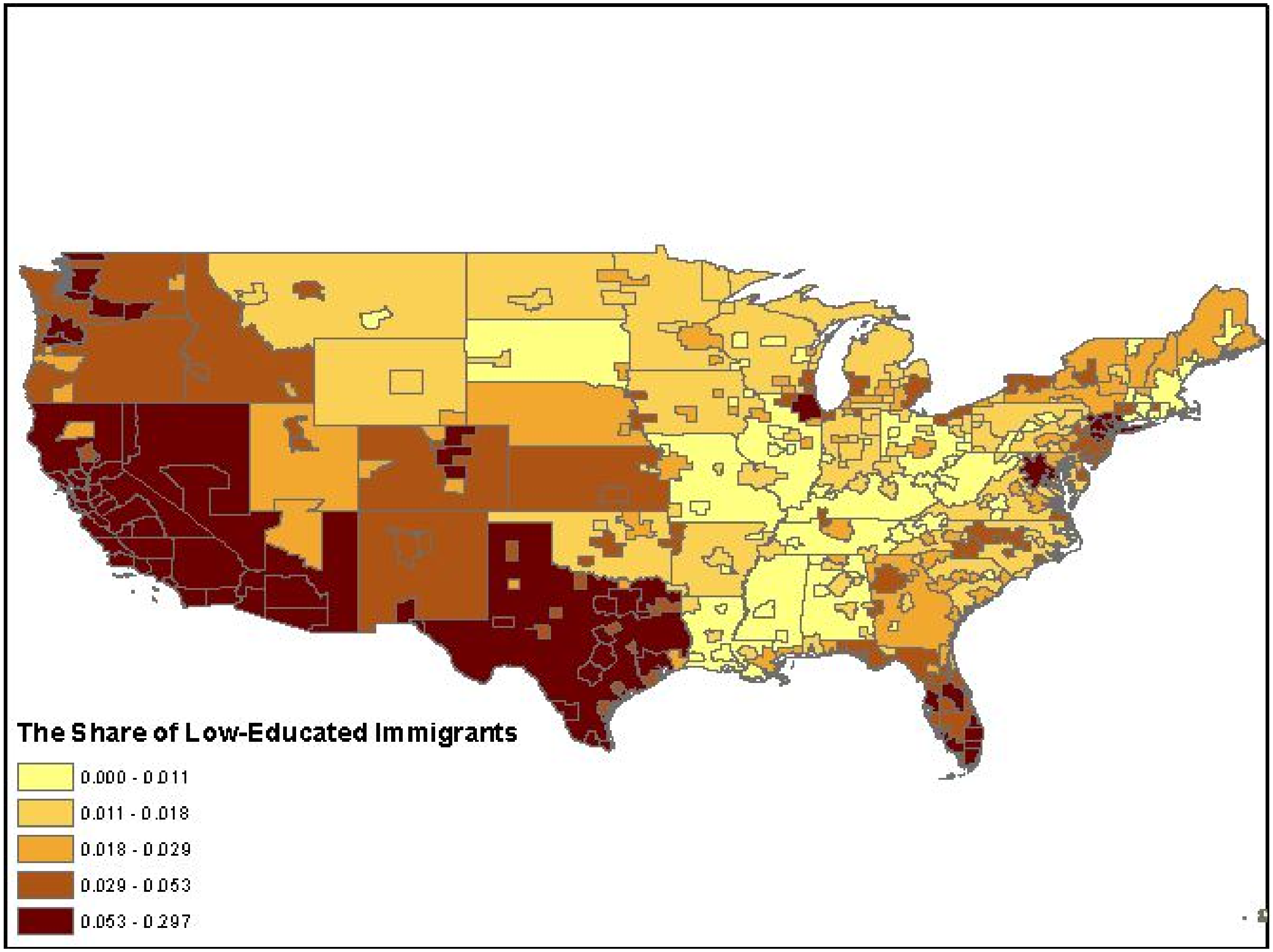
Notes: The map shows the distribution of immigrants across U.S. MSAs. The immigrant share is defined as $\frac{F_{rt}}{POP_{rt}}$, where F is local immigrant count and POP is local total population. The share is an average of immigrant shares in year 1980, 1990, 2000 and 2006. Areas with darker color have more immigrants on average. The figure is created using ArcGIS.

Figure 3.3: The Distribution Map of OneYearCollege Immigrants, 1980-2006



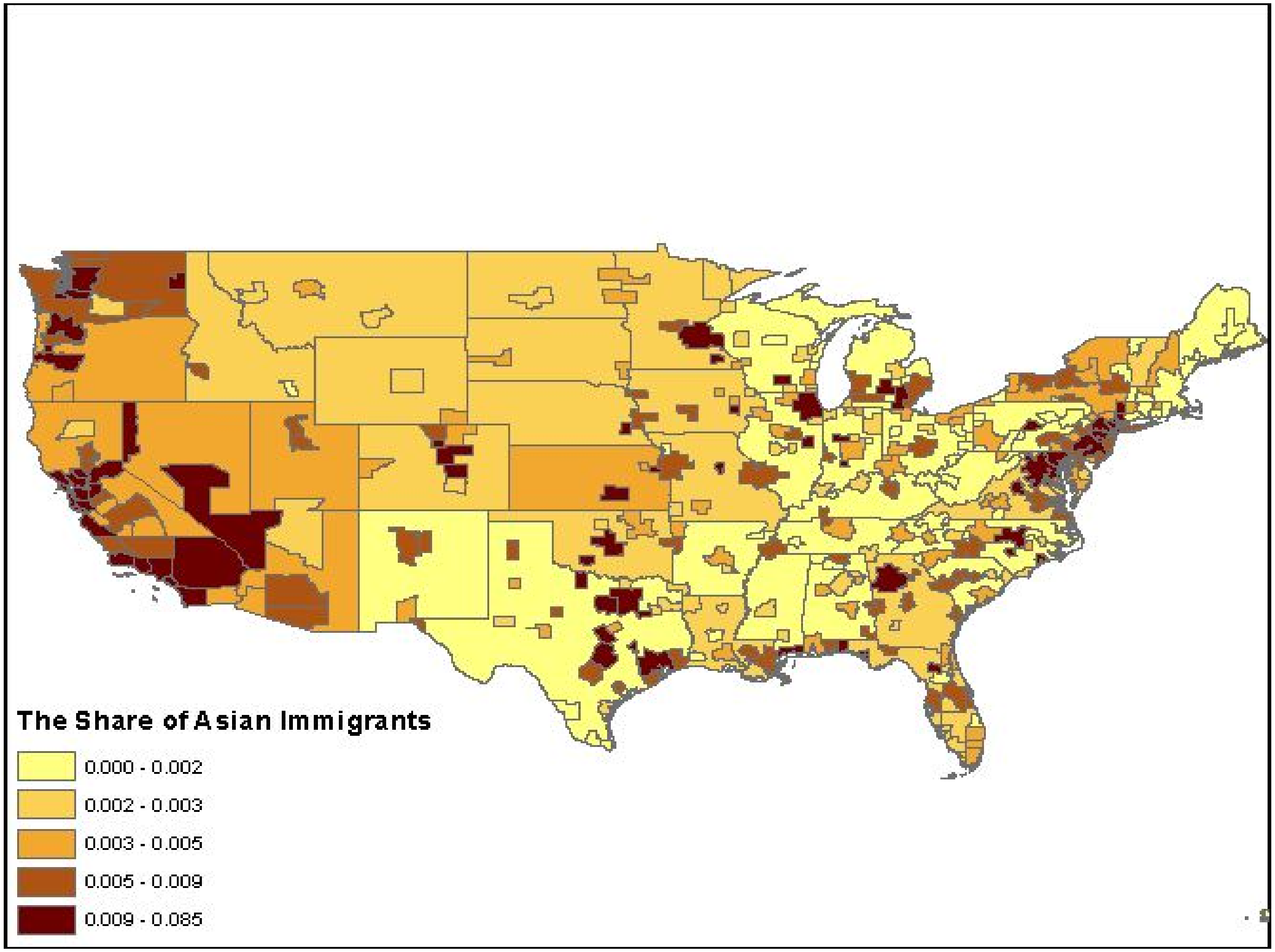
Notes: The map shows the distribution of high-educated immigrants across U.S. MSAs. Immigrants with at least one-year of college education are included in the OneYearCollege group. The immigrant share is defined as $\frac{F_{rt}}{POP_{rt}}$, where F is local high-educated immigrant count and POP is local total population. The share is an average of immigrant shares in year 1980, 1990, 2000 and 2006. Areas with darker color have more high-educated immigrants on average. The figure is created using ArcGIS.

Figure 3.4: The Distribution Map of HighSchool Immigrants, 1980-2006



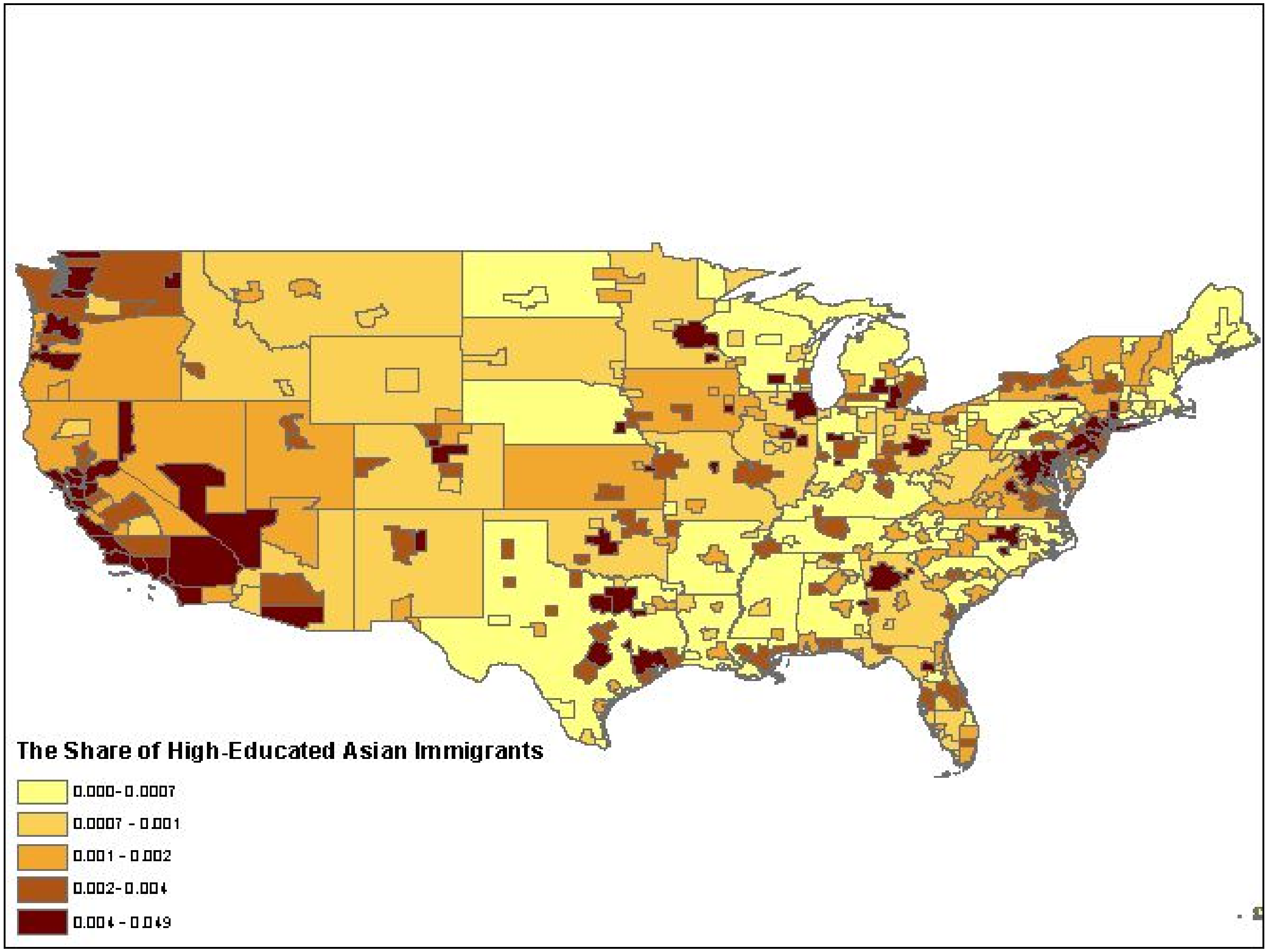
Notes: The map shows the distribution of low-educated immigrants across U.S. MSAs. Immigrants with at most high school degree are included in the HighSchool group. The immigrant share is defined as $\frac{F_{rt}}{POP_{rt}}$, where F is local low-educated immigrant count and POP is local total population. The share is an average of immigrant shares in year 1980, 1990, 2000 and 2006. Areas with darker color have more low-educated immigrants on average. The figure is created using ArcGIS.

Figure 3.5: The Distribution Map of Asian Immigrants



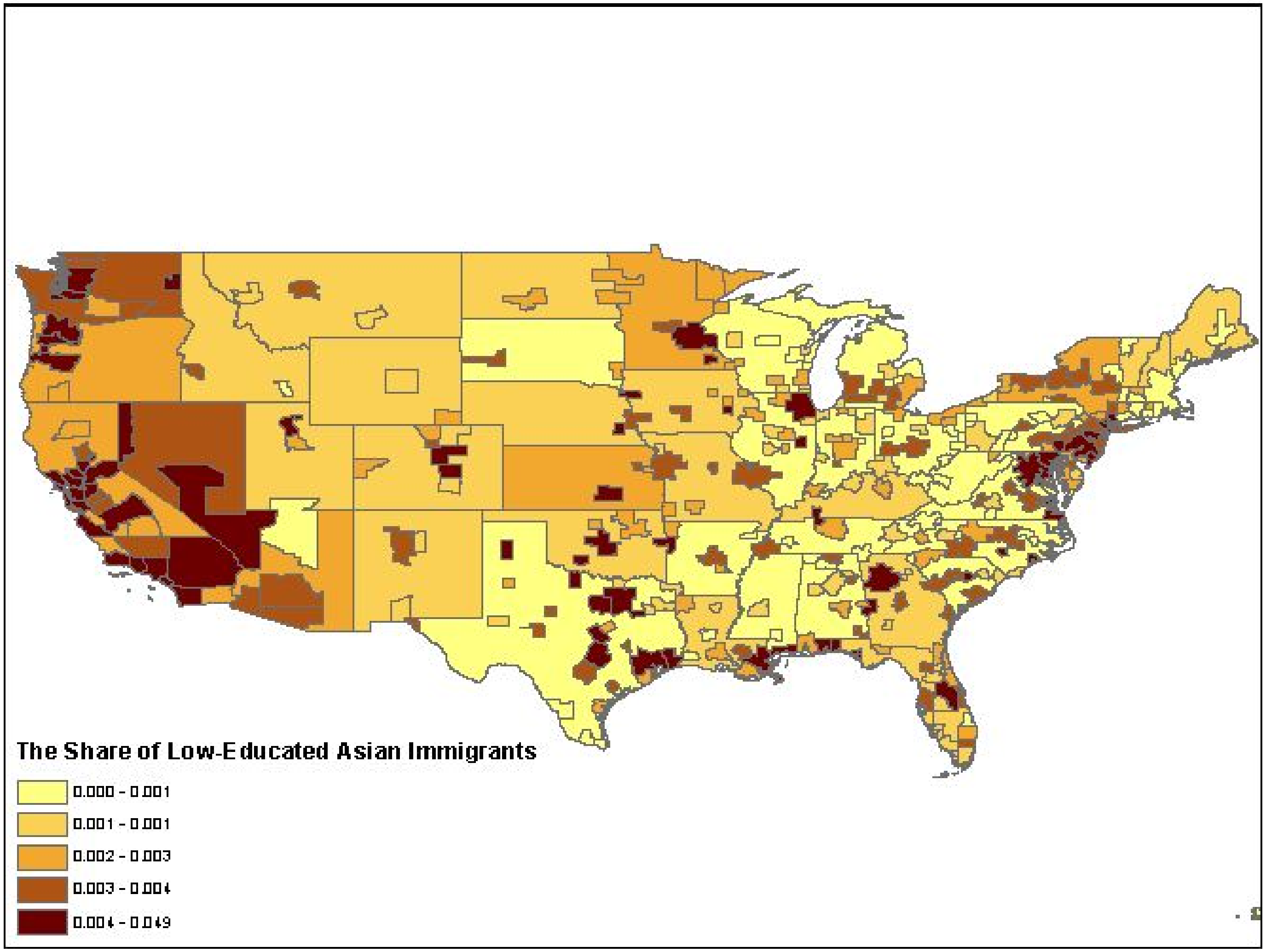
Notes: The map shows the distribution of Asian immigrants across U.S. MSAs. The Asian immigrants in the chapter includes immigrants from China, Japan, and Korea. The immigrant share is defined as $\frac{F_{rt}}{POP_{rt}}$, where F is local Asian immigrant count and POP is local total population. The share is an average of immigrant shares in year 1980, 1990, 2000 and 2006. Areas with darker color have more Asian immigrants on average. The figure is created using ArcGIS.

Figure 3.6: The Distribution Map of OneYearCollege Asian Immigrants



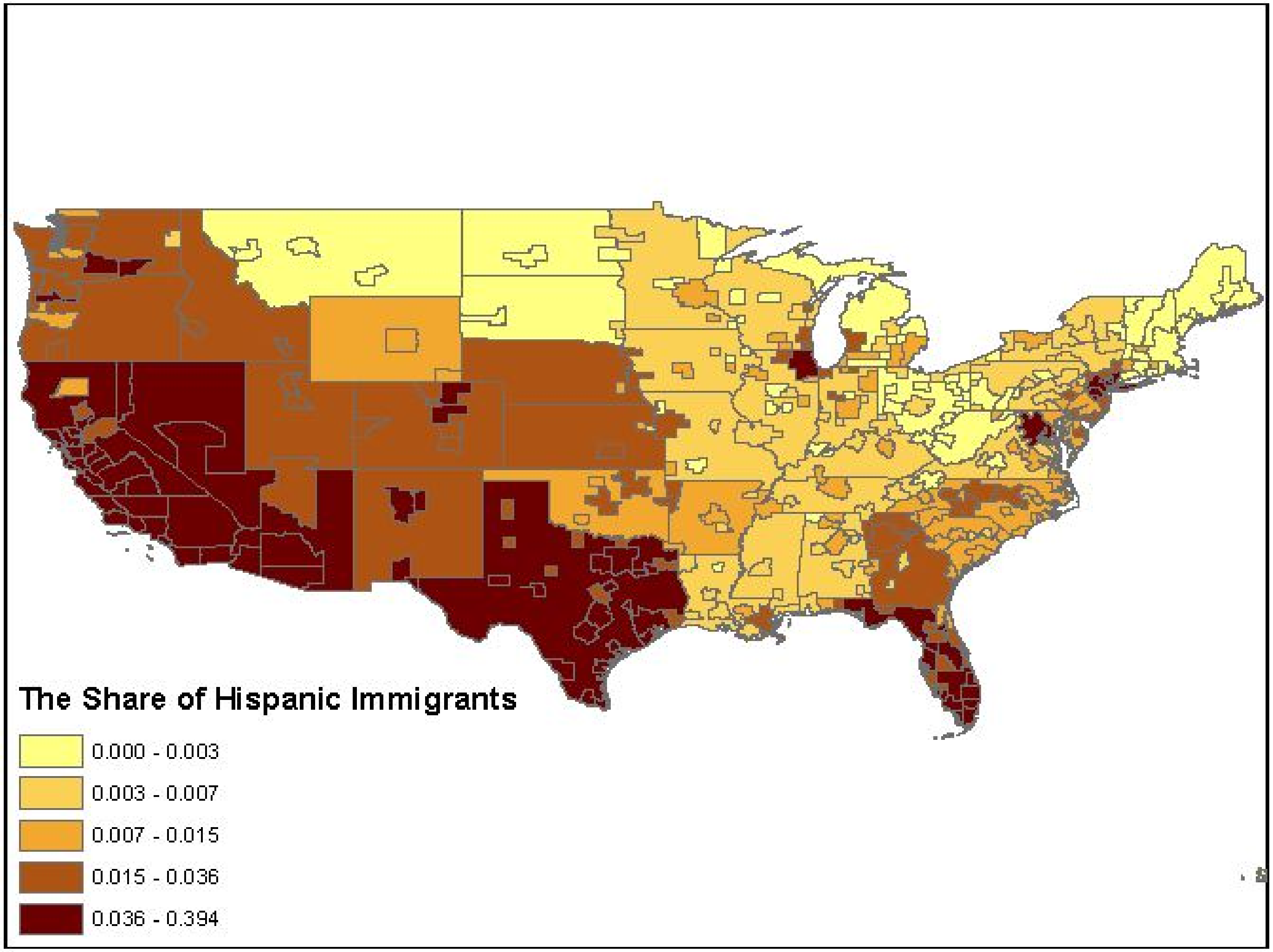
Notes: The map shows the distribution of high-educated Asian immigrants across U.S. MSAs. The Asian immigrants in the chapter includes immigrants from China, Japan, and Korea. And Asian immigrants with at least one-year of college study are included in the OneYearCollege Asian group. The immigrant share is defined as $\frac{F_{rt}}{POP_{rt}}$, where F is local high-educated Asian immigrant count and POP is local total population. The share is an average of immigrant shares in year 1980, 1990, 2000 and 2006. Areas with darker color have more high-educated Asian immigrants on average. The figure is created using ArcGIS.

Figure 3.7: The Distribution Map of HighSchool Asian Immigrants



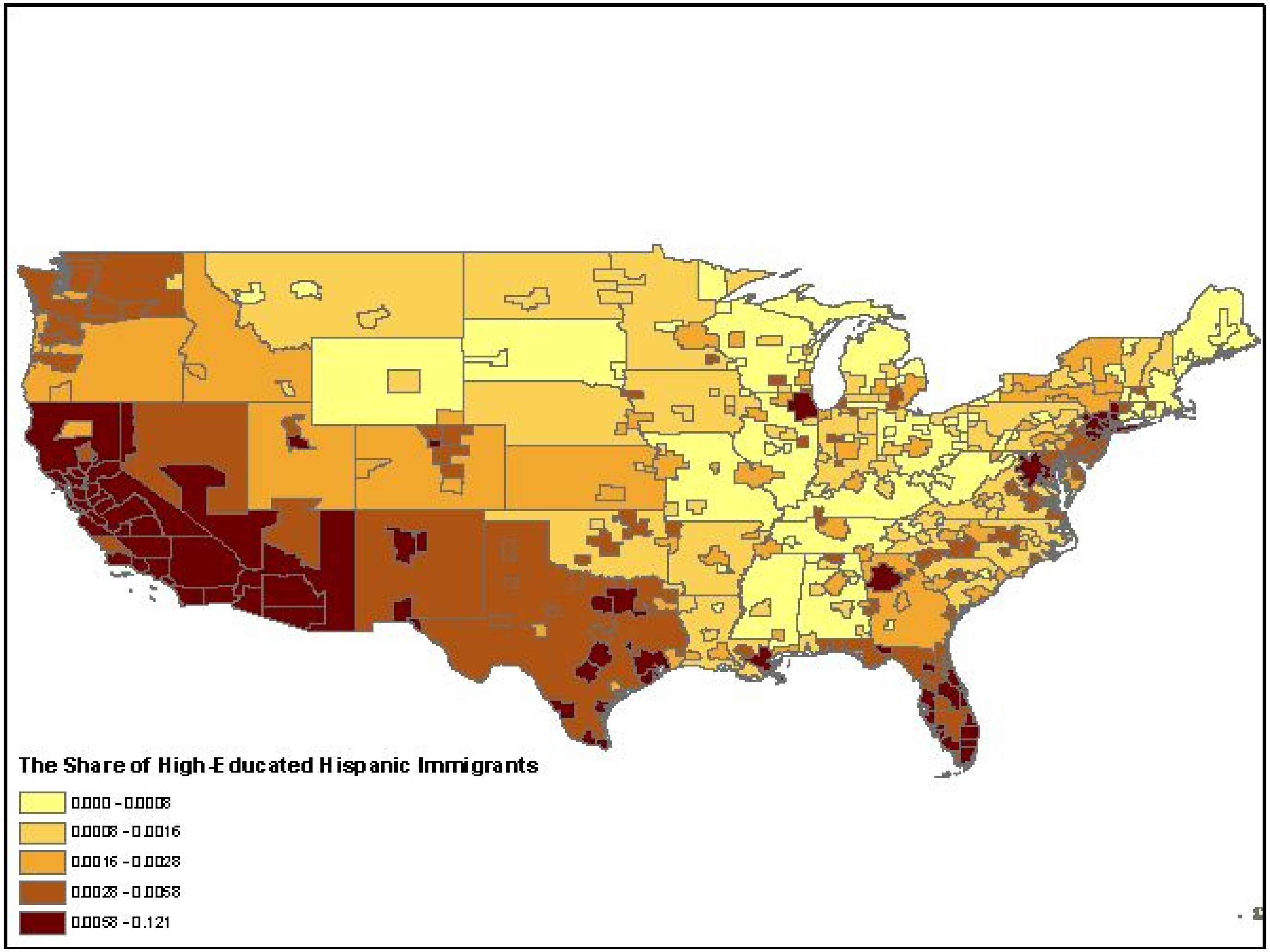
Notes: The map shows the distribution of low-educated Asian immigrants across U.S. MSAs. The Asian immigrants in the chapter includes immigrants from China, Japan, and Korea. And Asian immigrants with at most high school degree are included in the HighSchool Asian group. The immigrant share is defined as $\frac{F_{rt}}{POP_{rt}}$, where F is local low-educated Asian immigrant count and POP is local total population. The share is an average of immigrant shares in year 1980, 1990, 2000 and 2006. Areas with darker color have more low-educated Asian immigrants on average. The figure is created using ArcGIS.

Figure 3.8: The Distribution Map of Hispanic Immigrants



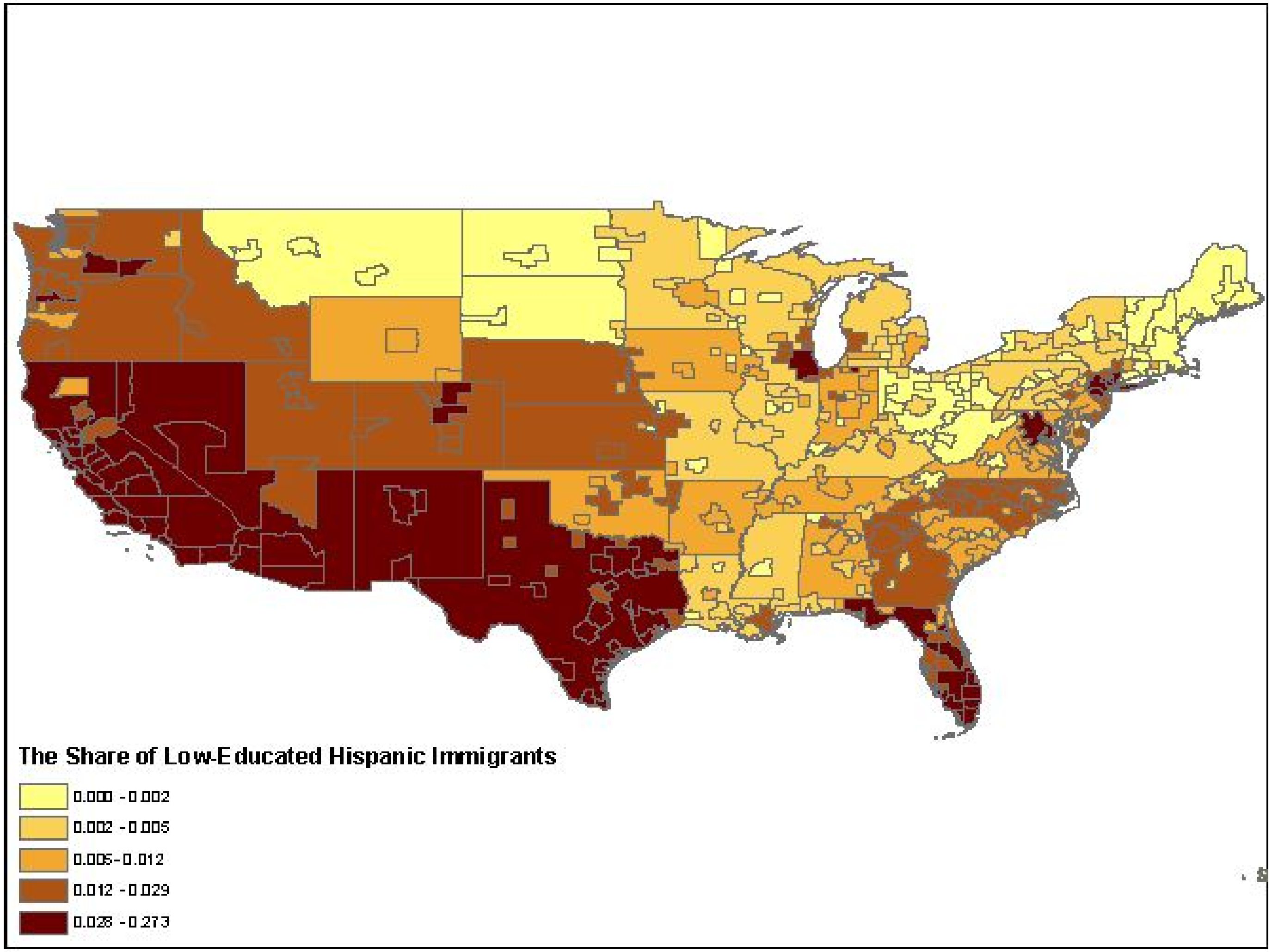
Notes: The map shows the distribution of Hispanic immigrants across U.S. MSAs. The Hispanic immigrants in this chapter include immigrants from Mexico, Central America, Caribbean, and South America. The immigrant share is defined as $\frac{F_{rt}}{POP_{rt}}$, where F is local Hispanic immigrant count and POP is local total population. The share is an average of immigrant shares in year 1980, 1990, 2000 and 2006. Areas with darker color have more Hispanic immigrants on average. The figure is created using ArcGIS.

Figure 3.9: The Distribution Map of OneYearCollege Hispanic Immigrants



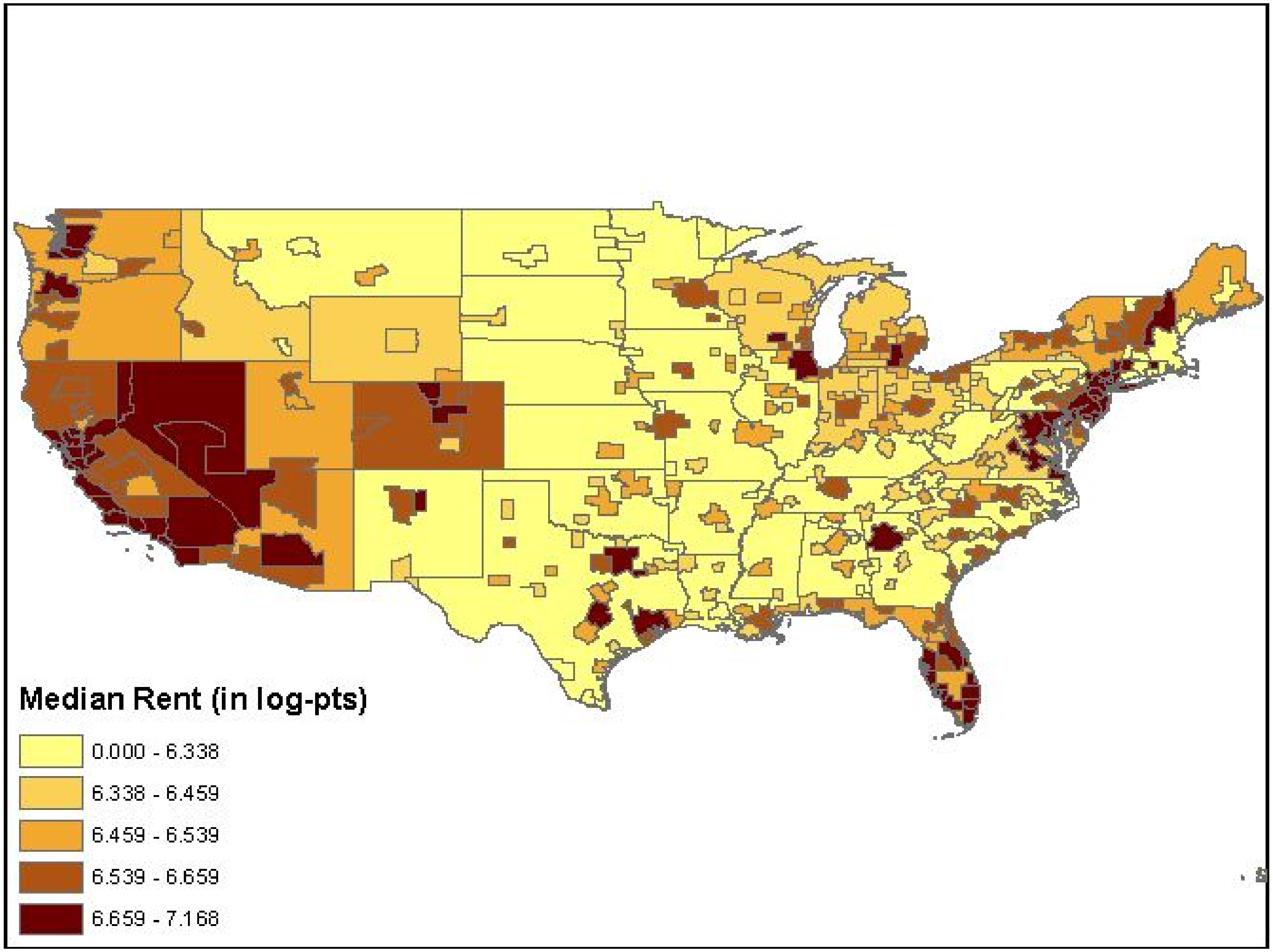
Notes: The map shows the distribution of high-educated Hispanic immigrants across U.S. MSAs. The Hispanic immigrants in this chapter include immigrants from Mexico, Central America, Caribbean, and South America. And Hispanic immigrants with at least one-year of college study are included in the OneYearCollege Hispanic group. The immigrant share is defined as $\frac{F_{rt}}{POP_{rt}}$, where F is local high-educated Hispanic immigrant count and POP is local total population. The share is an average of immigrant shares in year 1980, 1990, 2000 and 2006. Areas with darker color have more high-educated Hispanic immigrants on average. The figure is created using ArcGIS.

Figure 3.10: The Distribution Map of HighSchool Hispanic Immigrants



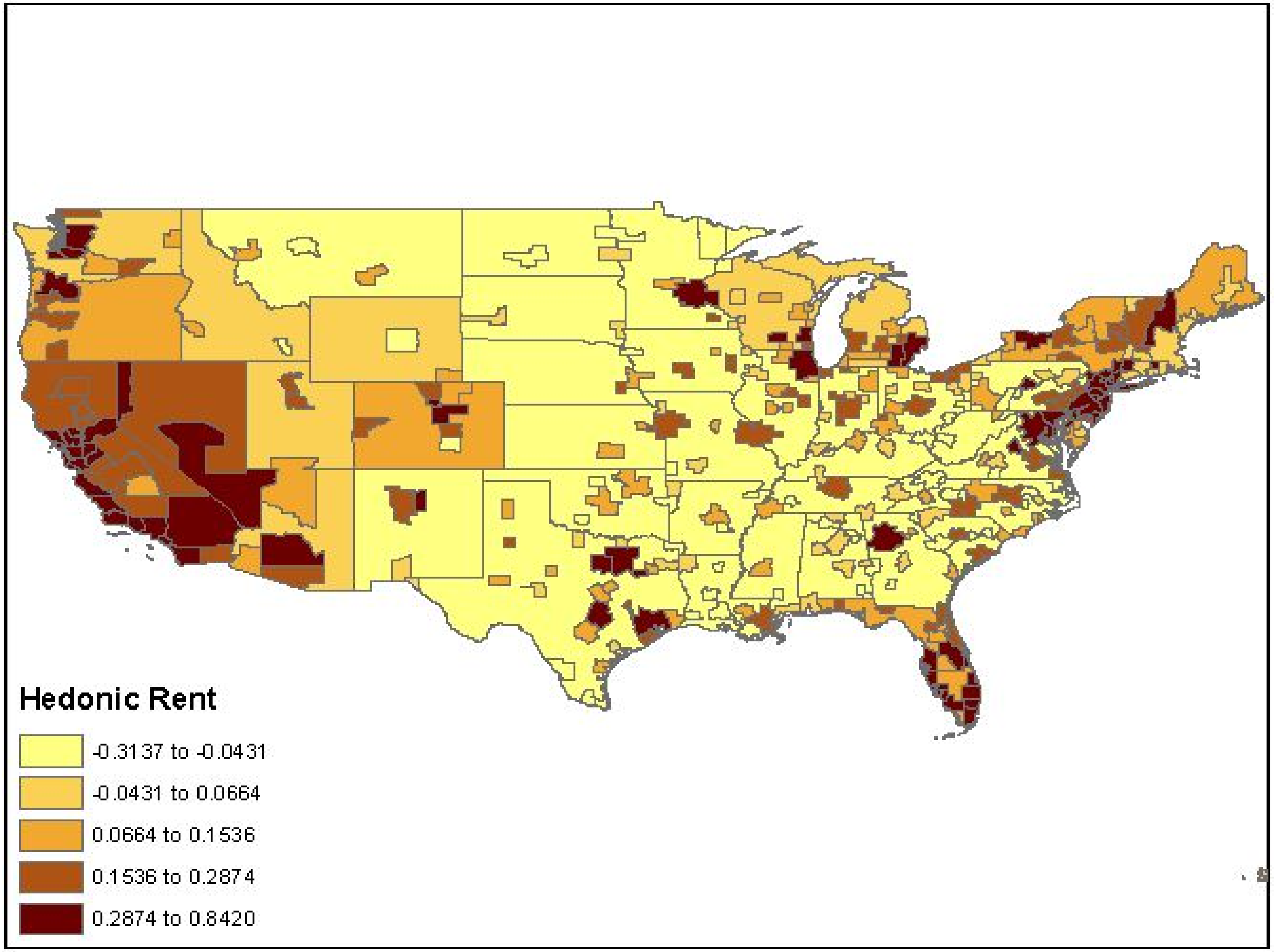
Notes: The map shows the distribution of low-educated Hispanic immigrants across U.S. MSAs. The Hispanic immigrants in this chapter include immigrants from Mexico, Central America, Caribbean, and South America. And Hispanic immigrants with at most high school degree are included in the HighSchool Hispanic group. The immigrant share is defined as $\frac{F_{rt}}{POP_{rt}}$, where F is local low-educated Hispanic immigrant count and POP is local total population. The share is an average of immigrant shares in year 1980, 1990, 2000 and 2006. Areas with darker color have more low-educated Hispanic immigrants on average. The figure is created using ArcGIS.

Figure 3.11: The Distribution Map of Median Rent



Notes: The map shows the distribution of local median rent across U.S. MSAs. The median rent is an average of median rents in year 1980, 1990, 2000 and 2006. MSAs with darker color have higher local median rent on average. The figure is created using ArcGIS.

Figure 3.12: The Distribution Map of Hedonic Rent



Notes: The map shows the distribution of hedonic rent across U.S. MSAs. The hedonic rent is an average of hedonic rents in year 1980, 1990, 2000 and 2006. Yearly hedonic rents are measured based on hedonic regressions with considerations of individual housing characteristics. MSAs with darker color have higher local rent on average. The figure is created using ArcGIS.

Table 3.2: The Summary Statistics of Local Immigrant Inflows and 10-year Changes of Local Rents, 1980-2006

	mean	sd	min	p50	max
Immigrant Inflows ($\frac{\Delta F_t}{POP_{(t-1)}}$)					
All	0.065	0.065	0.004	0.042	0.405
OneYearCollege	0.019	0.021	0.0007	0.013	0.196
HighSchool	0.040	0.045	0.003	0.024	0.268
Asian	0.007	0.010	0	0.004	0.122
OneYearCollege Asian	0.003	0.006	0	0.002	0.077
HighSchool Asian	0.004	0.005	0	0.002	0.056
Hispanic	0.028	0.045	0.0002	0.009	0.291
OneYearCollege Hispanic	0.005	0.008	0	0.002	0.092
HighSchool Hispanic	0.023	0.038	0	0.007	0.264
Natives					
OneYearCollege	0.253	0.066	0.103	0.253	0.519
HighSchool	0.345	0.067	0.123	0.350	0.494
Rent Changes					
Hedonic Rent (in log-pts)	0.112	0.289	-0.624	0.090	1.076
Median Rent (in log-pts)	6.546	0.224	6.084	6.525	7.320

Notes: The table lists the summary statistics for the local immigrant inflows, natives, and local rent measures. The immigrant inflows are defined as $\frac{\Delta F_t}{POP_{(t-1)}}$, where $\Delta F_t = F_t - F_{(t-1)}$, F is local foreign born count, and POP is local total population. The Asian immigrants are immigrants from China, Japan, or Korea. The Hispanic immigrants include immigrants from Mexico, Central America, Caribbean, and South America. The OneYearCollege are individuals with at least one-year of college education, while HighSchool are those with at most high school degree. The hedonic rent is measured based on a hedonic regression considering individual housing characteristics.

Table 3.3: The Estimates of Immigrant Inflows on Local Median Rent, 1980-2006

Dependent Variable: 10-year Changes of Local Median Rent (in log-pts)

$\frac{\Delta F_t}{POP_{(t-1)}}$		OLS		
Immi Inflow	0.507***	0.456**	0.358**	0.480***
	(0.189)	(0.187)	(0.178)	(0.180)
OneYearCollege Immi Inflow	0.721***	0.699***	0.683***	0.677***
	(0.102)	(0.102)	(0.0998)	(0.101)
HighSchool Immi Inflow	-0.021	-0.036	-0.085	-0.054
	(0.063)	(0.063)	(0.058)	(0.059)
		2SLS		
Immi Inflow	0.735**	0.655*	0.418	0.473
	(0.338)	(0.380)	(0.385)	(0.435)
OneYearCollege Immi Inflow	1.064***	1.114***	1.099***	1.022***
	(0.204)	(0.232)	(0.233)	(0.226)
HighSchool Immi Inflow	0.049	0.004	-0.120	-0.150
	(0.101)	(0.111)	(0.114)	(0.117)
		2SLS First Stage		
Imputed Immi Inflow	0.251***	0.248***	0.237***	0.216***
	(0.043)	(0.043)	(0.043)	(0.044)
F-stats	54.02	51.70	47.48	36.45
Imputed OneYearCollege Immi Inflow	0.316***	0.312***	0.307***	0.291***
	(0.101)	(0.100)	(0.099)	(0.098)
F-stats	51.82	49.84	46.21	39.75
Imputed HighSchool Immi Inflow	0.251***	0.249***	0.230***	0.215***
	(0.047)	(0.047)	(0.048)	(0.048)
F-stats	40.48	37.68	35.28	25.80
Regulation	No	Yes	Yes	Yes
Amenities	No	No	Yes	No
Amenity Score	No	No	No	Yes
Observation	912	912	912	912

Notes: The table shows the estimates of using total immigrant inflow, OneYearCollege immigrant inflow, or HighSchool immigrant inflow as the main explanatory variable, and the local median rent as the dependent variable. The OneYearCollege are immigrants with at least one-year of college education, while HighSchool are immigrants with at most high school degree. The first column of this table replicates result in Ottaviano & Peri (2012). The second column adds Wharton Land Use Regulation index as an additional control. The third column adds the Wharton Land Use Regulation index and local natural amenities as additional controls. The last column adds the Wharton Land Use Regulation index and local natural amenity score as additional controls.

*** p<0.01, ** p<0.05, * p<0.1

Table 3.4: The Estimates of Immigrant Inflows on Local Hedonic Rent, 1980-2006

Dependent Variable: 10-year Changes of Local Hedonic Rent (in log-pts)

$\frac{\Delta F_t}{POP_{(t-1)}}$	OLS			
Immi Inflow	0.204	0.168	0.142	0.265
	(0.199)	(0.198)	(0.192)	(0.191)
OneYearCollege Immi Inflow	0.629***	0.608***	0.603***	0.595***
	(0.107)	(0.107)	(0.106)	(0.108)
HighSchool Immi Inflow	-0.124**	-0.138**	-0.178***	-0.144**
	(0.062)	(0.062)	(0.058)	(0.058)
	2SLS			
Immi Inflow	-0.230	-0.281	-0.396	-0.472
	(0.446)	(0.444)	(0.437)	(0.480)
OneYearCollege Immi Inflow	1.019***	1.002***	1.003***	0.914***
	(0.268)	(0.272)	(0.279)	(0.269)
HighSchool Immi Inflow	-0.218**	-0.239**	-0.364***	-0.409***
	(0.110)	(0.111)	(0.113)	(0.119)
Regulation	No	Yes	Yes	Yes
Amenities	No	No	Yes	No
Amenity Score	No	No	No	Yes
Observation	912	912	912	912

Notes: The table shows the estimates of total immigrant inflow, OneYearCollege immigrant inflow, or HighSchool immigrant inflow on local hedonic rent. The OneYearCollege are immigrants with at least one-year of college education, while HighSchool are immigrants with at most high school degree. The hedonic rent is measured using a hedonic regression with consideration of individual housing characteristics. The first column of this table uses the same specification in Ottaviano & Peri (2012). The second column adds Wharton Land Use Regulation index as an additional control. The third column adds the Wharton Land Use Regulation index and local natural amenities as additional controls. The last column adds the Wharton Land Use Regulation index and local natural amenity score as additional controls.

*** p<0.01, ** p<0.05, * p<0.1

Table 3.5: The Estimates of OneYearCollege and HighSchool Immigrant Inflows on Local Hedonic Rent in a Single Regression, 1980-2006

Dependent Variable: 10-year Changes of Local Hedonic Rent (in log-pts)

$\frac{\Delta F_t}{POP_{(t-1)}}$	**OLS**	**2SLS**
OneYearCollege Immi Inflow	0.938***	1.569***
	(0.111)	(0.340)
HighSchool Immi Inflow	-0.439***	-0.958***
	(0.055)	(0.154)
	2SLS First Stage	
	OneYearCollege Immi Inflow	HighSchool Immi Inflow
Imputed OneYearCollege Immi Inflow	0.283**	-0.042
	(0.110)	(0.053)
Imputed HighSchool Immi Inflow	0.025	0.233***
	(0.023)	(0.050)
F-stats	44.76	30.52
Regulation	Yes	Yes
Amenity Score	Yes	Yes
Observation	912	912

Notes: The table uses both the OneYearCollege immigrant inflow and the HighSchool immigrant inflow in the same regression. The OneYearCollege are immigrants with at least one-year of college education, while HighSchool are immigrants with at most high school degree. The hedonic rent is measured using a hedonic regression with consideration of individual housing characteristics. The full control variables including the Wharton Land Use Regulation index and the local natural amenity score are included.
*** p<0.01, ** p<0.05, * p<0.1

Table 3.6: The Estimates of Asian and Hispanic Immigrant Inflows on Local Hedonic Rent in a Single Regression, 1980-2006

Dependent Variable: 10-year Changes of Local Hedonic Rent (in log-pts)

$\frac{\Delta F_t}{POP_{(t-1)}}$	**OLS**	**2SLS**	**Reduced Form**
Asian Immi Inflow	3.412***	11.29*	0.936**
	(0.934)	(6.109)	(0.446)
Hispanic Immi Inflow	-0.660***	-1.295***	-0.176**
	(0.145)	(0.473)	(0.069)
All Other Immi Inflow	2.042***	0.062	2.195***
	(0.446)	(1.836)	(0.412)
Natives	0.150*	0.100	0.136
	(0.087)	(0.098)	(0.093)
		2SLS First Stage	
	Asian Immi Inflow	Hispanic Immi Inflow	
Imputed Asian Immi Inflow	0.062**		
	(0.030)		
Imputed Hispanic Immi Inflow		0.288***	
		(0.049)	
F-stats	25.41	31.95	
Regulation	Yes	Yes	Yes
Amenity Score	Yes	Yes	Yes
Observation	912	912	912

Notes: This table shows the estimates of Asian immigrant inflow and Hispanic immigrant inflow on local hedonic rent. The specification uses the Asian and the Hispanic immigrant inflows in the same regression. Asian immigration includes immigrants from China, Japan, and Korea. Hispanic immigration includes immigrants from Mexico, Central America, Caribbean, and South America. The hedonic rent is measured using a hedonic regression with consideration of individual housing characteristics. The full control variables including the Wharton Land Use Regulation index and the local natural amenity score are included.
*** p<0.01, ** p<0.05, * p<0.1

Table 3.7: The First Stage Estimates of Asian and Hispanic Immigrants by Education Groups, 1980-2006

Dependent Variable: immigrant inflows ($\frac{\Delta F_t}{POP_{(t-1)}}$)

	OneYearCollege Asian	OneYearCollege Hispanic	HighSchool Asian	HighSchool Hispanic
Imputed OneYearCollege Asian Immi Inflow	0.035**	-0.062	-0.002	-0.031
	(0.016)	(0.043)	(0.007)	(0.069)
Imputed OneYearCollege Hispanic Immi Inflow	0.052**	0.437***	0.004	-0.141
	(0.028)	(0.112)	(0.016)	(0.151)
Imputed HighSchool Asian Immi Inflow	-0.003	-0.134***	0.077**	-0.227
	(0.018)	(0.045)	(0.034)	(0.249)
Imputed HighSchool Hispanic Immi Inflow	0.008*	0.017	0.008	0.277***
	(0.004)	(0.017)	(0.004)	(0.059)
F-stats	23.92	26.86	12.85	24.29
Regulation	Yes	Yes	Yes	Yes
Amenity Score	Yes	Yes	Yes	Yes
Observation	912	912	912	912

Notes: This table shows the first stage estimates of Asian and Hispanic immigrants by education groups for the 2SLS estimates in Table 3.8. Asian immigration includes immigrants from China, Japan, and Korea. Hispanic immigration includes immigrants from Mexico, Central America, Caribbean, and South America. The OneYearCollge are immigrants with at least one year college education, while the HighSchool are immigrants with at most high school degree. The full control variables including the Wharton Land Use Regulation index and the local natural amenity score are included. *** p<0.01, ** p<0.05, * p<0.1

Table 3.8: The Estimates of OneYearCollege-educated and HighSchool-educated Asian and Hispanic Immigrants on Local Hedonic Rent in a Single Regression, 1980-2006

Dependent Variable: 10-year Changes of Local Hedonic Rent (in log-pts)

$\frac{\Delta F_t}{POP_{(t-1)}}$	**OLS**	**2SLS**	**Reduced Form**
OneYearCollege Asian Immi Inflow	2.092***	3.780	0.077
	(0.451)	(4.091)	(0.190)
HighSchool Asian Immi Inflow	0.442	3.091	0.293
	(0.535)	(3.030)	(0.207)
OneYearCollege Hispanic Immi Inflow	0.540***	1.250*	0.899***
	(0.161)	(0.696)	(0.217)
HighSchool Hispanic Immi Inflow	-0.429***	-1.033***	-0.208***
	(0.0602)	(0.206)	(0.042)
All Other Immi Inflow	1.362***	-0.0334	1.969***
	(0.383)	(1.625)	(0.401)
Natives	0.178*	0.192	0.154*
	(0.0913)	(0.129)	(0.092)
Regulation	Yes	Yes	Yes
Amenity Score	Yes	Yes	Yes
Observation	912	912	912

Notes: This table shows the estimates of OneYearCollege and HighSchool Asian and Hispanic immigrant inflows on local hedonic rent in a single regression. The specification uses all of the immigrant inflows in the same regression. Asian immigration includes immigrants from China, Japan, and Korea. Hispanic immigration includes immigrants from Mexico, Central America, Caribbean, and South America. The OneYearCollege are immigrants with at least one-year of college, while HighSchool are immigrants with at most high-school degree. The hedonic rent is measured using a hedonic regression with consideration of individual housing characteristics. The full control variables including the Wharton Land Use Regulation index and the local natural amenity score are included.
*** p<0.01, ** p<0.05, * p<0.1

Table 3.9: The Estimates of Asian and Hispanic Immigrants on Local Hedonic Rent with the Consideration of Immigration Location Dummies, 1980-2006

Dependent Variable: 10-year Changes of Local Hedonic Rent (in log-pts)

	OLS	**2SLS**	**Reduced Form**
$\frac{\Delta F_t}{POP_{(t-1)}}$			
OneYearCollege Asian Immi Inflow	2.082***	3.511	0.0561
	(0.447)	(4.249)	(0.183)
HighSchool Asian Immi Inflow	0.404	3.017	0.268
	(0.538)	(2.974)	(0.208)
OneYearCollege Hispanic Immi Inflow	0.600***	1.306*	0.913***
	(0.160)	(0.732)	(0.216)
HighSchool Hispanic Immi Inflow	-0.422***	-1.020***	-0.204***
	(0.060)	(0.206)	(0.041)
Asian Location Dummy	0.015	0.012	0.017
	(0.010)	(0.017)	(0.010)
Hispanic Location Dummy	-0.020**	-0.012	-0.022**
	(0.009)	(0.014)	(0.009)
All Other Immi Inflow	1.357***	0.075	1.994***
	(0.383)	(1.668)	(0.402)
Natives	0.179*	0.199	0.150
	(0.094)	(0.135)	(0.094)
Regulation	Yes	Yes	Yes
Amenity Score	Yes	Yes	Yes
Observation	912	912	912

Notes: This table adds location dummies to indicate the places where many Asian and Hispanic live into the estimates. The Asian Location Dummy sets PMSAs in California, New York, New Jersey, and Washington State as 1. And the Hispanic Location Dummy set PMSAs in California,New York, Texas, Florida, New Mexico, Arizona, and Washington States as 1. The specification still uses all of the immigrant inflows in the same regression. Asian immigration includes immigrants from China, Japan, and Korea. Hispanic immigration includes immigrants from Mexico, Central America, Caribbean, and South America. The OneYearCollege are immigrants with at least one-year of college, while HighSchool are immigrants with at most high-school degree. The hedonic rent is measured using a hedonic regression with consideration of individual housing characteristics. The full control variables including the Wharton Land Use Regulation index and the local natural amenity score are included.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 3.10: The Estimates of Asian and Hispanic Immigrants on Local Hedonic Rent in Metropolitan Areas Only, 1980-2006

Dependent Variable: 10-year Changes of Local Hedonic Rent (in log-pts)

$\frac{\Delta F_t}{POP_{(t-1)}}$	**OLS**	**2SLS**	**Reduced Form**
OneYearCollege Asian Immi Inflow	2.015***	2.892	0.125
	(0.411)	(3.636)	(0.189)
HighSchool Asian Immi Inflow	0.544	3.534	0.276
	(0.526)	(2.909)	(0.187)
OneYearCollege Hispanic Immi Inflow	0.602***	1.098*	1.022***
	(0.141)	(0.603)	(0.227)
HighSchool Hispanic Immi Inflow	-0.309***	-0.721***	-0.165***
	(0.055)	(0.187)	(0.037)
All Other Immi Inflow	1.454***	0.199	2.231***
	(0.357)	(1.618)	(0.371)
Natives	0.384***	0.414***	0.369***
	(0.085)	(0.114)	(0.088)
Regulation	Yes	Yes	Yes
Amenity Score	Yes	Yes	Yes
Observation	795	795	795

Notes: This table shows the estimates of OneYearCollege and HighSchool Asian and Hispanic immigrant inflows on local hedonic rent in PMSAs only. Therefore, the sample size reduces. The specification uses all of the immigrant inflows in the same regression. Asian immigration includes immigrants from China, Japan, and Korea. Hispanic immigration includes immigrants from Mexico, Central America, Caribbean, and South America. The OneYearCollege are immigrants with at least one-year of college, while HighSchool are immigrants with at most high-school degree. The hedonic rent is measured using a hedonic regression with consideration of individual housing characteristics. The full control variables including the Wharton Land Use Regulation index and the local natural amenity score are included.
*** p<0.01, ** p<0.05, * p<0.1

Table 3.11: The Estimates of Asian and Hispanic Immigrants on Local Hedonic Rent in Metropolitan and Metropolitan-Adjacent Areas Only, 1980-2006

Dependent Variable: 10-year Changes of Local Hedonic Rent (in log-pts)

$\frac{\Delta F_t}{POP_{(t-1)}}$	**OLS**	**2SLS**	**Reduced Form**
OneYearCollege Asian Immi Inflow	2.116***	4.067	0.085
	(0.436)	(4.001)	(0.184)
HighSchool Asian Immi Inflow	0.420	3.209	0.290
	(0.521)	(2.992)	(0.196)
OneYearCollege Hispanic Immi Inflow	0.554***	1.119*	0.840***
	(0.152)	(0.675)	(0.207)
HighSchool Hispanic Immi Inflow	-0.387***	-0.911***	-0.174***
	(0.059)	(0.206)	(0.039)
All Other Immi Inflow	1.382***	-0.204	2.087***
	(0.366)	(1.649)	(0.385)
Natives	0.290***	0.309**	0.264***
	(0.089)	(0.129)	(0.090)
Regulation	Yes	Yes	Yes
Amenity Score	Yes	Yes	Yes
Observation	852	852	852

Notes: This table shows the estimates of OneYearCollege and HighSchool Asian and Hispanic immigrant inflows on local hedonic rent in PMSAs and PMSA-adjacent areas only. Therefore, the sample size reduces. The specification uses all of the immigrant inflows in the same regression. Asian immigration includes immigrants from China, Japan, and Korea. Hispanic immigration includes immigrants from Mexico, Central America, Caribbean, and South America. The OneYearCollege are immigrants with at least one-year of college, while HighSchool are immigrants with at most high-school degree. The hedonic rent is measured using a hedonic regression with consideration of individual housing characteristics. The full control variables including the Wharton Land Use Regulation index and the local natural amenity score are included.
*** p<0.01, ** p<0.05, * p<0.1

Table 3.12: The Estimates of Asian and Hispanic Immigrants on Local Hedonic Rent Separately in High and Low Rent Areas, 1980-2006

Dependent Variable: 10-year Changes of Local Hedonic Rent (in log-pts)

	High Price Areas			**Low Price Areas**		
	OLS	**2SLS**	**Reduced Form**	**OLS**	**2SLS**	**Reduced Form**
$\frac{\Delta F_t}{POP_{(t-1)}}$						
OneYearCollege Asian Immi Inflow	1.656***	7.465*	0.997**	2.094**	-7.667	-0.161
	(0.480)	(4.285)	(0.492)	(1.063)	(11.37)	(0.121)
HighSchool Asian Immi Inflow	0.658	2.339	0.421	1.062	0.503	0.00278
	(0.603)	(3.266)	(0.292)	(1.051)	(16.85)	(0.190)
OneYearCollege Hispanic Immi Inflow	0.609***	0.342	1.347***	0.0423	1.682	0.384*
	(0.177)	(1.045)	(0.263)	(0.325)	(1.082)	(0.210)
HighSchool Hispanic Immi Inflow	-0.245***	-0.950**	-0.270***	-0.512***	-1.095**	-0.171***
	(0.0661)	(0.439)	(0.0588)	(0.137)	(0.461)	(0.0491)
All Other Immi Inflow	1.437***	-1.468	2.051***	0.996	2.072	0.762
	(0.472)	(2.275)	(0.454)	(0.679)	(2.199)	(0.701)
Natives	0.256**	0.361*	0.158	0.155	0.478	0.272*
	(0.124)	(0.185)	(0.120)	(0.143)	(0.415)	(0.140)
Regulation	Yes	Yes	Yes	Yes	Yes	Yes
Amenity Score	Yes	Yes	Yes	Yes	Yes	Yes
Observation	459	459	459	453	453	453

Notes: This table shows the estimates of OneYearCollege and HighSchool Asian and Hispanic immigrant inflows on local hedonic rent separately in high price and low price areas. The high price areas are defined as places where housing prices are higher than median value in year 1970. And the remaining places are low price areas. The specification still uses all of the immigrant inflows in the same regression. Asian immigration includes immigrants from China, Japan, and Korea. Hispanic immigration includes immigrants from Mexico, Central America, Caribbean, and South America. The OneYearCollege are immigrants with at least one-year of college, while HighSchool are immigrants with at most high-school degree. The hedonic rent is measured using a hedonic regression with consideration of individual housing characteristics. The full control variables including the Wharton Land Use Regulation index and the local natural amenity score are included.
*** p<0.01, ** p<0.05, * p<0.1

Table 3.13: The Estimates of Asian and Hispanic Immigrants on Local Renting Rates of Natives, 1980-2006

Dependent Variable: 10-year Changes of Local Renting Rate of OneYearCollege or HighSchool Natives

	OneYearCollege Natives		**HighSchool Natives**	
	OLS	**2SLS**	**OLS**	**2SLS**
$\frac{\Delta F_t}{POP_{(t-1)}}$	**All Immigrants**			
Asian Immi Inflow	-0.568	0.081	-0.173	0.064
	(1.857)	(0.198)	(1.214)	(0.199)
Hispanic Immi Inflow	-0.071	-0.144***	-0.053	-0.068
	(0.141)	(0.042)	(0.098)	(0.042)
	By Education Groups			
OneYearCollege Asian Immi Inflow	0.029	0.094	-0.353	0.005
	(0.733)	(0.144)	(0.748)	(0.128)
HighSchool Asian Immi Inflow	0.868	0.014	-0.340	0.075
	(0.690)	(0.122)	(0.513)	(0.125)
OneYearCollege Hispanic Immi Inflow	-0.119	-0.050	-0.044	-0.006
	(0.147)	(0.050)	(0.147)	(0.049)
HighSchool Hispanic Immi Inflow	-0.076*	-0.064***	-0.015	-0.039**
	(0.042)	(0.016)	(0.033)	(0.016)
Regulation	Yes	Yes	Yes	Yes
Amenity Score	Yes	Yes	Yes	Yes
Observation	912	912	912	912

Notes: This table shows the estimates of Asian and Hispanic immigrant inflows on local renting rates of natives. The local renting rate of natives is defined as $\frac{N\_rent}{N\_rent+N\_own}$ where the N_rent is the number of natives who rent a house, while N_own is the number of natives who own a house. Asian immigration includes immigrants from China, Japan, and Korea. Hispanic immigration includes immigrants from Mexico, Central America, Caribbean, and South America. The OneYearCollege are people with at least one-year of college education, while HighSchool are people with at most high school degree. The specification uses the Asian and the Hispanic immigrant inflows by education group in the same regression. The full control variables including the Wharton Land Use Regulation index and the local natural amenity score are included.

*** p<0.01, ** p<0.05, * p<0.1

Appendix A

Labor Demand Solution

In the appendix, I derive the labor demand functions (1), (2) and the rent function (3) in the spatial model. I only derive the demand function (2) for the non-tradable sector and the rent function (3) here because the derivation of the demand function (1) follows the same process.

Consider any sector in region r with industries i=1,...,N in non-tradable sector. Each industry i use labor, land and imported intermediate inputs to produce $Y_{ri} = A_{ri}(L_{ri}^{\rho} + I_i^{\rho} + K_{ri}^{\rho})^{\frac{1}{\rho}}$. Let a_{Lri}, a_{Kri} and a_{Iri} as required quantities of labor input, land input and imported intermediate input in producing one unit of industry i's output respectively. Suppressing the region subscript r from then on in this section, the factor market clearing conditions are

$$a_{Ii}Y_i = I_i, \forall i$$

$$\sum_i a_{Li}Y_i = L$$

$$\sum_i a_{Ki}Y_i = K$$

where L and K are labor and land available in the region. Totally differentiating the three equations gives

$$\hat{Y_i} = -\hat{a_{Ii}} + \hat{I_i} \tag{A1}$$

$$\sum_i \lambda_{Li}(\hat{a_{Li}} + \hat{Y_i}) = \hat{L} \tag{A2}$$

$$\sum_i \lambda_{Ki}(\hat{a_{Ki}} + \hat{Y_i}) = \hat{K} \tag{A3}$$

where $\lambda_{Li} = \frac{L_i}{L}$, $\lambda_{Ki} = \frac{K_i}{K}$. Combining (A1) with (A2), and (A1) with (A3) provides

$$\sum_i \lambda_{Li}(\hat{a_{Li}} - \hat{a_{Ii}} + \hat{I_i}) = \hat{L} \quad (A4)$$

$$\sum_i \lambda_{Ki}(\hat{a_{Ki}} - \hat{a_{Ii}} + \hat{I_i}) = \hat{K} \quad (A5)$$

According to the definition of elasticity of substitution among inputs, we can write down $\hat{a_{Li}} - \hat{a_{Ii}} = \sigma_i(\hat{R_{Ii}} - \hat{W_i})$, $\hat{a_{Ki}} - \hat{a_{Ii}} = \sigma_i(\hat{R_{Ii}} - \hat{R})$. Here R_{Ii} and R are imported intermediate input price in industry i and land rental price. Substituting the elasticity equations into (A4) and (A5) gets

$$\sum_i \lambda_{Li}(\hat{I_i} + \sigma_i(\hat{R_{Ii}} - \hat{W_i})) = \hat{L} \quad (A6)$$

$$\sum_i \lambda_{Ki}(\hat{I_i} + \sigma_i(\hat{R_{Ii}} - \hat{R})) = \hat{K} \quad (A7)$$

Because we assume all markets are perfect competitive, output price should equals the total factor cost. The identity below follows

$$a_{Li}W_i + a_{Ii}R_{Ii} + a_{Ki}R = P_i, \forall i$$

Denoting θ_{Li} and θ_{Ki} as industry i's cost share of labor and capital inputs. The cost minimization gives

$$\theta_{Li}\hat{W_i} + \theta_{Ki}\hat{R} + (1 - \theta_{Li} - \theta_{Ki})\hat{R_{Ii}} = \hat{P_i}, \forall i \quad (A8)$$

Where $\hat{P_i}$ is the price of the produced good, and $\hat{W_i}$ is industry i's wage.

In order to solve system of equations (A6), (A7) and (A8) implicitly, we need to assume labor is homogeneous for different industries in any region. The system of equations is, thus

$$\begin{pmatrix} 1-\Theta & \Theta \\ \lambda'\sigma & \Omega \end{pmatrix} \begin{pmatrix} R_I \\ R_M \end{pmatrix} = \begin{pmatrix} \hat{P} \\ \hat{M} \end{pmatrix}$$

Where $1-\Theta = \begin{pmatrix} 1-\theta_{L1}-\theta_{K1} & 0 & ... & 0 \\ 0 & 1-\theta_{L2}-\theta_{K2} & ... & 0 \\ . & . & & . \\ . & & . & . \\ . & & & . \\ 0 & 0 & ... & 1-\theta_{LN}-\theta_{KN} \end{pmatrix}$, $\Theta = \begin{pmatrix} \theta_{K1} & \theta_{L1} \\ \theta_{k2} & \theta_{L2} \\ . & . \\ . & . \\ . & . \\ \theta_{KN} & \theta_{LN} \end{pmatrix}$,

$\Omega = \begin{pmatrix} -\sum_i \lambda_{Ki}\sigma_i & 0 \\ 0 & -\sum_i \lambda_{Li}\sigma_i \end{pmatrix}$, $R_I = \begin{pmatrix} R_{I1} \\ R_{I2} \\ . \\ . \\ . \\ R_{IN} \end{pmatrix}$, $R_M = \begin{pmatrix} \hat{R} \\ \hat{W} \end{pmatrix}$, $\hat{P} = \begin{pmatrix} \hat{P}_1 \\ \hat{P}_2 \\ . \\ . \\ . \\ \hat{P}_N \end{pmatrix}$,

$\hat{M} = \begin{pmatrix} \hat{K} - \sum_i \lambda_{Ki}\hat{I}_i \\ \hat{L} - \sum_i \lambda_{Li}\hat{I}_i \end{pmatrix}$.

Solving for $\hat{W}_r$ and $\hat{R}_r$ gives

$$\hat{W}_r = -d_{1r}\hat{L}_r + d_{2r}\hat{K}_r + d_{3r}\sum_i \rho_{ri}\hat{P}_i - d_{4r}\sum_i a_{ri}\hat{I}_i \qquad (A9)$$

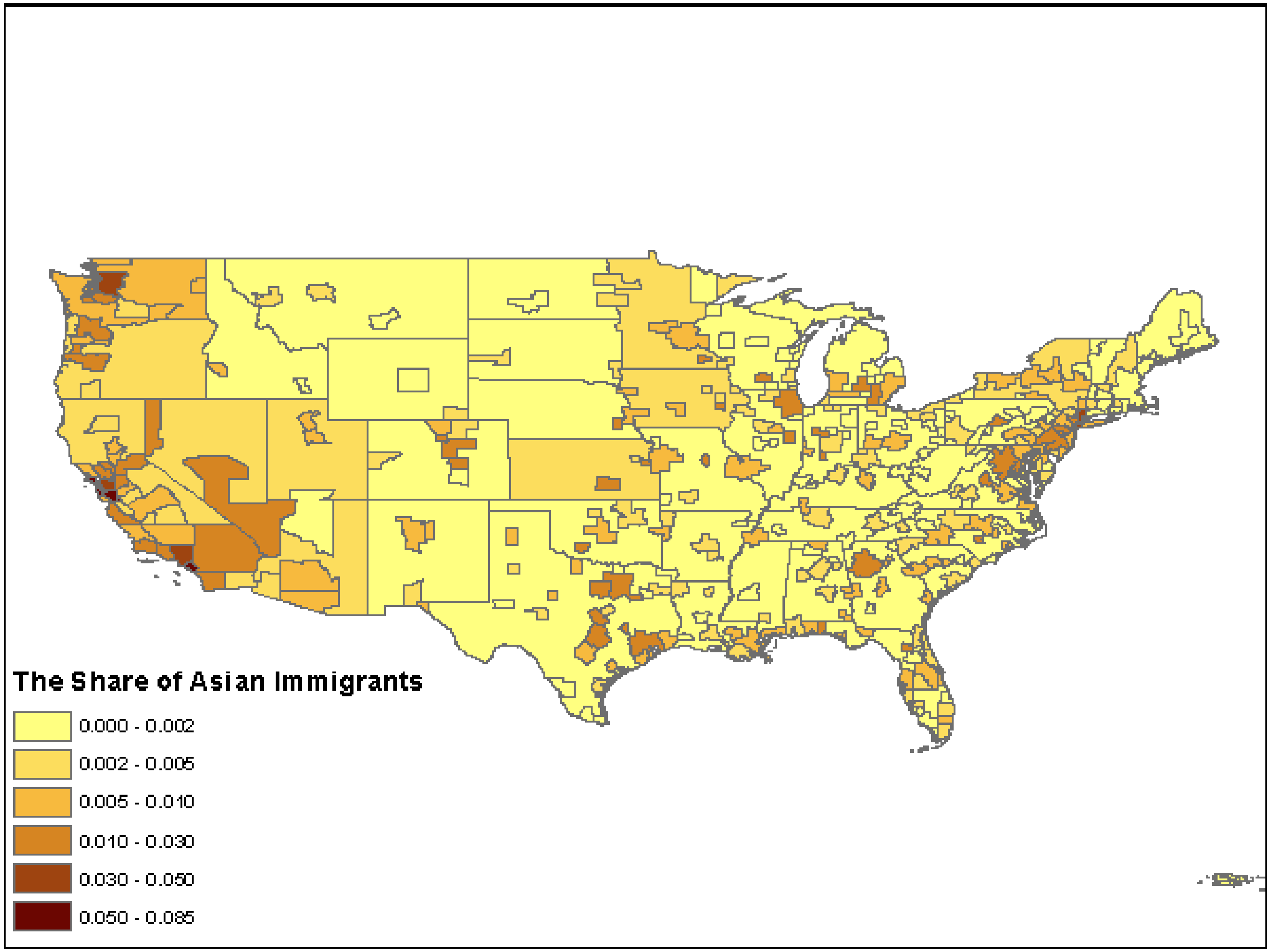
$$\hat{R}_r = -e_{1r}\hat{L}_r + e_{2r}\hat{K}_r + e_{3r}\sum_i \rho_{ri}\hat{P}_i - e_{4r}\sum_i a_{ri}\hat{I}_i \qquad (A10)$$

Where $a_{ri} = \frac{L_{ri}}{L_i L_r}$ with L_i as national employment for industry i, L_{ri} as local employment for industry i, and L_r as total local employment. By assuming local land is fixed, I can get rid of the $\hat{K}_r$ term in the equations. The parameter d_{4r} and e_{4r} are functions of elasticity of substitution, i.e. $d_{4r} = F_1(\rho)$ and $e_{4r} = F_2(\rho)$ with $F_1'(\rho) < 0$ and $F_2'(\rho) < 0$. Following the model, the local import is, thus, defined as $IMP_r = \sum_i a_{ri}\hat{I}_i$. The two equations (A9) and (A10) are then exactly the equations (2) and (3) in Chapter 2.

Appendix B

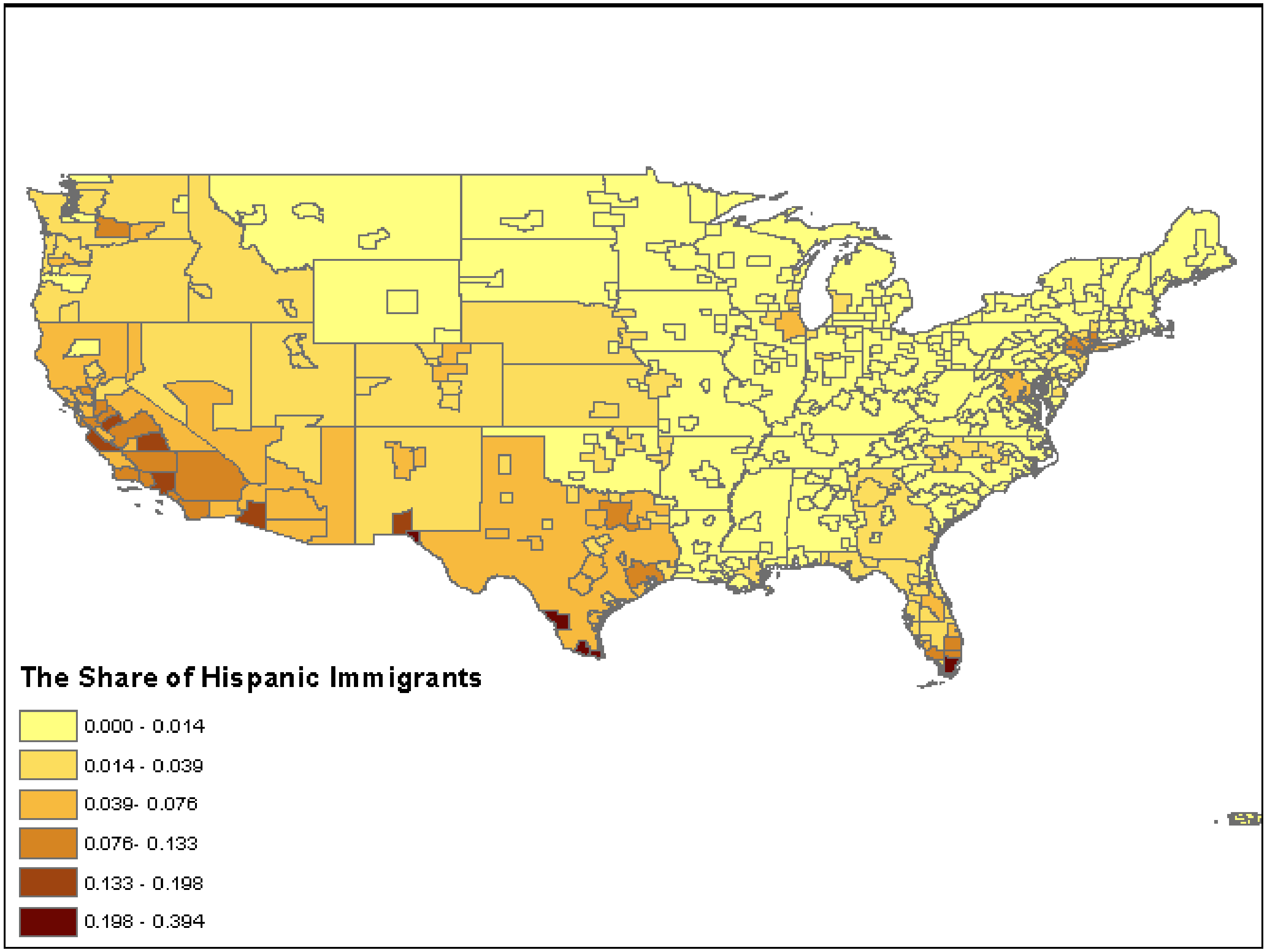
Distributions of Asian and Hispanic Immigrants in U.S.

Figure B.1: The Distribution Map of Asian Immigrants



Notes: The map shows the distribution of Asian immigrants across U.S. MSAs. The Asian immigrants in the chapter includes immigrants from China, Japan, and Korea. The immigrant share is defined as $\frac{F_{rt}}{POP_{rt}}$, where F is local Asian immigrant count and POP is local total population. The share is an average of immigrant shares in year 1980, 1990, 2000 and 2006. Areas with darker color have more Asian immigrants on average. The figure is created using ArcGIS.

Figure B.2: The Distribution Map of Hispanic Immigrants



Notes: The map shows the distribution of Hispanic immigrants across U.S. MSAs. The Hispanic immigrants in this chapter include immigrants from Mexico, Central America, Caribbean, and South America. The immigrant share is defined as $\frac{F_{rt}}{POP_{rt}}$, where F is local Hispanic immigrant count and POP is local total population. The share is an average of immigrant shares in year 1980, 1990, 2000 and 2006. Areas with darker color have more Hispanic immigrants on average. The figure is created using ArcGIS.

Bibliography

Albouy and Lue (forthcoming). "Driving to Opportunity: Local Wages, Commuting, and Sub-Metropolitan Quality of Life". American Economics Review.

Altonji and Card (2007). "The effects of immigration on the labor market outcomes of less-skilled natives". Immigration, Trade, and the Labor Market, 201.

Amiti and Wei (2005). "Fear of Service Outsourcing: Is It Justified?". Economic Policy, 20(42), 308-347.

Amiti and Wei (2009). "Service offshore and Productivity: Evidence from the US". The World Economy, 32(2), 203-220.

Artuc, Chaudhuri and McLaren (2010). "Trade Shocks and Labor Adjustment: A structural Empirical Approach". American Economic Review, 100(3), 1008-1045.

Autor and Acemoglu (2010). "Skills, Tasks and Technologies: Implications for Employment and Earnings". In Orley Ashenfelter and David Card, eds., Handbook of Labor Economics, 4, 1043-1171.

Autor, Dorn and Hanson (2013). "The China Syndrome: Local Labor Market Effects of Import Competition in the United States". American Economic Review, 103(6), 2121-2168.

Autor and Dorn (2013). "The Growth of Low Skill Service Jobs and the Polarization of the U.S. Labor Market". American Economic Review, 103(5), 1553-1597.

Autor and Dorn (2009). "This Job is "Getting Old": Measuring Changes in Job Opportunities Using Occupational Age Structure". American Economics Review Papers and Proceedings, 99(2), 45-51.

Autor, Katz and Kearney (2008). "Trends in U.S. Wage Inequality: Revising the Revisionists". Review of Economics and Statistics, 90(2), 300-323.

Bartel (1989). "Where do the new us immigrants live?". Journal of Labor Economics, 371-391.

Borjas (1995). "The Economic Benefits from Immigration". The Journal of Economic Perspectives, 9(2), 3-22.

Borjas (1999). "The economic analysis of immigration". Handbook of Labor Economics, (3), 1697-1760.

Borjas (2003)."The Labor Demand Curve is Downward Sloping: Reexamining the Impact of Immigration on the Labor Market". The Quarterly Journal of Economics, 118, 133574.

Borjas (2006). "Native Internal Migration and the Labor Market Impact of Immigration". The Journal of Human Resources, 41(2), 221258.

Calomiris, Longhofer and Miles (2012). "The housing wealth effect: The crucial roles of demographics, wealth distribution and wealth shares". National Bureau of Economic Research Working Series.

Card (1990). "The impact of the Mariel boatlift on the Miami labor market". Industrial and Labor Relations Review, 43(2), 245-257.

Card (2001). "Immigrant inflows, native outflows, and the local labor market impacts of higher immigration". Journal of Labor Economics, 19(1), 22-64.

Card (2005). "Is the New Immigration Really So Bad?" The Economic Journal, 115(507), F300F323.

Card and DiNardo (2000). "Do Immigrant Inflows Lead to Native Outflows?". American Economic Review, 90(2), 360367.

Charles, Hurst and Notowidgo (2013). "Manufacturing Decline, Housing Booms, and Non-Employment". National Bureau of Economic Research Working Series.

Charles, Hurst and Notowidgo (2014). "Housing Booms, Labor Market Outcomes, and Education Attainment". National Bureau of Economic Research Working Series.

Chang and Gurbaxani (2012). "Information Technology Outsourcing, Knowledge Transfer, and Firm Productivity: An Empirical Analysis". MIS Quarterly, 36(4), 1043-1063.

Chen and Portnoy (1996). "Two-stage regression quantiles and two-stage trimmed least squares estimators for structural equation models". Communications in Statistics-theory and Methods, 25(5), 1005-1032.

Chiquiar and Hanson (2005). "International migration, self-selection, and the distribution of wages: Evidence from Mexico and the United States". Journal of Political Economy, 113(2).

Chongvilaivan and Hur (2011). "Outsourcing Labour productivity and Wage Inequality in the U.S. : a Primal Approach". Applied Economics, 43, 487-502.

Cortes (2008). "The Effect of Low-Skilled Immigration on U.S. Prices: Evidence from CPI Data". Journal of Political Economy, 116(3), 381-422.

Crino (2009). "Service Offshore and White-Collar Employment". The Review of Economic Study, 77, 595-632.

Dix-Carneiro (2014). "Trade Liberalization and Labor Market Dynamics". Econometrica, 82(3), 825-885.

Feenstra and Hanson (1996). "Globalization, Outsourcing, and Wage Inequality". AEA Papers and Proceedings, 240-245.

Feenstra and Hanson (1999). "The Impact of Outsourcing and High-Technology Capital on Wages: Estimates for the United States, 1979-1990". The Quarterly Journal of Economics, 907-940.

Feenstra and Hanson (2003). "Global Production Sharing and Rising Inequality: A Survey of Trade and Wages". Kwan Choi and James Harrigan, eds., Handbook of International Trade, Basil Blackwell.

Ferreira, Fernando and Gyourko (2012). "Heterogeneity in Neighborhood-Level Price Growth in the United States, 1993-2009". American Economic Review 102(3), 134-140.

Firpo, Fortin and Lemieux (2010). Occupational Tasks and Changes in the Wage Structure. SSRN Research Paper.

F.R.Casas (1984). "Imperfect factor mobility: a generalization and synthesis of two-sector models of international trade". Canadian Journal of Economics, 8(4), 747-761.

Glaeser, Gyourko, Morales and Nathanson (2014). "Housing Dynamics: An Urban Approach". Journal of Urban Economics, 81, 45-56.

Gyourko, Mayer and Sinai (2013). "Superstar Cities". American Economic Journal: Economic Policy, 5(4), 167-199.

Gyourko, Saiz and Summers (2008). "A New Measure of the Local Regulatory Environment for Housing Markets: The Wharton Residential Land Use Regulatory Index". Urban Study, 45(3), 693-729.

Harrison and McMillan (2011). "offshore Jobs? Multinational and U.S. Manufacturing Employment". The Review of Economics and Statistics, 857-875.

Holmes and Snider (2011). "A Theory of Outsourcing and Wage Decline". American Economic Journal: Microeconomics, 3, 38-59.

Jensen and Kletzer (2007). "Measuring the Task Content of Offshorable Service Jobs, Tradable Services and Job Loss". Peterson Institute for International Economics.

Jones (1975). "Income Distribution and Effective Protection in a Multicommodity Trade Model". Journal of Economic Theory 11. 1-15.

Kambourov and Manovskii (2009). "Occupational Mobility and Wage Inequality". Review of Economic Studies, 76, 731-759.

Kambourov and Manovskii (2009). "Occupational Specificity of Human Capital". International Economic Review, 50(1), 63-115.

Kerr and Kerr (2011). "Economic impacts of immigration: A survey". National Bureau of Economic Research Working Series.

Kovak (2013). "Regional Effects of Trade Reform: What is the Correct Measure of Liberalization?". American Economics Review, 103(5), 1960-1976.

Krugman (2008). "Trade and Wages, Reconsidered". Brooking Papers on Economic Activity, Spring, 103-137.

Lee and Lin (2013). "Natural Amenities, Neighborhood Dynamics, and Persistence in the Spatial Distribution of Income". Federal Reserve Bank of Philadelphia Working Paper.

Lemieux (2006). "Increasing Residual Wage Inequality: Composition Effects, Noisy Data, or Rising Demand for Skill?". American Economic Review, 96(3), 461-498.

Liu and Trefler (2008). "Much Ado about Nothing: American Jobs and the Rise of Service Outsourcing to China and India". National Bureau of Economic Research Working Paper Series.

Longhi, Nijkamp and Poot (2006). "The impact of immigration on the employment of natives in regional labour markets: A meta-analysis". IZA Working Paper.

Mian and Sufi (2014). "What Explains the 2007-2009 Drop in Employment?". National Bureau of Economic Research Working Paper Series.

Ottaviano and Peri (2006). "Rethinking the Effect of Immigration on Wages". Journal of the European Economic Association, 10(1), 152-197.

Ottaviano and Peri (2012). "The effects of immigration on US wages and rents: a general equilibrium approach". Migration Impact Assessment, chapter 3, 107-146.

Parai and Beladi (1997). "Imperfect Labor Mobility and Unemployment in LDCs". Southern Economic Journal, 64(1), 180-190.

Peri (2007). "Immigrants' complementarities and native wages: Evidence from California". National Bureau of Economic Research Technical report.

Saiz (2003). "Room in the kitchen for the melting pot: Immigration and rental prices". Review of Economics and Statistics, 85(3), 502-521.

Saiz (2007). "Immigration and housing rents in American cities". Journal of Urban Economics, 61(2), 345-371.

Saiz (2010). "The Geographic Determinants of housing supply". The Quarterly Journal of Economics, 125(3), 1253-1296.

Saiz and Wachter (2011). "Immigration and the neighborhood". American Economic Journal: Economic Policy, 169-188.

Topalova (2007). "Trade Liberalization, Poverty and Inequality: Evidence from Indian Districts". National Bureau of Economic Research Chapters, in: Globalization and Poverty, 291-336.

Wang, Gwebu and Wang (2008). "The Aftermath of Information Technology Outsourcing: An Empirical Study of Firm Performance Following Outsourcing Decisions". Journal of Information Systems, 22, 125-159.