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Globalization, migration and the U.S. labor market for physicians: The impact of immigration on local wages

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Globalization, Migration and the U.S. Labor Market for Physicians:

The Impact of Immigration on Local Wages

by

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Dedication

I would like to dedicate this dissertation to my husband, Joel, and to my parents, Karl and Carolyn Riedl. To my husband Joel, for being there for me throughout the entirety of my graduate studies, for sympathizing with me during times of stress and always understanding when the demands of my academic life took priority over those at home, I owe you a great deal of thanks. You never doubted that I would succeed in this endeavor and the experience was made so much more enjoyable with your love and encouragement throughout. I also thank my parents, who always encouraged me to reach as high as possible, not only with regard to education but also in life. Without your guidance, I would not have had the maturity and dedication required to achieve this goal. You always remind me that I am capable of anything I wish to accomplish as long as I put my mind to it, and always believed in my ability to succeed. I am blessed to have such a wonderful family support system.

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ABSTRACT

The healthcare labor market has experienced some significant changes in the last half century, including the establishment of Medicare and Medicaid in 1965, the emergence of managed care in the 1980s, and the worldwide mobility of labor encouraged by globalization. Currently, more than 25% of physicians working in the U.S. are foreign-born. The existing body of literature related to the impact of immigration on local wages has to date found conflicting results. The purpose of this research is to evaluate the impact of immigration of foreign physicians on local physician wages. This study employs physician survey data from the AMA Physician Masterfile for the years 1997 through 2007 combined with wage data published by the Bureau of Labor Statistics and data from other government sources. Several econometric models are employed to analyze the wage impacts of immigration, including ordinary least squares, fixed effects, two-stage least squares and a first-difference approach to control for endogenous location choice.

The results of this study provide evidence that in the short-run, the impacts of immigration of physicians on area wages is small but positive. In the long run, however, wages adjust and the impact becomes negative and statistically significant, although the magnitude of the impact of a one percentage point increase in the share of immigrant

physicians in an area is less than 0.2%. The negative wage effects of immigration tend to be larger for foreign-born physicians educated in the U.S. compared with foreign-born international medical graduates.

The study also finds evidence that the negative effects of immigration tend to be offset by outflows of the lowest paid native physicians. Furthermore, physicians tend to locate in areas where wages are already higher, and foreign-born physicians are more likely than their native counterparts to work in larger cities as opposed to rural areas.

The research has important policy implications in the presence of current debate over immigration law and healthcare reform and in an era of increasing mobility of labor due to globalization.

Preface

I would like to express my gratitude to everyone who helped make this dissertation possible. I would like to thank my dissertation committee members: Donald Bellante, Ph.D., Mark Herander, Ph.D., and Murat Munkin, Ph.D. for taking the time to serve on my committee, review my research and provide their expert advice. I would especially like to thank my major professor, Gabriel Picone, Ph.D., for spending countless hours of his busy schedule assisting me in this research. I would not have been able to complete this study without his expert knowledge and guidance.

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Chapter 1: Introduction

The market for labor in the medical care industry has experienced some significant changes in the last half century. The establishment of Medicare and Medicaid in 1965, followed by the emergence of managed care in the 1980s, has dramatically changed the way physicians operate their practices and receive payment. Furthermore, globalization has encouraged worldwide mobility of labor and the U.S. labor market for medical professionals no longer consists only of native workers; on the contrary, data published in the 2009 Statistical Abstract of the United States indicate that as of 2006, more than 25% of physicians in the U.S. were educated at foreign medical schools. In addition, many graduates of U.S. medical schools are foreign students who often stay in the U.S. after achieving their degree. The following research analyzes immigrant doctors: who are they demographically, where do they come from, and where do they locate? Furthermore, this paper investigates the impact of physician immigration on the average wages of doctors in the U.S.

Chapter 2: Globalization and Immigration

2.1: Migration in the Contemporary Period

One important feature of modern globalization involves migration. The world has seen recent growth in immigration to developed countries. The number of working-age individuals born in one country and living in another country increased from 42 million in 1990 to 59 million in 2000, or 1.7 million per year, on average (Docquier 2005). According to Massey and Taylor (2004), “contemporary international migration unfolds in a context of the globalization of markets.” Castles and Miller (1998) posit, “while movements of people across borders have shaped states and societies since time immemorial, what is distinctive in recent years is their global scope, their centrality to domestic and international politics and their enormous economic and social consequences.” The United States is by far the world’s largest immigrant destination. Although the relative intensity of immigration into the U.S. was greater in the 19th century than in the contemporary period of globalization, there has been a change in the *kind* of migrant in the contemporary period. Changes in U.S. immigration law since 1952 have resulted in an increase in immigration of high-skilled workers as well as persons from Asia and Latin America.

2.2: History of Immigration and Immigration Law in the U.S.

In 1952, the Immigration and Nationality Act (INA), the first legislation emphasizing labor qualification as a preference for entry into the United States, became law. Amendments to the Immigration and Nationality Act in 1965 opened the doors to immigrants from non-European countries including Asians and Latin Americans. The 1990 Immigration Act was designed to increase the number of immigrants admitted on the basis of skill level, but also maintained the importance of family reunion and refugee acceptance (Gardner and Bouvier 1990, Castles and Miller 1998). Current immigration law provides preferential treatment to family members of U.S. citizens, and otherwise allows for immigration of three types of immigrants: employment based immigrants with their spouses and children, refugees and asylum seekers, and diversity immigrants (immigrants from countries which have been underrepresented in recent immigration) (Massey 2004).

2.3: Changes in Immigration in the Contemporary Period

Prior to World War II, most U.S. immigrants were low-skilled workers employed in "menial jobs in the public services and dirty jobs in the manufacturing sector" (Held 1999). As a result of the changes in legislation since 1952, increasing numbers of migrants are employed in private and domestic service industries. Furthermore, a steady movement of highly skilled, highly trained professionals ("elite migrants") has been occurring (Held 1999). This phenomenon has been referred to in the development economics literature as the "brain drain" from developing to developed countries. In addition to the changes in legislation, Castles and Miller (1998) argue that an increase in the international mobility of highly qualified personnel, in both temporary and permanent flows, is also attributable to globalization. The Immigration Act of 1990 further emphasized selection of high-skilled workers, employing a system of quotas favoring candidates with academic degrees or specific professional skills (Docquier 2005). According to the 2005-07 American Community Surveys, 19.1% of foreign-born U.S. citizens had a bachelor's degree, compared with 17.4% of native U.S. citizens (only 12.9% of foreign-born *non*-U.S. citizens living in the United States had a bachelor's degree). Furthermore, 12.6% of foreign-born U.S. citizens and 9.3% of foreign-born non-U.S. citizens living in the U.S. had advanced degrees beyond the bachelor's, compared with 9.7% of native U.S. citizens. The immigrants possessing bachelor's degrees or higher overwhelmingly come from Asia.

The largest migration of Asians in recent history occurred after the passage of the 1965 amendments to immigration law. The number of migrants from Asia increased from 17,000 in 1965 to more than 250,000 on average annually in the 1980s, to over 350,000 per year in the early 1990s. In addition, the number of Asian students studying in the U.S. increased from 82,709 in 1965 to 453,787 in 1995. This statistic is important, because it is not uncommon for students to come to America to study and eventually stay in the country; in the late 1960s, 90% of students from Taiwan and Korea who came to the U.S. for training never returned home. Since 1980, more than half of all U.S. doctorates awarded in the field of engineering have gone to foreigners, predominantly Asian. According to the 1990 Census, over 60% of immigrants over age 25 from Taiwan and India had college degrees, and over 45% of the immigrants from these countries hold management or professional positions (Castles 1998, Massey 2004).

Waldinger and Gilbertson (1994) report that in the 1980s, "a substantial portion of the new immigrants is far more highly skilled than native whites of native parentage." They found that Asian and Iranian immigrants, in particular, had substantially higher levels of education, on average, than their native white counterparts. However, of non-European immigrants, only the Japanese had higher average per capita income than the native white population. According to Madhavan (1985), "the occupational composition of Indian immigrants in the United States was much more professionally and technically oriented than the U.S. labor force as a whole. Over 80 percent of the Indian immigrant labor force in 1981 was engaged in professional, technical, and management categories of employment… as against 27 percent for the nation as a whole."

Chapter 3: Literature Review

3.1: The Effect of Immigration on Native/Local Wages

Immigration law is currently a topic of national debate in the United States. The U.S. Census Bureau estimates that from July 1, 2007 to July 1, 2008, 888,825 people immigrated legally to the United States. This represents 32% of the total change in population, after considering births and deaths of the native population. Much of the current debate involves illegal immigration, and the impact that both legal and illegal immigration have on the wages and employment of native citizens.

Although numerous studies have focused on the effect of immigration on wages and employment, particularly with regard to low-skilled workers, no consensus on the issue has yet been reached. Basic economic theory posits that an increase in the supply of low-skilled (high-skilled) workers should result in a decrease in the wage of low-skilled (high-skilled) workers, all else being equal. If a shift in the supply of labor decreases wages and thus increases employment, the country experiences a gain in national income, or *immigration surplus*. Borjas (1995) illustrates that the immigration surplus is proportional to the demand elasticity of factor price for labor. The greater the impact of immigration on wages, the *higher* the gain to the nation as a whole. Borjas reports that studies summarized in Hamermesh (1993) indicate that the demand elasticity of factor price is greater for skilled workers than unskilled workers; this would suggest that immigration of high-skilled workers would have a greater impact on wages of native high-skilled workers than immigration of low-skilled workers would have on wages of native low-skilled workers. Thus, the immigration surplus would be larger when immigrants are more skilled. Furthermore, skilled labor is likely to have production complementarities with capital, which adds to the potential immigration surplus. However, these results rely on the result that immigration shifts the labor supply curve and decreases native wages. This result has not been proven in the empirical literature; there is conflicting evidence in the literature as to whether immigration has any effect on native wages at all. Some studies have found that immigration either lowers the wages of low-skilled workers or widens the income gap between the rich and poor, although the magnitudes of these effects are relatively small. Furthermore, even if immigration does reduce wages and thus produces an immigration surplus, this surplus generally involves a transfer of wealth from labor to capital, which may not be in agreement with policy objectives. The impact of immigration of physicians on wages and employment of their native counterparts is even less clear, as it is complicated by licensing requirements and payment mechanisms involving third party payors.

There are two generally accepted methods of testing the effects of immigration on wages and employment: area analyses and factor-proportions analyses.

3.2: Area Analysis Approach

Area analyses exploit the fact that immigration is usually geographically concentrated, and contrast the level (or change) in immigration by area with the level (or change) in earnings of nonimmigrant workers (Borjas 1996). They usually calculate a spatial correlation between wages in a particular metropolitan statistical area (MSA) and the ratio of immigrants to native population in that area. These studies have found that, in general, immigration has a minimal effect on native wages. Butcher and Card (1991) employed the area analysis approach and analyzed changes in the distribution of wages in 24 major cities during the 1980s, particularly focusing on the "lower tail" of the wage distribution. They found that the labor market consequences of an immigration influx tended to be relatively small, in part because immigrant inflows were often offset by outflow migration of natives. They also found that, although there was no significant decline in wages at the lower end of the earnings distribution, higher levels of immigration were associated with more rapid increases in the 90th percentile of wages, contributing to a widening gap between the rich and the poor.

Borjas, Freeman and Katz (1996) use data from the 1980 and 1990 Census to estimate the cross-sectional effect of immigration, measured as the ratio of immigrants to natives in the relevant area, on the log of weekly earnings of natives in that area. Their model takes a differences-in-differences approach to control for changes in local labor market conditions from 1980 to 1990 as well as educational achievement of natives and immigrants, which allows them to measure the impact of immigration on earnings after controlling for other factors that affect wages. They find that, for a small geographical area, such as an MSA, the effect of immigration on wages is nearly zero, but positive. However, widening the geographic focus to the state or region level turns the effect of immigration on wages negative, although the magnitudes of the coefficients are still relatively small.

Orrenius and Zavodny (2007) use data from the Immigration and Naturalization Service (INS) and the Current Population Surveys (CPS) to study the relationship between immigration and native wages by broad occupational group, over the time period from 1994 to 2000. Their method regresses the average earnings of natives in a particular occupation group (professional, service-related, or manual labor) on the fraction of workers in that group who are immigrants and other control variables. The ordinary least squares regression results indicate that higher immigrant shares are associated with positive wage effects on more skilled natives and negative effects on less skilled natives. Because immigration into an area may not be independent of local wages, they also control for endogeneity by using immigrants who are admitted to the U.S. in a given year as the spouse of a U.S. citizen as an instrumental variable. The results of the two-stage least squares regression indicate essentially no effect of immigration on wages of professionals, a negative but insignificant effect on wages of service workers, and a statistically significant negative effect on wages of manual laborers. In addition, they find that all of the adverse wage impacts come from immigrants who are not new arrivals, presumably as it takes some time for immigrants to assimilate into the labor force.

Area analyses have been criticized because, by taking a "snapshot in time" approach to studying the effect of immigration on wages in a particular metropolitan area, the approach implicitly assumes that local labor markets are closed. This assumption obviously does not concur with reality. If, in fact, native workers respond to an influx in immigration by migrating to other U.S. cities, this would reduce the impact of immigration in a particular MSA. This hypothesis is consistent with the findings of Butcher and Card (1991). In addition, Frey (1994) found that during the 1980s, as foreigners from Mexico, China, and other countries immigrated to the cities of Los Angeles and New York, large numbers of native whites moved away. Specifically, competition for low-skilled jobs and the growing population encouraged low and middle income native whites to migrate elsewhere, but generally did not affect migration of high income natives. Furthermore, if immigrants intentionally choose to locate in areas where wages are high, then choice of location is endogenous and the correlation between immigration and wages in that particular area would be artificially positive.

Card (2001) addresses the two main criticisms of area analyses in a study of the effect of immigration on employment and wages by broad occupational group. His analysis uses data from the late 1980s and focuses mainly on the impact of immigration on less-skilled occupational groups. In contrast to earlier studies that used the fraction of immigrants in a city as a measure of immigrant competition, Card breaks the immigrant share down by occupational grouping. His analysis of the data indicates that, at least in the short term, if anything, immigration encourages native migration *to* rather than *away from* the immigrant-heavy city. To control for the possibility that unobserved city and occupation specific factors (productivity shocks) attract immigrants and are therefore correlated with both wages and immigration flows, Card constructs an instrumental variable based on the fact that newly arriving immigrants tend to move to cities where earlier immigrants from their country are already established. In particular, he estimates an "exogenous supply-push component", the actual inflow of immigrants from a given source country moving to a given city based on total inflows from the country and the fraction of earlier immigrants from that country who live in the city, multiplied by the fraction of immigrants from that country who fall into a particular occupation group. After controlling for the two criticisms of area analysis studies, Card's empirical analysis finds a systematically negative effect of immigration on both employment and wages of native workers.

3.3: Factor Proportions Analysis

Factor-proportions analyses take a general equilibrium perspective, treating immigrants as a source of an increased national supply of workers of the relevant skill, and applying an elasticity of substitution to estimate the effects of changes in the labor supply on native wages (Borjas, Freeman and Katz 1996).

Borjas, Freeman and Katz (1992) employ a factor proportions approach to determine the impact of trade and immigration on wages and employment of native workers, particularly those with a high school diploma or less, using data from the 1970s and 1980s. They identify that in the 1980s, the wages and employment rate of less-skilled workers fell in relation to those of more skilled workers, and suggest that this change could be caused both by changes in the trade deficit as well as immigration. Their analysis concludes that the immigration flow did not significantly alter the nation's relative supplies of high school and college graduates during the 1980s and therefore is unlikely to have had much effect on relative wages of these groups of workers. However, both trade and immigration greatly expanded the supply of high school dropouts relative to other workers and had a negative impact on the wages of these workers during this time period. The authors confirmed in their 1996 study (Borjas, Freeman and Katz 1996) that immigration contributed moderately to a rise in wage inequality in the 1980s.

Ottaviano and Peri (2005) introduce a production function in which capital accumulates endogenously and make a critical assumption that U.S. and foreign-born workers with similar levels of education and experience are imperfect substitutes for one another. The imperfect substitutability occurs because of differences in training, job choice, or other unobservable differences between U.S. and foreign-born workers. The authors' analysis estimates the *total* effect of immigration on U.S. aggregate wages, both through "own" and "cross" elasticities. They use country-level data from the Integrated Public Use Microdata Sample for 1970, 1980, 1990, and 2000, and divide the groups by education and experience level. Their analysis yields an elasticity of substitution of foreign graduates to natives of about 4 for college graduates, 7 for high school dropouts and 10 for high school graduates and college dropouts. This finding suggests that, of all education groups, it is hardest to substitute foreign-born college graduates for native college graduates. Using these elasticity of substitution estimates, the authors estimate the impact of immigration on native wages to be large and positive in the aggregate: an 8% increase in foreign-born workers increases the average U.S. wage by 2.2%. The top three education groups gain by about 2.4% each, while the high school dropouts lose; their wages decrease by about 2.4%. Furthermore, the authors simulate several counterfactual immigration policy situations, in which different types of workers were precluded from immigrating. They find that the most harmful scenario for the U.S., in terms of aggregate native wages, would be to replace immigration of high school dropouts with immigration of college graduates: the effect of immigration on aggregate wages would then drop to approximately zero.

Borjas, Freeman & Katz (1996) compare the area analysis and factor proportions approaches, and find that the estimated effect of immigration on native workers is very sensitive to the empirical experiment employed. They find very unstable results for both methods of analysis, suggesting that results should be interpreted cautiously. Overall, they conclude that immigration has played a role in reducing the pay of high school dropouts, while having a smaller negative effect on earnings of high school graduates.

3.4: Other Research

Johnson (1980) and Topel (1994) studied the effect of immigration on wages of low-skilled workers and found that, indeed, immigration has a negative effect on native wages. Johnson's analysis is concerned mainly with illegal immigration of low-skilled workers and concludes that, although immigration decreases native wages of low-skilled workers, it has little effect on employment, and actually *increases* the wages of high-skilled workers and holders of capital. Thus, immigration tends to widen the income gap between the rich and the poor. Topel's analysis finds that, in particular, increased immigration of less-skilled Hispanic and Asian workers in the western United States has had a negative impact on the wages of natives, thus causing a greater increase in income inequality than anywhere else in the country.

Less research has been done to determine the effect of immigration of *high-skilled* workers on the wages of high-skilled native workers in the United States. Borjas (2003) analyzed the effect of immigration on native wages and employment by education and years of experience, using data from the 1960, 1970, 1980, and 1990 Census as well as the 1999, 2000, and 2001 Current Population Surveys. His model assumes that similarly educated workers with different levels of experience participate in a national labor market and are not perfect substitutes for each other. His analysis finds a clear negative impact of immigration on native wages; an influx of immigration was found to decrease the wages of native high school dropouts by 8.9%, those of high school graduates decreased 2.6%, and those of college graduates decrease by 4.9%. Overall, a 10% increase in the supply of workers through immigration decreases wages by 3% to 4%.

Borjas (2005) and Borjas (2006) evaluate the impact of immigration of foreign students on the earnings of doctorates. Using data from the National Science Foundation's Survey of Earned Doctorates (SED) and Survey of Doctoral Recipients (SDR), Borjas employs a two stage least squares regression analysis and finds, in agreement with Borjas (2003), that a 10% increase in the supply of doctorates due to immigration results in a 3% to 4% decrease in wages of doctorates in the same field.

Camarota (2007) found a negative impact of immigration on the employment opportunities for native-born workers. He notes that most of the increase in immigration he studied came not from the very bottom of the labor pool; about 50% of the growth in immigrant employment from 2000 to 2004 came from immigrants with at least a high school education.

Chiswick (2005) addresses the increased demand in the late 20th and early 21st centuries for high-skilled technology workers in OECD countries, largely due to the Computer Revolution, globalization, and immigration of low-skilled workers. The United States Immigration Act of 1990 shifted the focus from family reunification (which largely involved low-skilled workers) to an increased role of high-skilled worker immigration. Chiswick posits that while tending to lower the average wage of high-skilled workers, high-skilled worker immigration actually increases the average wage of the low-skilled workers who complement the productivity of said high-skilled immigrants. This, in turn, reduces poverty and income inequality, and alleviates the burden of the government to provide welfare programs for the poor. He therefore argues that overall, immigration of high-skilled workers to developed countries has a positive effect on the economy. In contrast, he opines that immigration of low-skilled workers tends to lower the average wage of low-skilled workers and worsens the income gap, increases poverty and results in an increased need for government spending. Low-skilled workers tend to draw more government benefits than they pay for in taxes, which can contribute to already fiscally-strained social welfare programs in developed nations, including the United States.

3.5: Immigration of Physicians

Weiss (2000) made use of what was essentially a natural experiment that took place in Israel: the sudden and large influx of highly-skilled migrants from the former U.S.S.R. Specifically, 12,200 medical doctors migrated from the former U.S.S.R. to Israel between 1989 and 1993, compared with 15,600 doctors living in Israel in 1989. Weiss' analysis finds that highly-skilled immigrants initially accepted lower wages and worked in lower-skilled occupations, slowly climbing the "occupational ladder" and finding jobs that suited their occupation, skill-level, and earning capacity. The study concludes that even a significantly large influx of high-skilled immigrants had negligible effects on native wages and employment.

Svorny (1991) uses a factor-proportions type analysis to estimate the effects of liberalization of restrictions on physician migration in a time of increased demand in the U.S. Specifically, she uses aggregate data for the time period 1966-71, just after the passing of the Immigration Act of 1965 and shortly after the creation of Medicare and Medicaid. Svorny argues that over such a short time period, the native supply of physicians should be relatively inelastic, even in the face of an unexpected increase in demand. Thus, she argues that any change in consumer welfare during the time period is attributed solely to the change in immigration law. Although the inelasticity of supply assumption is likely to hold in the short run, it seems that her results apply *only* in the face of an increase in demand. In other words, although she is able to identify the effect of immigration under specific conditions, the results may not apply to a labor market in the absence of such a demand shock. In addition, the study makes assumptions about the price elasticity of demand for physician services and attempts to calculate the number of physicians and residents that would have been present in the U.S. in a given year under the counterfactual assumption that the law had not changed. The study finds that "the dollar value of the benefits to consumers from the 1965 liberalization of immigration restrictions reached 2.9 billion dollars by 1971" and that "if the additional migration had not been permitted and if prices had been free to adjust to equate supply and demand, physician earnings would have been at least 11% higher in 1971." Svorny uses physician earnings as a proxy for price. Although this may have been an effective measure in the 1960s, today it is not necessarily the case that physician earnings and prices for medical care are so highly correlated. A reduction in the price charged for medical care may or may not translate into a change in the price of care that patients actually pay for (in the form of insurance premiums, co-pays, or actually paying directly for the service) and similarly may or may not affect physician earnings.

Table 1 summarizes the results of the existing literature.

Table 1
Summary of Existing Empirical Literature: Labor Market Effects of Immigration

Author (Year)	Results of Analysis
Butcher & Card (1991)	No significant effect on wages of low-skilled workers, wages of high-skilled workers grew more rapidly, increased income gap. (1980s data)
Svorny (1991)	Consumer gains and decrease in physician wages after the Immigration Act of 1965. (1966-1971 data)
Borjas, Freeman and Katz (1992)	Negative impact on wages and employment of high school dropouts. (1980s data)
Topel (1994)	Increased income gap in the West. (1972-1990)
Borjas, Freeman & Katz (1996)	Small positive effect of immigration on wages in an MSA, small negative effect in broader geographic area. Rise in wage inequality. (1970s-1980s data)
Weiss (2000)	Negligible effects of high skilled immigration on wages and employment of high skilled workers. (Israel, 1989)
Card (2001)	Significant negative impact on wages and employment. (late 1980s)
Borjas (2003)	Negative impact on wages for all education groups. (1960-2001 data)
Ottaviano & Peri (2005)	Large positive aggregate effect on wages. High school dropouts lose, more highly educated workers gain. (1970-2000 data)
Borjas (2005), Borjas (2006)	Negative impact of foreign doctoral student program on native wages. (1968-2000 data)
Orrenius & Zavodny (2007)	No effect on wages of professionals, insignificant effect on service workers, negative effect on manual laborers. (1994-2000 data)
Camarota (2007)	Negative impact on employment for all education groups

It is evident that, although the literature tends to support a negative impact of immigration on wages of low-skilled workers, even the most recent studies conflict as to the effect on wages of high-skilled workers. Most notably, Ottaviano and Peri (2005) find that immigration *increases* wages of native high-skilled workers, while Borjas (2003, 2005, 2006) find just the opposite: that immigration *decreases* the wages of native high-skilled workers. In addition, research focused on specific occupations is almost nonexistent. The study by Svorny (1991) is an interesting one with respect to physicians; however, changes in the medical care industry since 1965 certainly merit further, more current research in this area.

Chapter 4: Justification for Study

4.1: Academic Value

As discussed in the previous chapter, earlier studies of the impact of immigration on local wages find conflicting results. This research makes use of an excellent data source, the AMA Physician Masterfile, which has not previously been employed in studies of this type. For the first time, the effect of immigration on a particular occupation will be studied using detailed data that isolates the effects being studied from the "noise" which is present in other studies that use aggregate data to analyze broader occupational groups or skill categories. According to Card (2001), because of the large differences in skill levels among immigrants in different areas, studying "the overall fraction of immigrants in a city is simply too crude an index of immigrant competition for any particular subgroup of natives." Card argues for studying the impacts of immigration at the occupational level. The particular choice of occupation in this study, the physician, extends the application of the data and results beyond simply the academic question of whether immigration decreases native wages to policy issues pertaining to healthcare and immigration policy in the U.S. Furthermore, this study has applications in many fields of economics; including, but not limited to health, international, development, and labor economics.

4.2: Immigration and Healthcare Policy

Since the early 1900s, there has been an ongoing debate as to whether the U.S. has too many or too few physicians, and whether the government should be involved in controlling the physician supply. The Flexner report published in 1910 concluded that there was an oversupply of largely under trained medical professionals in the U.S. The relative supply of physicians subsequently fell due to the closing of a number of medical schools of lesser quality. The general consensus that the U.S. had an oversupply of physicians continued until the publication of the Bane report in 1959, which predicted a shortage of physicians in the U.S. by 1975. This was followed by government subsidies encouraging the expansion of the number of medical schools as well as the number of students admitted. In 1981, the Graduate Medical Education National Advisory Committee published a report indicating that by 1990, the U.S. would again face a surplus of physicians and recommended that the number of students admitted to U.S. medical schools as well as the number of foreign physicians allowed to immigrate be restricted. Subsequent reports by the Council on Graduate Medical Education (COGME) in the early 1990s, the Bureau of Health Professions, and Tarlov (1986) and Weiner (1994) confirmed that a surplus of physicians would occur by the year 2000. Thus, policymakers in the 1980s and 90s generally took steps to limit first, the number of students admitted to U.S. medical schools and, later, the number of foreign physicians admitted to the country as immigrants. However, just as it seemed a consensus had been reached that the U.S. was, in fact, facing a surplus of physicians, the research of Cooper (1998) projected just the opposite: that by 2010 the U.S. would be facing a *shortage* of physicians, especially specialists (Blumenthal 2004). Reports in the recent medical literature have brought to light this pending physician shortage (Moore 2003, Cross 2007, Arvantes 2007). Based on a recent study by the COGME, the American Medical Association adopted a resolution at their 2008 Annual House of Delegates Meeting recognizing that "there is currently a shortage of physicians" (Resolution 309). The shortage of physicians is generally thought to be even larger in rural and inner city areas. Physician supply becomes an even more relevant topic due to the current political climate with regard to healthcare reform. According to an April 2009 article in the New York Times, "Obama administration officials, alarmed at doctor shortages, are looking for ways to increase the supply of physicians to meet the needs of an aging population and millions of uninsured people who would gain coverage under legislation championed by the president" (Pear 2009).

Whether the U.S. is truly facing a "shortage" of physicians in the economic sense of the word and, if so, whether it is appropriate for the AMA and/or the government to attempt to control the supply are matters for debate. However, given that for the last century these organizations *have* attempted to do just that, the supply of physicians can be affected through a change in the number of students admitted to U.S. medical schools and/or a change in immigration policy with respect to international medical graduates. Current immigration policy provides preferential treatment to more highly educated immigrants, and also favors immigrant physicians willing to work in underserved areas. Although many studies have attempted to estimate physician demand and supply to determine whether a shortage or surplus exists, no work has been done to evaluate how changes in the supply due to immigration would affect the wages and employment of the local labor market. Given that there is likely to be a growing demand for medical care in the future due to the aging population of baby boomers as well as potentially newly insured patients, a study of the effect of an increase in the supply of foreign physicians is certainly merited.

Thus, the study has important policy implications in the presence of current debate over immigration law and healthcare reform and in an era of increasing mobility of labor due to globalization. From the point of view of the United States, whether foreign physicians are filling positions in areas that have a physician shortage or whether they compete directly with domestic doctors for jobs in already populated areas should be considered when determining immigration policy. Current proposals for future immigration law include implementing a point system, under which potential immigrants would receive additional points based on higher levels of education. Thus, the proposed legislation would make it easier, all else equal, for highly educated foreigners to immigrate to the United States. Borjas (1995) concludes that the benefits of immigration can be increased by pursuing policies that attract high-skilled workers. Chiswick (2005) also seems to imply that policies favoring high-skilled immigrants are preferable. However, Ottaviano and Peri (2005) find just the opposite; that, in fact, any net welfare gains from immigration could be eliminated by establishing policies that resulted in an increase in high-skilled immigration at the expense of low-skilled immigration. Thus, before drawing such a conclusion the effect of such immigration on their native counterparts should be better understood.

Chapter 5: Immigrant Physicians: Visa Requirements

This study analyzes immigration of both physicians educated in the U.S. as well as in a foreign country. Graduates of foreign medical schools are typically referred to in the literature as IMGs (international medical graduates). In order to practice medicine in the U.S., IMGs are required to pass federal and state licensing examinations pertaining both to medical knowledge and English language before they are eligible to apply for a visa.

Graduates of international medical schools may enter the United States under one of several visa programs: the temporary work visa, H-1B, is the most common. This visa is restricted to highly-skilled individuals with at least a bachelor's degree who are obtaining work in a high-skilled occupation. This visa requires an employer, such as a hospital, to sponsor the visa of the immigrating physician. Unless the physician obtains another type of visa later or obtains citizenship through marriage at some point (which is likely), the H-1B visa is for a term of three to six years.

Some IMGs may enter the U.S. under the O visa program. This visa is restricted to persons with extraordinary abilities in their field. Thus, the physician must be considered an expert in their field or have achieved a significant amount of exemplary research experience in order to qualify for such a visa. This visa has less stringent restrictions with regard to employer sponsorship. In addition, although the O visa is typically approved for three years, it may be extended indefinitely and thus there is no limit set on the amount of a time a physician with an O visa can remain in the U.S.

Finally, most immigrants who move to the U.S. to study at a U.S. medical school do so under the J-1 training visa. This visa program was enacted to encourage exchange of knowledge between the U.S. and other countries. The J-1 visa normally requires immigrants to return to their home country for a minimum of two years after completing their residency in the U.S. before returning under another visa. However, the U.S. government makes an exception to this requirement in three cases: persecution, hardship, and government recommendation. A persecution waiver may be obtained if the physician is seeking asylum in the U.S. from persecution in their home country. A hardship waiver may be available if, due to immediate family living in the U.S., the physician and/or his family would suffer "exceptional hardship" if the physician were forced to return to his or her home country for two years. Finally, and most common, if the physician agrees to provide primary care services in federally-designated health professional shortage areas (HPSAs or MUAs) for a minimum of three years, a waiver of the two year return-home requirement may be granted. Foreign physicians who graduate from U.S. medical schools are normally subject to the same licensing examinations as their native-born counterparts.

All immigrant physicians may eventually be able to apply for permanent residence in the United States under several alternative circumstances. Asylum-seekers, physicians who marry a U.S. citizen, and those who start substantial successful businesses in the U.S that employ at least ten U.S. workers are eligible to apply for permanent residency. Physicians in the U.S. on an O visa, as previously stated, may continuously extend their visas. Finally, almost any foreign physician who agrees to work in primary fields in HPSAs (Health Professional Shortage Areas) or MUAs

(Medically Underserved Areas) for a minimum of five years may apply for permanent residency. Thus, there are many circumstances in which an immigrant physician who moves to the U.S. for education purposes may end up living and practicing in the U.S. for many years (Ester 2004, Klasko 1999, Mautino 2002).

Chapter 6: Theoretical Foundations

6.1: Physician Labor Demand and Supply

The basic theoretical model underlying this study is a simple model of labor demand and supply. In economics, the study of the demand for healthcare has been framed in terms of the demand for "health" itself. An individual's demand for health influences their demand for health services, which are produced, like other goods, using both labor and capital. The production function for health services can therefore be written: $Q = f(\mathrm{L,K})$.

The demand for each input will depend, in part, on the price of the final good (or service, as the case may be). As the price of the health service increases, so does the marginal revenue product of labor and, therefore, so should the wage rate. The wage rate also depends on productivity; if new technology allows a physician to become more productive, the marginal revenue product increases and so should the physician's wage rate.

The demand for each input also depends on the degree of substitutability between the factors as well as their relative prices (which, in the case of labor, is the wage rate). The degree of substitution between capital and labor will depend on the particular service desired. For example, new advances in technology have resulted in machines which can dispense pills just as a pharmacist could. In this case, hospitals may somewhat easily substitute between labor and capital. However, some surgeries may require specific skills of a surgeon that no machine is capable of performing; in this case, the degree of substitutability is very small. In the last few decades, and particularly with the increasing pressure from managed care companies to control costs, firms in the healthcare industry have not only attempted to substitute capital and labor but also to substitute less-skilled, cheaper labor for high-priced physicians. Many services that formerly were performed by physicians are now performed by nurse practitioners or physician assistants. Furthermore, advances in technology now require more technicians to operate machinery and fewer specialized physicians to actually perform complex tests.

The supply curve of labor is upward sloping, such that more doctors will be willing to work for a higher wage rate. Higher wages may encourage physicians to work more hours and/or see more patients. In addition, physicians working in other areas, both in the U.S. and abroad, are encouraged to move to areas where wages are higher. The demand curve of labor is downward sloping, such that the lower the price of labor, the greater is the amount of labor demanded. The equilibrium market wage rate is determined where the supply and demand curves intersect.

The equilibrium physician wage will change in response to a shift in either the demand or supply curve. The supply curve can be shifted outward by an increase in the number of physicians in an area, either due to an influx of new medical school graduates or physicians moving in from other areas, whether from within the U.S. or due to immigration. In the absence of any demand shocks, basic economic theory posits that, in the presence of such a supply shift, the wage of physicians will decrease in the short run. In the long run, native physicians may respond by moving out of the area, or fewer students will apply to medical school as the decrease in wages reduces the expected lifetime returns of becoming a physician.

On the other hand, the equilibrium wage rate could be increased due to an increase in the demand for medical care. It would take several years for U.S. residents who are not already physicians to respond to the increase in wages by attending and graduating from medical school and residency programs. Foreign medical graduates practicing outside the U.S. can respond more quickly to such an increase in expected wages. Thus, the physician labor supply is more elastic due to immigration of foreign physicians (Folland 2007).

6.2: Physician Immigration: Decision to Emigrate

Migration theory segregates the reasons for worker migration into two categories: supply-push factors and demand-pull factors. Supply-push factors are generally negative factors in the home country that encourage workers to leave and seek work elsewhere, such as unfavorable employment conditions, poor healthcare, and lower wages. Supply-push factors are normally more important in migration decisions of workers from developing countries than from developed nations. Demand-pull factors are those factors in the potential destination countries that attract foreign workers, including better living and working conditions and higher wages. Networks also play an important role in migration decisions: potential immigrants often acquire information about living conditions, wages and employment in a potential destination country from people they know who already live there. Furthermore, networks help immigrants in the assimilation process once in the new country (Clark 2006).

When the decision of a foreign medical doctor to migrate is primarily based on expected earnings (which is often the case), the decision will be determined by relative wages in the U.S. and the foreign country in which the doctor currently lives, as well as migration costs and non-wage factors that affect a physician's choice to move. Specifically, a physician will wish to migrate if:

$$W_{US} - W_F - C > Z ,$$

where W_{US} and W_F are the wage rates in the U.S. and the physician's home country (foreign), C is the cost of migrating, and Z represents the compensating differential in favor of staying in the home country, which is generally positive and reflects the fact that, all else equal, most potential migrants would prefer *not* to move. Thus, the physician will wish to migrate if the increase in his wage, less the cost of moving, is greater than the value of his desire to stay in his home country (Vujicic 2004).

6.3 Exceptions to the Rule in the Healthcare Industry

The model predicts that an increase in the supply of physicians through immigration will, consistent with basic economic theory, cause wages to fall. However, this result is complicated by many factors in the medical care industry. First, it assumes that a foreign physician is a perfect substitute for a native one. This assumption is likely to be violated, as patients may (rightly or wrongly) believe that a physician educated outside of the U.S. is of inferior quality. Studies have generally found no difference in the quality of care provided by foreign medical graduates compared to U.S. medical graduates (Folland 2007). Prejudices may exist even against foreign physicians educated in the U.S. Patients have imperfect information regarding quality of care from any physician, native or foreign.

Furthermore, because they receive payment from third party payors including managed care companies, Medicare, and Medicaid, physicians are limited in the amount they can charge in some cases, and their compensation structure may not behave in the way theory would predict. Specifically, physician wages are more likely to be "sticky" than wages in many other occupations.

On the other hand, there are at least two reasons that allow the effects of immigration on wages of physicians to be more easily identified than most other occupations: first, because physicians are subject to strict licensing requirements by states, there are unlikely to be many foreign physicians working illegally in the U.S. Therefore, it will not be necessary to attempt to estimate a measure of illegal immigration, for which there is little reliable data, a problem that has plagued many of the studies surveyed earlier. Second, immigration can be considered as an importation of labor. To the extent that production is shipped overseas or jobs are outsourced, policy decisions either limiting or encouraging immigration might be rendered meaningless. Although some outsourcing of medical care, and even physician care, does exist (media reports of U.S. citizens traveling to foreign countries for medical procedures which would otherwise be unaffordable to them come to mind), it is certainly very minimal compared to other occupations. Physician care, unlike many labor services, is difficult to outsource.

6.4 Hypotheses of this Research

This research study hypothesizes that immigration of foreign physicians has a negative impact on area wages, and that this negative impact comes not only from the increase in physician supply caused by immigration but also from the fact that immigrant physicians will be willing to accept lower wages than their native counterparts. This research expects, however, that once country of education is controlled for, the results will show that immigration of foreign-educated doctors has a more negative impact on area wages than immigration of U.S.-educated foreign-born doctors. This hypothesis is based on the idea that foreign-born doctors educated in the U.S. are likely to be more similar to their U.S. counterparts. The researcher hypothesizes that an influx of U.S.-born, foreign-educated doctors, on the other hand, will have a negative impact on area wages. These physicians may be viewed as being of lower quality by potential employers.

It is expected that wages will be higher in areas with more male physicians. Furthermore, wages are expected to increase with age, but at a decreasing rate. An increase in the physician stock is anticipated to have a negative impact on area wages, consistent with basic economic theory of labor supply and demand.

Finally, this researcher hypothesizes that, ceteris paribus, areas with a larger percentage of the population covered by Medicare B will have higher wages. Medicare B patients are either disabled and/or over the age of 65; therefore, areas with more Medicare B patients are likely to have higher demand for physician services.

Chapter 7: Research Methodology

7.1: The Basic Ordinary Least Squares Model

The intent of this research study is to test the hypothesis that immigration of foreign physicians, by increasing the supply of workers in the field, lowers the average wage of physicians in the United States. The approach employed mimics the area analyses discussed earlier, while correcting for some criticisms of that approach, as will be described below. Incorporating methods from Borjas (2005, 2006) and Orrenius and Zavodny (2007), the basic model takes the following form:

$$\ln w_{a,t} = \beta_0 + \gamma I_{a,t} + \beta_1 X_{a,t} + \beta_2 A_a + \beta_3 T_t + \beta_4 MedB_{a,t} + \varepsilon_{a,t} \text{ ,}$$

where *ln w* represents the natural log of the average hourly wage of physicians indexed by MSA (*a*) and year (*t*). Data have been sampled for every other year from 1997 to 2007, rather than every year, due to budget constraints.

I represents immigrant share and is measured as the number of foreign physicians in a given MSA in a given year relative to the total number of physicians:

$I = \dfrac{ForeignPhysicians_{a,t}}{TotalPhysicians_{a,t}}$. γ is the parameter of interest; it measures the percent-change in area wages for a one percentage point increase in the immigrant share and is expected to be negative. This method of calculating the percentage of immigrants (whether it be in general, or by specific occupation or education level and also at either the MSA, state, or national level) and employing it as the measure of immigration has been previously performed in studies by Altonji and Card (1991), Orrenius and Zavodny (2007), Borjas (2003) and Borjas (2005, 2006).

X is a vector that controls for the demographic characteristics of physicians in the MSA during the given year, including physician sex and age. *A* and *T* represent area and year fixed-effects, respectively, and control for unobserved determinants of wages within a particular MSA or year. The OLS regressions are performed both with and without the area fixed effects.

MedB measures the percentage of the population in the physician's service area that is covered by Medicare Part B. This controls for the influence of large buyers, namely government programs and managed care companies, over physician charges. Managed care penetration rates have been shown to affect wages of medical professionals. Hadley and Mitchell (1999) find evidence that higher HMO market penetration is associated with lower physician earnings. However, their study is limited to a cross-section of data from 1990 and therefore does not address changes over time in physician earnings. Buerhaus and Staiger (1996) use data from the Current Population Surveys for 1983 through 1994 to analyze the impact of managed care on employment and earnings of nurses. Their research finds that managed care has been associated with a shift in employment away from hospitals to other settings (home health care, nursing homes, physician offices), but has had minimal effects on nurses' wages. Simon, Dranove and White (1997) analyze data published in the American Medical Association's Socioeconomic Monitoring System survey from 1985 to 1993 and find that states with the fastest growth in managed care penetration experienced the highest growth rates in earnings of primary care physicians and the lowest growth rates in earnings of radiologists, anesthesiologists, and pathologists. Due to difficulties in obtaining managed care penetration rate data, Medicare penetration rate data have been employed in this study. Medicare is the largest single purchaser of healthcare in the U.S. Furthermore, many managed care companies structure their pricing using a mark-up based on the Medicare Resource-Based Relative Value Scale (RBRVS) Reimbursement System.

7.2: Extension of the Basic Model: Additional Variables

The first extension to the basic model is to control for changes in physician supply. The variable *S*, calculated as $S = \frac{\#ofPhysicians_{a,t}}{Population_{a,t}}$ is added to the regression. Note that this variable measures the *actual* number of physicians divided by the *actual* population in a given area and year; this variable is *not* a sample statistic. This variable measures the stock of physicians in a given MSA during a given year, and allows the effect of immigration on wages, *holding the number of physicians constant*, to be identified. By adding the variable *S*, the study can determine whether immigration affects wages of physicians only because it increases the supply of physicians, or whether the effects are compounded because there is something specifically different about foreign doctors. Now the parameter of interest, γ, measures specifically the effect that an increase in the proportion of *foreign* physicians has on wages in a given area. If γ is negative, this suggests that foreign physicians are less productive than domestic ones or are willing to accept lower paying jobs. Furthermore, if γ is more negative than in the analysis without the supply control, this would provide evidence that local physicians move out of the area in response to an influx of immigrant physicians.

The next extension to the model is to control for whether the physician obtained their medical degree at a domestic or foreign medical school (for purposes of this analysis, Canadian medical schools are grouped with U.S. medical schools, consistent with the categorization of the American Medical Association). Simply including a variable that controls for foreign medical education would not be appropriate, as the effect of foreign medical education is likely to be different for foreign-born doctors and U.S.-born doctors. Technically, there are four different categories of doctors to be considered: U.S.-born and educated (USBUSE), U.S.-born and foreign-educated (USBFE), foreign-born and foreign-educated (FBFE) and foreign-born educated in the U.S. (FBUSE). Thus, three additional variables are added to the model, with U.S.-born and educated physicians being the base category for comparison. The variable *FBFE_Share* is calculated as the total number of foreign-born, foreign-educated physicians in the sample in a given area and year divided by the total number of physicians sampled in that area and year. The variables *FBUSE_Share* and *USBFE_share* are similarly defined. Adding these variables allows the determination of whether effects on wages are explained by country of birth or where the physician went to medical school, or both.

7.3: Extension of the Basic Model: Instrumental Variable Approach

The next specification of the model involves the incorporation of an instrumental variable to control for endogenous location choice. As discussed earlier, results are potentially biased if physicians choose to move to areas where wages are already higher than others. Results could also be biased if occupation-specific local productivity shocks raise wages and encourage migration to a particular area. In the presence of such endogeneity, the parameter estimates will be inconsistent and causation cannot be assumed (i.e., does immigration actually cause higher wages, or do higher wages attract immigrants?). Prior studies including those of Orrenius and Zavodny (2007) and Friedberg and Hunt (1995) have employed an instrumental variable to control for endogenous location choice. An appropriate instrument is one that is correlated with immigration but not directly correlated with wages or the error term in the wage equation. Following Altonji and Card (1991) and Card (2001), the fraction of immigrants in a given MSA in 1990 can be used as an instrumental variable. Bartel (1989) finds that the number of immigrants already living in a given area acts as a pull factor for future immigrants; thus, this variable should be correlated with immigrant inflows from 1997-2007, the years which the study will analyze. Furthermore, this variable does not directly relate to future wage increases. The instrumental variable applied in this analysis is referred to as FB90 and calculated as: $FB90 = \frac{foreignbornpop_{a,1990}}{totalpop_{a,1990}}$.

If immigrant share is likely to be endogenous, then the variable *FBFE_Share* is likely to be endogenous as well. A second instrument *FE_IV* (the instrument for foreign education), constructed as FB90 multiplied by the share of physicians sampled in a given area and year who were educated abroad, is added to the model in the specifications that include this physician education variable. This instrument is loosely based on Card (2001), where an instrumental variable is constructed using immigrant inflows multiplied by the fraction of immigrants in certain occupational groups (in the case of this study, the category of concern is educational, not occupational, group).

7.4: Extension of the Basic Model: First-Difference Approach

Finally, a first-difference approach, with and without the instrumental variable, is employed to control for area-specific factors that effect wages, endogenous location choice and the possibility that local physicians migrate away from cities when foreign doctors move in. The first-difference approach examines changes in physician wages as a function of changes in the share of immigrant physicians within an MSA. This method "abstract[s] from differences across cities that might bias a simpler cross-sectional analysis… the first differenced analysis… eliminates any bias introduced by city-specific fixed effects that are correlated with the fraction of immigrants in a city and the labor market outcomes of natives" (Altonji and Card 1991). Furthermore, if immigrants move to a certain MSA because wages are high, but not because they expect them to rise more in the future, regressing the change in wage on the change in immigrant share will correctly identify the parameter of interest (Friedberg & Hunt 1995). In this specification, the model to be estimated is as follows:

$$\Delta \ln w_{a,t} = \gamma \Delta I_{a,t} + \beta_1 \Delta X_{a,t} + \beta_2 \Delta T_t + \beta_3 \Delta MedB_{a,t} + \Delta \varepsilon_{a,t}$$

As in earlier regressions, the variables *FBFE_Share*, *FBUSE_Share*, *USBFE_Share* and *S*, as well as the instrumental variables *FB90* and *FE_IV* are added as additional specifications. The first-difference approach alleviates some of the potential bias that could be caused by area specific location choice factors; however, it does not completely solve the endogeneity problem. Therefore, following Altonji and Card (1991), the instrumental variable approach can be combined with the first-difference approach to control for local economic conditions that attract immigrants. According to Friedberg and Hunt (1995) an appropriate instrument that is correlated with *changes* in the immigrant share but does not directly influence changes in wages can be used “to remove the bias due to immigrant choice of regions with improving outcomes.” Altonji and Card (1991) use the existing immigrant population as an instrumental variable; as previously explained, this analysis employs the instrument *FB90*, the existing foreign-born population in an area according to the 1990 Census.

Chapter 8: Data Sources and Building the Database

The data for this project come primarily from 4 sources: (1) the American Medical Association (AMA) Physician Masterfile, (2) the Occupational Employment Statistics (OES) Survey published by the Bureau of Labor Statistics (BLS), (3) the Fee for Service Data published by the U.S. Department of Health and Human Services, Centers for Medicare and Medicaid Services and (4) data from the U.S. Census Bureau.

8.1: The AMA Physician Masterfile

The Physician Masterfile, compiled annually by the American Medical Association (AMA), contains current and historical data on the over 940,000 physicians practicing in the U.S. and its territories, including more than 243,000 graduates of foreign medical schools. The AMA maintains a high standard of accuracy in data collection and reporting.

Relevant variables included in the Physician Masterfile data are: type of practice (hospital based, office based), state, county, PMSA/MSA and zip code of practice location, size of practice area (population), gender, birth date, *birth country*, licensure information, residency training information, medical school information including *country* and name of school attended, medical school graduation year and physician specialty. The data on country of physician birth and country of medical school attended are of particular importance to this research study. Data on country of birth allow the calculation of the share of immigrant physicians in a given MSA. Data on country of medical school allow further specifications of the model as described above, in order to determine whether there is a significant difference in the earnings of immigrant physicians educated abroad as compared to the United States. Demographic variables, including gender and age are obtained from this data set.

The AMA data are proprietary and can only be purchased subject to strict licensing agreements as to the use of said data. A random sample of 184,563 observations from the AMA Physician Masterfile Survey data was purchased from Medical Marketing Service, Inc. for purposes of this research. Specifically, a random five year sample of 30,021 observations from the 1997 AMA survey data, 30,505 observations from the 1999 survey, 30,708 from the 2001 survey, 31,201 from the 2003 survey, 30,975 from the 2005 survey, and 31,153 from the 2007 survey were purchased. The number of observations purchased and the number of years of data purchased were limited by budget constraints.

The greatest challenge involving the AMA data was the manipulation required on the birth country variable. This variable did not contain a unique identifier for the country of origin of each physician. Instead, it often contained a city and state of birth, a city and country, a country with a name misspelled, a country abbreviation, a city name only, or, in some cases, an identifier of “unknown”. As whether the physician is foreign born or not is the most critical variable to the analysis, observations for which the birth country could not be identified as at least either foreign or U.S. had to be dropped. After dropping these observations, 170,858 observations remained in the dataset. For the remaining observations, the data had to be cleaned so that the countries of birth had a uniform description.

8.2: Wage Data from the Occupational Employment Statistics Survey

The physician observations from the AMA Masterfile were assigned a wage using the average wage for their specialty, practice area and survey year as obtained from the Occupational Employment Statistics (OES) Survey. Published by the U.S. Department of Labor, Bureau of Labor Statistics, the OES Survey reports average wage data for over 800 occupations for 375 MSAs, 34 metropolitan divisions, and over 170 nonmetropolitan areas. This study employs wage data for 1997 through 2007 from the OES Survey.

Although the AMA data assign each physician a detailed specialty code, with more than 200 possible specialties, the wage data for physicians for 1999 through 2007 are reported by broad specialty code, including: anesthesiologists, family practitioners, internists, OB/GYN, pediatricians, psychiatrists, and surgeons. Therefore, each specialty designation in the AMA database had to be assigned a broader specialty code to correspond with the OES wage data. Physicians with specialties which clearly fell into one of the seven categories listed above were assigned wages based on that specialty. Physicians with other specialties, such as cardiology or urology, which did not clearly fit into one of the broad categories, were classified as “Other Specialty” and assigned the average wage of all physician specialties in their area for the given year.

For physicians who practice within a primary metropolitan statistical area (PMSA), the OES data by MSA was employed. However, for those physicians who do not practice within a PMSA or nonmetropolitan area for which wage data was collected (i.e. they practice in rural areas), the average wage from the OES state wage data for their given specialty and year were used (the OES does not publish county-level occupational wage data).

The OES data for 1997 report only the average wage by area for "physicians and surgeons"; the data are not broken down more specifically by specialty. Therefore, for each area (MSA or state-level, where appropriate) the average wage of all physician specialties for 1999 was calculated (as a second option, when data for a particular specialty and area were not available in 1999, the data for 2001 were employed). Then, for each specialty, the average wage by area *relative* to the average of all specialties was calculated. This ratio was then applied to the average wage in 1997 to conform to the data for later years. For example, if in a particular MSA anesthesiologists earned 20% more than the average physician in 1999 (or 2001), it is assumed that anesthesiologists also earned 20% more than the average physician in that area in 1997.

8.3: Medicare Enrollment Data

Medicare enrollment rates by county are reported in the Fee for Service Data published by the Department of Health and Human Services, Centers for Medicare and Medicaid Services for 1998 through 2006. Medicare Part B is the arm of Medicare that covers physician services and is therefore the relevant variable to this study. In order to calculate a Medicare Part B penetration rate, however, the percentage of the population covered by Medicare Part B, not the number of people, is required. Thus, the Medicare data were merged with annual county population data published by the U.S. Census Bureau. Medicare penetration rates for each county and year were calculated. In order to properly merge the Medicare penetration rate data with the AMA data and wage data, Medicare penetration rates for each physician's practice area were required. Since most physicians in the database practice within an MSA, the Medicare penetration rate data needed to be recategorized from the county level to the PMSA level. A list of counties within each PMSA was obtained from a geocode file available through The Ohio State University's Center for Human Resource Research. For PMSA's consisting of more than one county, a weighted average Medicare penetration rate was calculated. Medicare data were then merged with the AMA and wage data by PMSA or county, depending on whether the physician practiced within a PMSA or not. Since Medicare penetration rate data were not available for 1997 or 2007 at the time this analysis was performed, physicians surveyed during 1997 were assigned the Medicare penetration rates for 1998 and physicians surveyed during 2007 were assigned Medicare penetration rates for 2006.

8.4: Data from the U.S. Census

In order to calculate the variable $S = \frac{\# ofPhysicians_{a,t}}{Population_{a,t}}$ for the first extension of the model, population data by MSA were downloaded from the U.S. Census Bureau. Population by MSA for the fifty U.S. states is available by year from 2000 through 2007. The population for earlier years was estimated using the population from the 1990 and 2000 Census and assuming a constant linear growth rate. Population data for the U.S. Virgin Islands and Guam are available only from Census 2000; therefore, this analysis is forced to assume that population in these territories did not change significantly between 1997 and 2007. Population data for Puerto Rico's municipalities is available from 2000 through 2007; Puerto Rico's population is assumed to be unchanged from 1997 through 2000. The number of physicians employed by PMSA and year are reported in the OES data referenced above. As data on the number of physicians employed by county are unavailable, the use of this stock variable S will be limited to regression analysis of the PMSA areas only, and cannot be employed with regressions which include rural (non-metropolitan) areas. As will be discussed later, this limitation turns out to not be as problematic as it may seem.

Finally, the model required a measure of the immigrant population, as a fraction of total, by MSA (or county, when the physician did not practice within an MSA) in 1990 to be used as an instrumental variable. The foreign born population and native born populations, by MSA and county, are recorded in the 1990 Census were obtained from the U.S. Census Bureau online.

Chapter 9: Descriptive Statistics of the Data

9.1: Country of Physician Birth

Of the 170,858 physicians sampled from the AMA survey for which country of birth was available, 26% (44,503) were born outside the U.S. (foreign-born) and 74% (126,355) were born in the U.S. The proportion of foreign born physicians in each year sampled is roughly the same:

Table 2
Physician Sample: U.S.-Born and Foreign-Born by Year

Survey Year	# Foreign-Born	% Foreign-Born	# U.S.-Born	% U.S.-Born	Total
1997	7,421	26%	21,497	74%	28,918
1999	7,734	27%	21,337	73%	29,071
2001	7,658	27%	21,161	73%	28,819
2003	7,521	26%	21,280	74%	28,801
2005	7,181	26%	20,748	74%	27,929
2007	6,988	26%	20,332	74%	27,320
Total	44,503	26%	126,355	74%	170,858

Summary statistics of the key independent variable in this study, *I*, the share of immigrant physicians in a particular area, are reported by year in Table 3.

Table 3
Summary Statistics of the Variable I = Immigrant Share

Year	Mean	Standard Deviation
1997	0.2566222	0.1417947
1999	0.2660383	0.1392615
2001	0.2657275	0.1390750
2003	0.2611368	0.1368208
2005	0.2571163	0.1332611
2007	0.2557833	0.1336291

The top twenty countries that most of the foreign-born physicians in the sample come from are reported in Table 4. For a complete listing, see Table A1 in the Appendix.

Table 4
Foreign-Born Physicians Practicing in the U.S. by Country of Birth

Birth Country	# of Physicians	% of Foreign-Born Physicians
India	8,352	18.8%
The Philippines	3,905	8.8%
Canada	2,105	4.7%
Korea (South)	1,705	3.8%
Pakistan	1,523	3.4%
Iran	1,486	3.3%
China	1,343	3.0%
Cuba	1,252	2.8%
Germany	1,139	2.6%
United Kingdom	1,123	2.5%
Vietnam	999	2.2%
Taiwan	908	2.0%
Egypt	823	1.8%
Mexico	639	1.4%
Syria	601	1.4%
Poland	593	1.3%
Colombia	537	1.2%
Israel	516	1.2%
Argentina	484	1.1%
Nigeria	473	1.1%

The largest single source country of immigrant physicians, by far, is India, followed by the Philippines. This is not surprising, given the earlier review of literature that discussed the predominance of highly educated Asian immigrants. Of the 44,503 foreign-born physicians in the sample, only 11,353 (26%) come from advanced economies as defined by the International Monetary Fund. The remaining 33,150 (74%) come from emerging and developing economies.

9.2 Country of Medical School Attended

Of the 170,858 physicians in the sample, 21.9% (37,390) attended a medical school outside of the United States (foreign medical school) and 78.1% (133,468) attended medical school in the U.S. Although, as expected, foreign-born doctors are much more likely to have attended a foreign medical school, a significant percentage of them did, in fact, attend medical school in the U.S. Of all U.S.-born physicians sampled, only 4% attended medical school outside the U.S. Meanwhile, 72% of foreign-born physicians were educated at foreign medical schools while 28% of them were actually educated here in the U.S. These values are reported in Table 5.

Table 5
Location of Medical School Attended by Place of Birth

	Place of Birth:			
Location of School:	United States		Foreign	
United States	120,890	96%	12,578	28%
Foreign	5,465	4%	31,925	72%
	126,355	100%	44,503	100%

Note: Percentages may not add to 100% due to rounding.

Summary statistics of the key variables measuring physician education, *FBFE_Share*, *FBUSE_Share*, *USBFE_Share*, as well as the base category, *USBUSE_Share*, are reported in Table 6.

Table 6
Summary Statistics of the Birthplace/Education Variables

	USBUSE_Share		*USBFE_Share*		*FBFE_Share*		*FBUSE_Share*	
Year	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
1997	.7092	.1570	.0336	.0587	.1944	.1271	.0620	.0475
1999	.7014	.1521	.0322	.0537	.1955	.1248	.0704	.0528
2001	.7006	.1536	.0337	.0580	.1926	.1235	.0730	.0529
2003	.7073	.1516	.0315	.0563	.1868	.1189	.0743	.0512
2005	.7118	.1475	.0309	.0569	.1785	.1145	.0785	.0535
2007	.7143	.1469	.0298	.0530	.1716	.1128	.0841	.0612

9.3: Physician Practice Area

Although the majority of all doctors sampled work in large MSAs, this is especially true of immigrant physicians. Foreign physicians in the sample are more likely than U.S. doctors to practice in big cities and less likely than their native counterparts to work in small cities or rural areas. U.S.-born physicians are more likely than their foreign-born counterparts to work in medium and small cities and rural areas.

Table 7
U.S. and Foreign-Born Physicians by Practice Area Size

MSA	Population	# of U.S.-Born Physicians	% of U.S. Born Physicians	# of Foreign-Born Physicians	% of Foreign-Born Physicians
A	1,000,000+	82,567	65%	33,661	76%
B	250,000-999,999	20,319	16%	5,107	11%
C	100,000-249,999	9,163	7%	2,203	5%
D	<100,000	1,091	1%	207	0%
N/A	Rural	13,215	10%	3,325	7%

Note: Percentages may not add up to 100% due to rounding.

This would seem to contradict the idea that foreign physicians serve in rural parts of America where doctors are scarce, and suggests that policies encouraging physicians to locate in these areas are unsuccessful. However, the result that foreign physicians are more likely to work in big cities does not invalidate the theory that they are serving in shortage areas per se; the Health Professional Shortage Areas and Medically Underserved Areas as defined by the U.S. Department of Health and Human Services are comprised of rural areas as well as inner city areas in large cities, or anywhere that there is a shortage of primary medical care, dental, or mental health providers.

Table 8 reports the twenty MSAs with the largest number of foreign-born physicians sampled. The number of foreign-born physicians in the sample in each MSA, for all MSAs in the sample, can be found in Table A2 in the Appendix.

Table 8
Foreign-Born Physicians by MSA

MSA	# of Foreign-Born Physicians	% of Total Foreign-Born Physicians
New York, NY	3,669	8.2%
Los Angeles-Long Beach, CA	2,380	5.3%
Chicago, IL	2,139	4.8%
Boston, MA	1,317	3.0%
Washington, DC-MD-VA	1,315	3.0%
Detroit, MI	1,064	2.4%
Nassau-Suffolk, NY	1,056	2.4%
Philadelphia, PA-NJ	1,047	2.4%
Miami, FL	985	2.2%
Houston, TX	941	2.1%
Orange County, CA	777	1.7%
Baltimore, MD	679	1.5%
Cleveland, OH	641	1.4%
Newark, NJ	512	1.2%
St. Louis, MO-IL	511	1.1%
Riverside-San Bernardino, CA	506	1.1%
Bergen-Passaic, NJ	505	1.1%
Atlanta, GA	504	1.1%
San Francisco, CA	490	1.1%
Dallas-Plano-Irving, TX	483	1.1%

9.4: Physician Demographic Characteristics

Foreign-born doctors in the sample tended to be slightly older: the mean age of foreign born doctors in the sample is 48.69 (standard deviation: 12.83) and the mean age of U.S. born doctors in the sample is 47.16 (standard deviation: 13.21). For both groups of doctors, the median occurs between ages 51 and 60.

Table 9 reports the percent of U.S.-born and foreign-born physicians working in each size MSA by age group.

Table 9
Physicians by Age and Size of Practice Area

U.S.-Born Physicians

	MSA Size					
Age	A	B	C	D	Rural	Total
20-30	75%	15%	6%	0%	4%	100%
31-40	68%	16%	7%	1%	9%	100%
41-50	63%	17%	8%	1%	12%	100%
51-60	63%	16%	8%	1%	12%	100%
61+	65%	15%	7%	1%	12%	100%

Foreign-Born Physicians

	MSA Size					
Age	A	B	C	D	Rural	Total
20-30	85%	9%	4%	0%	2%	100%
31-40	76%	11%	5%	1%	7%	100%
41-50	74%	13%	5%	0%	7%	100%
51-60	74%	12%	5%	0%	8%	100%
61+	76%	11%	4%	0%	8%	100%

Note: Percentages may not add up to 100% due to rounding.

The previously discovered phenomenon that foreign-born doctors are more likely to practice in large cities than their native-born counterparts holds across all age groups. The same is true for the conclusion that U.S.-born physicians are more likely than their foreign-born counterparts to work in rural areas. Younger doctors, no matter where they were born, are most likely to live in the largest MSAs, while older physicians are more likely than younger physicians to practice in rural areas.

Table 10 reports the sex of physicians sampled by birthplace and year. There are notably more men than women in the sample: 119,309 men compared with only 42,526 women. Foreign-born physicians are more likely to be female. This is especially the case in earlier years of the survey; in 1997, 27% of foreign-born physicians sampled were female compared with only 22% of U.S.-born physicians. This difference tends to decrease over time as the gap between native-born male and female doctors has been narrowing since 1997. In fact, for both foreign-born and U.S.-born doctors as well as for all doctors combined, the proportion of doctors who are female has been increasing since 1997. The number and percentage of physicians born in the U.S. and abroad, by sex and by year, are reported in the Appendix in Table A3.

Table 10
Sex of Physician by Place of Birth and Year

U.S-Born Physicians	1997	1999	2001	2003	2005	2007
Female	22%	23%	24%	26%	28%	29%
Male	78%	77%	76%	74%	72%	71%

Foreign-Born Physicians	1997	1999	2001	2003	2005	2007
Female	27%	29%	29%	30%	31%	30%
Male	73%	71%	71%	70%	69%	70%

Total (All Physicians)	1997	1999	2001	2003	2005	2007
Female	23%	24%	25%	27%	29%	29%
Male	77%	76%	75%	73%	71%	71%

Note: Percentages may not add to 100% due to rounding.

For purposes of this analysis, physicians were grouped into the seven categories of specialties reported in the OES wage data: anesthesiology, family/general practice, internal medicine, OB/GYN, pediatrics, psychiatry, and surgery. Those physicians whose specialties did not fall into one of these major categories were classified as "other". The number of physicians by specialty and sex are reported in Table 11.

Table 11
Physician Specialty by Sex

Specialty	All Physicians		Male		Female	
Anesthesiology	8,939	5%	7,030	6%	1,909	4%
Family/General Practice	23,212	14%	16,767	13%	6,445	14%
Internal Medicine	24,089	14%	16,892	13%	7,197	16%
OBGYN	10,337	6%	6,320	5%	4,017	9%
Pediatrics	14,760	9%	7,258	6%	7,502	17%
Psychiatry	10,900	6%	7,332	6%	3,568	8%
Surgery	27,232	16%	24,096	19%	3,136	7%
Other Specialty	51,389	30%	40,429	32%	10,960	25%

Note: Percentages may not add to 100% due to rounding.

As can be seen in the table, men are much more likely than women to specialize in surgery and somewhat more likely to specialize in anesthesiology. Women, on the other hand, are more likely to specialize in psychiatry, and are far more likely than men to specialize in OB/GYN. These specialty choices become important later in this paper in explaining differences in the wages between men and women.

The specialties of foreign-born and native physicians as well as those educated at U.S. medical schools and abroad are reported in Table 12.

Table 12
Physician Specialty by U.S. / Foreign Birth and Education

Specialty	U.S.-Born		Foreign-Born		U.S. Med School		Foreign Med School	
Anesthesiology	6,171	5%	2,768	6%	6,550	5%	2,389	6%
Family/General Practice	18,515	15%	4,697	11%	19,003	14%	4,209	11%
Internal Medicine	16,170	13%	7,919	18%	17,311	13%	6,778	18%
OBGYN	7,815	6%	2,522	6%	8,289	6%	2,048	5%
Pediatrics	10,725	8%	4,035	9%	11,242	8%	3,518	9%
Psychiatry	7,664	6%	3,236	7%	7,750	6%	3,150	8%
Surgery	21,858	17%	5,374	12%	23,373	18%	3,859	10%
Other Specialty	37,437	30%	13,952	31%	39,950	30%	11,439	31%

Note: Percentages may not add to 100% due to rounding.

As family/general practice and internal medicine are very similar specialties, grouping them together for comparative purposes, there are approximately the same proportion of general practitioners in the sample of U.S.-born and foreign-born doctors. In fact, the percentages of physicians in each specialty are almost exactly the same across birthplace with the notable exception of surgery: U.S. born physicians are more likely to be surgeons than their foreign-born counterparts. A similar conclusion can be drawn when comparing physicians educated at medical schools located within and outside the U.S.: physicians educated in the U.S. are much more likely to become surgeons, but there are no other remarkable differences in specialty choice.

9.5: Wages of Physicians: Summary Statistics

Although the AMA sample produced 170,858 observations for which physician country of birth was available, there are a few cases where the OES database did not report a wage for a particular physician specialty or locality for a given year. Thus, after merging the AMA physician survey data with the OES wage data, wages were available and assigned to 161,835 physicians. In the discussion that follows, it is important to keep in mind that "physician wages" are not necessarily the actual wages of the physician sampled; they are the average wage for the physician's specialty in the physician's practice area in the relevant year.

The mean hourly wage of all the wages assigned to the physicians in the sample is \$65.87893 with a standard deviation of \$15.14222. Physician wages ranged from a low of \$10.20 per hour to a high of \$103.00. The average wages by year are reported in Table 13.

Table 13
Average Physician Wages by Year

Year	Mean Wage	Standard Deviation	Min	Max
1997	49.37990	7.693108	10.20	95.16
1999	55.56695	8.231586	16.10	70.00
2001	58.51647	7.523859	14.32	69.92
2003	75.34824	14.27231	17.00	101.28
2005	74.52094	11.43191	21.15	94.00
2007	78.43643	11.46004	24.00	103.00

The wages assigned to women in the sample were, on average, lower than those assigned to men. The mean wage of women is estimated to be \$65.378 per hour (standard deviation: $14.92697) while the mean wage of men is estimated to be $66.05748 per hour (standard deviation: $15.21429). The averages of the wages assigned to male and female physicians by year are reported in Table 14.

Table 14
Average Physician Wages by Sex

	Men		Women	
Year	Mean Wage	Standard Deviation	Mean Wage	Standard Deviation
1997	49.73773	7.568217	48.14859	7.987421
1999	55.82967	8.229977	54.74475	8.182890
2001	58.87995	7.492362	57.44544	7.514875
2003	76.09952	14.31077	73.32031	13.96856
2005	75.21550	11.30691	72.78799	11.55812
2007	79.01703	11.32920	77.02602	11.65265

A comparison of means test rejects the null hypothesis that there is no significant difference in the average wage assigned to men compared to women and supports the alternative hypothesis that women, on average, are more likely to live in areas where wages are lower and/or specialize in lower paying fields:

Table 15
Comparison of Means Test: Wages by Sex

Sex	Observations	Mean Wage	Standard Error	95% Confidence Interval
F	42,526	65.37800	.0723843	65.23613 - 65.51988
M	119,309	66.05748	.0440469	65.97115 - 66.14381
Total	161,835	65.87893	.0376403	65.80516 - 65.95271
Difference		-.6794786	.0855025	-.8470616 - -.5118956

Difference = mean(F) - mean(M) t = -7.9469

H_o: Difference = 0 degrees of freedom = 161,833

H_a: diff < 0	H_a: diff = 0	H_a: diff > 0
Pr(T < t) = 0.0000	Pr(|T| > |t|) = 0.0000	Pr(T > t) = 1.0000

The data further suggest that foreign-born doctors are more likely to earn slightly less than U.S.-born physicians. The mean wage of native-born physicians in the sample is estimated to be $65.96572 per hour (standard deviation: $15.29789) while the mean wage of foreign-born doctors is estimated to be $65.62861 per hour (standard deviation: $14.68132). The averages of the wages assigned to U.S.-born and foreign-born physicians by year, based on specialty and practice area, are reported in Table 16.

Table 16
Average Physician Wages: U.S.-Born and Foreign Born

	U.S.-Born		Foreign-Born	
Year	Mean Wage	Standard Deviation	Mean Wage	Standard Deviation
1997	49.39742	7.822257	49.31997	7.234232
1999	55.73508	8.260620	55.11172	8.135574
2001	58.57167	7.564645	58.36383	7.408262
2003	75.53049	14.40141	74.83422	13.88978
2005	74.71374	11.58896	73.96442	10.94773
2007	78.63872	11.68048	77.84919	10.77394

A comparison of means test rejects the null hypothesis that there is no significant difference in the average wage assigned to immigrant physicians compared to native-born doctors and supports the alternative hypothesis that foreign-born doctors, on average, are more likely to live in areas where wages are lower and/or specialize in lower paying fields.

Table 17
Comparison of Means Test: Wages by Birthplace

Birthplace	Observations	Mean Wage	Standard Error	95% Confidence Interval
U.S.	120,171	65.96572	.0441298	65.87923 – 66.05222
Foreign	41,664	65.62861	.0719258	65.48763 – 65.76958
Total	161,835	65.87893	.0376403	65.80516 – 65.95271
Difference		.3371175	.0860848	.1683932 - .5058418

Difference = mean(U.S.) - mean(Foreign) t = 3.9161

H_o: Difference = 0 degrees of freedom = 161,833

H_a: diff < 0	H_a: diff = 0	H_a: diff > 0
Pr(T < t) = 1.0000	Pr(|T| > |t|) = 0.0001	Pr(T > t) = 0.0000

Physicians educated at foreign medical schools seem to earn considerably less than those educated at medical schools in the U.S.; the difference in wages appears to be more drastic than the difference in wages based on place of birth. The mean wage of U.S. educated physicians in the sample is estimated to be $66.245 per hour (standard deviation: $15.10868) while the mean wage of foreign educated doctors is estimated to be $64.55275 per hour (standard deviation: $15.18964). The averages of the wages assigned to physicians by location of medical school and year, based on specialty and practice area, are reported in Table 18.

Table 18
Average Physician Wages: by Location of Medical School Attended

	U.S.-Educated		Foreign-Educated	
Year	Mean Wage	Standard Deviation	Mean Wage	Standard Deviation
1997	49.57645	7.427113	48.62338	8.599974
1999	55.84859	8.082030	54.63304	8.644367
2001	58.66989	7.399834	57.99196	7.911378
2003	75.79231	14.03253	73.76393	14.99110
2005	74.80303	11.28907	73.45767	11.89602
2007	78.83199	11.34080	76.87175	11.79168

A comparison of means test rejects the null hypothesis that there is no significant difference in the average wage assigned to physicians educated abroad compared to those educated in the U.S. and supports the alternative hypothesis that doctors who attended foreign medical schools, on average, are more likely to live in areas where wages are lower and/or specialize in lower paying fields:

Table 19
Comparison of Means Test: Wages by Location of Medical School Attended

Med School	Observations	Mean Wage	Standard Error	95% Confidence Interval
U.S.	126,827	66.24500	.0424249	66.16185 – 66.32815
Foreign	35,008	64.55275	.0811827	64.39363 – 64.71187
Total	161,835	65.87893	.0376403	65.80516 – 65.95271
Difference		1.692255	.0913224	1.513265 – 1.871245

Difference = mean(U.S.) - mean(Foreign) t = 18.5305

H_o: Difference = 0 degrees of freedom = 161,833

H_a: diff < 0	H_a: diff = 0	H_a: diff > 0
Pr(T < t) = 1.0000	Pr(|T| > |t|) = 0.0000	Pr(T > t) = 0.0000

These results suggest that location of medical school may be a more important factor in determining wages than birthplace.

A comparison of wages by both birthplace and location of medical school reveals an interesting result: the estimated wage of U.S.-born physicians educated abroad is the *lowest* of all physicians. This could be explained if U.S. born physicians who are educated abroad are doing so out of necessity; perhaps they are of lower quality in terms of scholastic achievement and cannot get accepted to medical school in the U.S. The comparison of means tests of estimated wages of U.S. and foreign-born physicians by location of medical school are reported in Table 20.

Table 20
Comparison of Means Test:
Wages by Birthplace and Location of Medical School Attended

U.S.-Born Physicians

Med School	Observations	Mean Wage	Standard Error	95% Confidence Interval
U.S.	115,017	66.17106	.0445914	66.08366 – 66.25846
Foreign	5,154	61.38346	.2534297	60.88663 – 61.88029
Total	120,171	65.96572	.0376403	65.87923 – 66.05222
Difference		4.787601	.2173727	4.361554 – 5.213648

Difference = mean(U.S.) - mean(Foreign) t = 22.0249
H_o: Difference = 0 degrees of freedom = 120,169

H_a: diff < 0	H_a: diff = 0	H_a: diff > 0
Pr(T < t) = 1.0000	Pr(|T| > |t|) = 0.0000	Pr(T > t) = 0.0000

Foreign-Born Physicians

Med School	Observations	Mean Wage	Standard Error	95% Confidence Interval
U.S.	11,810	66.96512	.1375882	66.69542 – 67.23482
Foreign	29,854	65.09989	.0841467	64.93496 – 65.26482
Total	41,664	65.62861	.0719258	65.48763 – 65.76958
Difference		1.865227	.1593351	1.552927 – 2.177527

Difference = mean(U.S.) - mean(Foreign) t = 11.7063
H_o: Difference = 0 degrees of freedom = 41,662

H_a: diff < 0	H_a: diff = 0	H_a: diff > 0
Pr(T < t) = 1.0000	Pr(|T| > |t|) = 0.0000	Pr(T > t) = 0.0000

For both U.S.-born and immigrant physicians, the null hypothesis that there is no significant difference in average wages of physicians educated in U.S. or foreign medical schools is rejected in favor of the alternative, that physicians educated in the U.S. are more likely to live in areas and/or specialize in fields for which wages are higher.

As previously explained, wages were assigned to physicians based on practice area (PMSA, MSA or state, where applicable) and specialty. For all years and areas in the sample, surgeons are the highest paid of all specialists with an average hourly wage of $74.05, while family/general practitioners and psychiatrists tend to be the lowest paid with average wages of $59.95 and $60.07 per hour, respectively. The average wages by specialty for all years and areas in the sample, as well as estimated wages by place of birth and education, are reported in Tables 21 through 23.

Table 21
Average Wages by Physician Specialty

Specialty	Mean Wage	Standard Deviation
Anesthesiology	69.86168	18.35551
Family/General Practitioners	59.94589	13.87846
Internal Medicine	66.40683	14.91470
OB/GYN	70.66007	16.42572
Pediatrics	60.99174	13.40880
Psychiatry	60.06922	13.41130
Surgeons	74.05098	16.18843
Other	64.97257	12.49072

Table 22
Average Wages by Physician Specialty and Birthplace

Specialty	U.S.-Born Mean Wage	U.S.-Born Standard Deviation	Foreign-Born Mean Wage	Foreign-Born Standard Deviation
Anesthesiology	69.83370	18.38523	69.92542	18.29101
Family/General Practitioners	60.11647	13.85956	59.26293	13.93452
Internal Medicine	66.18644	15.11365	66.86565	14.48198
OB/GYN	70.59882	16.49930	70.85211	16.19482
Pediatrics	61.18670	13.53934	60.46149	13.03417
Psychiatry	59.90264	13.56181	60.47003	13.03556
Surgeons	74.17250	16.32209	73.54924	15.61601
Other	64.99336	12.64371	64.91615	12.06612

Table 23
Average Wages by Physician Specialty and Location of Med School Attended

Specialty	U.S.-Educated Mean Wage	U.S.-Educated Standard Deviation	Foreign-Educated Mean Wage	Foreign-Educated Standard Deviation
Anesthesiology	70.14947	18.32521	69.05622	18.42028
Family/General Practitioners	60.48336	13.51183	57.50910	15.19694
Internal Medicine	66.40421	14.92556	66.41366	14.88749
OB/GYN	70.90430	16.32767	69.65452	16.79034
Pediatrics	61.38920	13.35084	59.68996	13.51736
Psychiatry	60.09691	13.46288	60.00015	13.28386
Surgeons	74.29921	16.18393	72.52526	16.13460
Other	65.16821	12.43361	64.28210	12.66670

As reported earlier in Table 11, women in the sample were more likely to be general practitioners or to specialize in OB/GYN, pediatrics or psychiatry. Wages for these specialties, with the exception of OB/GYN, tend to be lower than other specialties. Men, on the other hand, are more likely to specialize in anesthesiology and surgery, which are two of the highest-paying fields. This provides evidence that differences in pay by sex may be attributable to specialty choice, and not necessarily based on discrimination.

As reported in Table 12, U.S. born physicians were more likely to specialize in surgery than their immigrant counterparts. Again, as surgery is the highest paid specialty, differences in average physician wages by birth country might be explained by specialty choice. Similarly, graduates of foreign medical schools were more likely to be general practitioners and much less likely to be surgeons; therefore, the fact that graduates of foreign medical schools are estimated to have lower wages than doctors educated in the U.S. might also be at least partially explained by specialty. In this case, specialty could refer to specialty choice, or lack thereof, if foreign medical graduates specialize in other fields but must resort to practicing general medicine in the U.S.

Interestingly, when comparing the estimated wages of U.S.-born and foreign-born physicians by specialty, overall the wages tend to be quite similar. However, when comparing estimated wages of physicians educated in the U.S. and abroad, the wage estimates for physicians educated at foreign medical schools are noticeably lower than physicians educated in the U.S. This implies that lower average wages of physicians educated outside the U.S. may result from specialty choice as well as location of practice area, with foreign-educated physicians locating in areas where wages are already lower or where migration of foreign-educated physicians actually causes wages to be lower in a specific area.

Chapter 10: Regression Results

10.1: Variable Summary

A summary of the variables employed in this study is reported in Table 24. It is important to note that in the following regression analyses, the dependent variable, the natural log of wages *lnw*, is not the actual wage of the individual physician sampled from the survey. Instead, average physician wages as reported in the Occupational Employment Statistics survey were assigned to the physicians sampled by specialty, MSA or state, where applicable, and year.

Table 24
Summary of Variables

Variable	Description
Ln $w_{a,t}$	Dependent variable, natural log of the average hourly wage rate of physicians by specialty, indexed by area and year
$I_{a,t}$	Immigration share, percentage of physicians in a given area and year who are foreign-born
Male	Dummy variable = 1 if physician is male, = 0 if female
Age	Physician age
Age^2	Square of physician age
$MedB_{a,t}$	Percentage of population in physician's service area in a given year who are covered by Medicare Part B
FBFE_ $Share_{a,t}$	Foreign-born foreign-educated share, percentage of immigrant physicians in a given area and year who attended a foreign medical school
FBUSE_ $Share_{a,t}$	Foreign-born U.S.-educated share, percentage of immigrant physicians in a given area and year who attended a U.S. medical school
USBFE_ $Share_{a,t}$	U.S.-born foreign-educated share, percentage of native-born physicians in a given area and year who attended a foreign medical school
$S_{a,t}$	Physician Stock, number of physicians as a percentage of the area population in a given year
FB90	Instrumental Variable: percentage of area population that was foreign-born as of the 1990 Census

The correlations between the independent variables employed in this analysis are reported in Table 25.

Table 25
Pairwise Correlations between Independent Variables

Variable:	I	FBFE Share	FBUSE Share	USBFE Share	Male	Age	Age^2	MedB	S
I	1.000								
FBFE		1.000							
FBUSE		0.109	1.000						
USBFE		0.082	-0.043	1.000					
Male	-0.028	-0.011	-0.048	0.055	1.000				
Age	0.030	0.040	-0.013	0.040	0.239	1.000			
Age^2	0.036	0.044	-0.007	0.040	0.229	0.987	1.000		
MedB	-0.144	0.001	-0.370	0.051	0.065	0.047	0.039	1.000	
S	0.033	0.014	0.060	-0.048	-0.019	0.011	0.011	-0.104	1.000

10.2: Ordinary Least Squares and Two-Stage Least Squares Results

The OLS and 2SLS estimates of the impact of immigration on area wages are reported in Table 26. Estimation of these regressions is performed at the individual level, where the immigrant share in an area and year are regressed on the natural log of the wage assigned to the individual physicians sampled. All regressions include time fixed effects and robust standard errors are reported in parentheses.

Table 26
OLS and 2SLS Estimates of the Relationship between Immigration and Physician Wages

Dependent Variable: Natural Log of Physician Wages: ln w

	(1) OLS w/ Time Fixed Effects						(2) 2SLS w/ Time Fixed Effects					
Independent Variable	(a)		(b)		(c)		(a)		(b)		(c)	
I = Immigrant Share	-0.0131	***	-0.0720	***			-0.1688	***	-0.1723	***		
	(.0031)		*(.0044)*				*(.0055)*		*(.0058)*			
FBFE_Share					0.0564	***					-0.0696	***
					(.0057)						*(.0065)*	
FBUSE_Share					-0.1621	***					-0.4770	***
					(.0143)						*(.0253)*	
USBFE_Share					-1.2630	***						
					(.0254)							
Male	0.0306	***	0.0310	***	0.0297	***	0.0289	***	0.0295	***	0.0295	***
	(.0010)		*(.0011)*		*(.0011)*		*(.0009)*		*(.0010)*		*(.0010)*	
Age	0.0011	***	0.0010	***	0.0011	***	0.0006	***	0.0008	***	0.0007	***
	(.0002)		*(.0002)*		*(.0002)*		*(.0002)*		*(.0002)*		*(.0002)*	
Age^2	-0.0000	***	-0.0000	***	-0.0000	***	-0.0000	***	-0.0000	***	-0.0000	***
	(.0000)		*(.0000)*		*(.0000)*		*(.0000)*		*(.0000)*		*(.0000)*	
MedB	0.4714	***	0.5449	***	0.7278	***	0.3673	**	0.5627	***	0.3526	***
	(.0117)		*(.0168)*		*(.0185)*		*(.0113)*		*(.0152)*		*(.0212)*	
S = Physician Stock			-0.4487	***	-0.4994	***			-0.4643	***	-0.4696	***
			(.0102)		*(.0105)*				*(.0102)*		*(.0103)*	
First-Stage											23,569	
F-Test of Instrument							68,737		96,185		29,492	
# of obs	161,811		129,375		129,375		159,448		128,074		128,074	
R-Squared	0.4946		0.5076		0.5491		0.5483		0.5513		0.5508	

**p<.10, **p<.05, ***p<.01 All coefficients reported with robust standard errors.*
Note: Parts (1)(b), (1)(c), (2)(b) and (2)(c) have fewer observations due to lack of data on the physician stock variable.
2SLS regressions have fewer variables due to lack of data on the instrumental variable.

The first specification of the model (1) employs an ordinary least squares analysis, with time dummy variables to control for time fixed effects, to test for the impact of immigration on local area wages. The joint test of significance reveals that, for all three specifications (1)(a), (1)(b) and (1)(c), the included independent variables are significant in explaining variation in area wages at the 1% level. The R-squared coefficients of determination indicate that between 49.46% and 54.91% of the variability in wages can be explained by the regression models above.

The first regression run, (1)(a), indicates a highly significant, although practically small, impact of immigration on local wages. Specifically, areas with a one percentage point larger immigrant share (where the immigrant share is the percentage of doctors in the area who are foreign-born), ceteris paribus, have 0.0131% lower wages, on average.

Adding the variable *S* (1)(b), which measures the stock of physicians, the percentage of physicians in a given area and year relative to total population, controls for the increase in supply that occurs when an immigrant physician moves to an area and the possibility that, in response, other physicians move away from the area. The coefficient on this variable is negative, as expected, large and highly significant. All else constant, areas with one percentage point more physicians per capita have 0.4487% lower average wages. This result is consistent with the basic supply and demand theory that an increase in supply, holding demand constant, should result in a lower wage. After including this supply control, the negative effects of immigration become larger, and remain significant at the 1% level. In this case, holding physician supply constant, a one percentage point increase in the number of foreign physicians in a given area is predicted to result in .0720% lower area wages, on average. The result that the effect is smaller when supply is not held constant suggests that local physicians may respond to the lower wages caused by an influx of immigrant physicians by moving away from the area.

The third specification of the OLS regression model (1)(c) adds controls for country of education. Specifically, the three variables *FBFE_Share*, *FBUSE_Share*, and *USBFE_Share* are added to the model, with U.S.-born and educated physicians omitted as the base group for comparison purposes. The coefficients on all three of these birth/education variables are significant at the 1% level. Areas with a one percentage point larger share of physicians who were born and educated abroad are predicted to have 0.0564% higher wages, on average. Areas with a one percentage point larger share of physicians born in a foreign country but educated in the U.S. are predicted to have 0.1621% lower wages, on average, and areas with a one percentage point larger share of physicians born in the U.S. but educated abroad are predicted to have 1.263% lower average wages.

These results provide evidence that the negative impacts of immigration come not from foreign born and educated doctors, but from immigrant physicians who are educated in the U.S. At first this result may seem counterintuitive, but there is a probable explanation for it. Foreign-born, U.S.-educated physicians could be one of two types: those who migrated to the U.S. as small children and grew up in America and those who came to the United States as adults for purposes of higher education. Both groups of physicians may have benefited from university and medical school admissions policies that favor foreign students. Furthermore, the latter group likely is less restricted by visa issues as the longer they have been in the U.S., the more likely that they have achieved resident alien or citizen status. Foreign-born and educated physicians, on the other hand, immigrated at some point in their lives after achieving their medical degree. They are more likely than their U.S.-educated counterparts to have entered the United States through the H-1B visa program by a sponsored employer or through the O visa program as an extraordinary physician in their field. In either of these cases, the foreign-born foreign-educated physician is likely to be either the cream of the crop in their specialty or one who is extremely driven and dedicated to achieve his or her goals. This theory is consistent with the findings of Chiswick (1999) that migrants tend to be favorably self-selected. Thus, it is certainly plausible that these physicians do actually earn higher wages than their foreign-born, U.S.-educated counterparts.

The physicians who seem to have the most negative effect on wages are those born in the U.S. but educated abroad. This result is likely explained because U.S.-born physicians who attend a foreign medical school do so out of necessity; they may not have been accepted to a U.S. medical school. Therefore, they may be of lower quality which would result in them being more likely to practice as general practitioners than high paid specialists, potentially having less selection as far as jobs are concerned and thus being forced to work in less desirable, lower paying areas, and being less productive and thus paid a lower wage on average.

As previously discussed, the results of the OLS regressions likely suffer from endogeneity bias because immigrant location is not randomly selected but, rather, chosen by the immigrant. The results of the 2SLS analysis are previously reported in Table 26. In the first two specifications (2)(a) and (2)(b), where the measure of immigration is represented by *I*, the immigrant share, the instrument *FB90*, the foreign-born share of the area's population in 1990, has been employed. The results of the first stage regressions reveal that the instrument is highly significant in predicting *I* after controlling for the other independent regressors. Specifically, there is a strong positive relationship between the foreign-born population share in an area in 1990 and the current share of immigrant physicians. The F-Test of the significance of the instrument is extremely significant and shows that the instrument passes the first requirement, that it be highly correlated with *I* and significant in the first-stage regressions. The second assumption, that *FB90* is not correlated with the error term and is therefore not directly related to current wages, cannot be tested. Following the earlier research of Altonji and Card (1991) and Card (2001), this study assumes that the second condition is satisfied.

The results of the second-stage regressions show a highly significant negative effect of immigration on wages. In this case, the negative effect is even larger than reported in the OLS regressions. A one percentage point increase in the share of immigrant physicians in an area is associated with 0.1688% to 0.1723% lower average physician wages. The result that the negative impacts of immigration as measured by the 2SLS approach which controls for endogenous location choice are more negative than the OLS results provides evidence that immigrants are in fact drawn to areas where wages are higher prior to their arrival.

A comparison of the results from the OLS regression (1)(b) and the 2SLS regressions (2)(b) provides evidence that local physicians respond to the decrease in wages caused by immigration by moving out of the area, and that the lowest paid physicians in the area are more likely to move out than the higher paid physicians. These two specifications of the model include the physician supply control variable *S*, and measure the impact of immigration on wages *holding physician supply constant*.

However, this does NOT mean that these analyses do not allow local physicians to move out. Specifically, holding physician supply constant requires that for each physician moving into the area, one physician must move out. The results of the 2SLS analysis are more negative than those of the OLS regression; adding the control for endogeneity indicates that the true impact of immigration is more negative than is observable using the OLS approach. If immigrant physicians move into an area and drive out the lowest paid physicians, the decrease in average physician wages in the area would be offset by the flight of these low paid doctors, and the average wage observed in the area would be higher than it would have been if these lowest paid physicians had remained in the area.

Performing the 2SLS analysis on the impact of immigration by country of medical school on area wages requires the inclusion of not only the instrument *FB90* but also the *FE_IV*, the calculation of which was described earlier in Chapter 7.3. The results of the first stage regressions show a strong and highly statistically significant correlation between both instruments and the two endogenous regressors, *FBFE_Share* and *FBUSE_Share.* The F-tests for joint significance of the instruments in the regression of *FBFE_Share* and *FBUSE_Share* on the instruments and other exogenous regressors produce a value of 29,492 and 23,569, respectively, and show that the two instruments are highly significant in predicting immigrant share by country of education.

Breaking down the results of the 2SLS analysis by location of medical school attended in part (2)(c) also produces a uniformly more negative effect of immigration on wages. The coefficient on the *FBFE_Share* variable (foreign-born, foreign-educated share of physicians in an area) changes signs from positive to negative and is statistically significant at the 1% level. Specifically, after controlling for endogenous location choice, a one percentage point increase in the foreign-born, foreign-educated share of physicians in an area is associated with a 0.0696% decrease in average wages. A one percentage point increase in the foreign-born, U.S.-educated share of physicians in an area is associated with a 0.477% decrease in average area wages. This effect is also statistically significant at the 1% level. The negative impacts of immigration remain larger for the foreign-born, U.S.-educated physicians, the explanation for which was previously discussed. The change in sign of the *FBFE_Share* variable and the increase in the magnitude of the negative coefficient on the *FBUSE_Share variable* both support the previous hypotheses that immigrant physicians, regardless of where they are educated, are drawn to areas where wages are higher, and that local physicians, particular those from the low end of the pay scale, move out of the area in response to an influx of immigration, diffusing the potential negative wage impacts of the immigrant physicians.

The 2SLS analysis controlling for both country of birth and education had to be performed without the inclusion of the *USBFE_Share* variable. This variable is likely endogenous as well, as U.S.-born, foreign-educated physicians are just as likely to be drawn to higher paying locations as foreign-born physicians are. However, without a valid third instrument it is not possible to include this variable in the analysis. Thus, the base category that the wage impacts of *FBFE* and *USBFE* physicians is to be compared to is *all* U.S.-born physicians, regardless of where they were educated. As the focus of this study is to determine the impact of immigration of foreign physicians on wages, this limitation does not substantially hinder the research.

The signs of all of the demographic characteristic variables in parts (1) and (2) are as expected and all are significant at the 1% level. Male doctors are expected to be paid about 3% higher wages, on average, than females. Physicians' wages increase with age but at a decreasing rate.

The coefficient on *MedB* is large, positive, and highly significant. Areas where one percentage point more of the population are covered by Medicare Part B are associated with 0.3526% to 0.7278% higher physician wages, on average, depending on the specification of the model employed. The strong positive impact is likely due to areas with a higher percentage of patients covered by Medicare Part B having higher demand for physician services and, perhaps, also because physicians are more likely to actually receive payment when a patient is covered by Medicare compared to self-pay or uninsured patients. In order to be covered by Medicare Part B, patients must be over the age of 65 or disabled; these populations are large consumers of medical care.

In all specifications of the model reported in Table 26, the impact of an increase in the number of area physicians per capita is uniformly negative and highly significant. Areas with one percentage point more physicians per capita have 0.4643% to 0.4994% lower physician wages, on average. This result is consistent with the basic economic theory of labor supply and demand. A larger supply of physicians, ceteris paribus, should be associated with lower equilibrium wages.

10.3: OLS with Area Fixed-Effects and First-Difference Results

The following regression analyses employ the ordinary least squares method with area fixed effects and the first-differencing approach. Both of these methods control for unobserved area-specific factors that affect wages and isolate the *change* in wages due to *changes* in the immigrant share. The coefficients in each of these regressions are interpreted as the marginal effect of a change in immigration on area wages. Following Orrenius and Zavodny (2007) and Altonji and Card (1991), for both of these approaches the data are collapsed and analyzed at the area level. The number of observations, therefore, drops from 161,811 physicians to 599 areas (comprised of MSAs and counties) for the OLS regressions with area fixed effects, and even further to 487 areas for the first-difference analyses (areas which did not have physicians sampled in every year were dropped so as to create a balanced panel). The dummy variable, *male*, is not lost in these regressions as when it is collapsed at the area level it is no longer a dummy variable and instead becomes the proportion of area physicians who are men in a given year.

It is important to note that the first-difference approach is more likely than the cross-sectional (OLS and 2SLS) approach to capture short-run effects of immigration, in which local labor markets have not had time to adjust. Furthermore, "the relative magnitude of the short run and long run effects on wages depend on whether there are barriers to wage adjustments in the short run" (Altonji and Card 1991).

The results of the OLS regressions with area fixed effects and the first-difference regressions are reported in Table 27. All coefficient estimates are reported with robust standard errors in parentheses. For presentation purposes the independent variables are listed on the left, and it should be noted that in the case of the first-difference model they are not in level form but instead represent the change in the variable from one time period to the next (for example, *male* in the first-difference model is instead Δ*male,* but for ease of presentation is simply listed as *male*).

Table 27

Fixed Effects and First-Difference Estimates of the Relationship between Immigration and Physician Wages

Dependent Variable:	ln w			Δln w		
	(3) OLS w/ Time and Area Fixed Effects			(4) First-Difference		
Independent Variable	(a)	(b)	(c)	(a)	(b)	(c)
I = Immigrant Share	-0.0931	0.0058		0.1859 **	.0982	
	(.1111)	*(.1038)*		*(.0749)*	*(.0738)*	
FBFE_Share			0.0435			0.1776 *
			(.1262)			*(.0930)*
FBUSE_Share			-0.1157			0.0181
			(.1849)			*(.1677)*
USBFE_Share			-0.2701			-0.8188 **
			(.2478)			*(.3920)*
Male	0.0479	0.0757	0.0758	0.2057 **	0.2226 **	0.1859 *
	(.1023)	*(.1052)*	*(.1036)*	*(.0950)*	*(.0956)*	*(.0992)*
Age	-0.0151	-0.0160	-0.0168	0.0700 ***	0.0220	0.0328
	(.0230)	*(.0226)*	*(.0227)*	*(.0243)*	*(.0203)*	*(.0206)*
Age^2	0.0001	0.0001	0.0001	-0.0008 ***	-0.0003	-0.0004 *
	(.0002)	*(.0002)*	*(.0002)*	*(.0003)*	*(.0002)*	*(.0002)*
MedB	0.1521	0.3886	0.3856	0.8642 ***	0.3661 *	0.5601 ***
		(.6359)	*(.6373)*	*(.2475)*	*(.2130)*	*(.2106)*
S = Physician Stock		-0.2295	-0.2329		-0.5954 ***	-0.6873 ***
		(.1814)	*(.1832)*		*(.1288)*	*(.1461)*
# of obs	599	533	533	487	398	398
R-Squared	.8833	.8976	.8980	.1149	.0814	.1421
Adj. R-Squared	.8511	.8662	.8661			

**p<.10, **p<.05, ***p<.01 All coefficients reported with robust standard errors.*

Note: Parts (3)(b), (3)(c), (4)(b) and (4)(c) have fewer observations due to lack of data on the physician stock variable.
First-Difference Regressions represent a balanced panel and therefore have fewer observations than OLS Regressions.

The first set of regression results presented in Table 27 are those of the fixed effects estimation. The results of these regressions are somewhat unsatisfactory in that none of the individual regressors is statistically significant. A loss of efficiency compared to other econometrical methods is generally associated with fixed effects estimation, and in this case the sample size compared to the previous OLS and 2SLS regressions has been greatly reduced. So far all coefficient estimates, even those of the OLS and 2SLS models, have been relatively small. Therefore, if there is even less variation of wages *within* areas than there is *between* areas it will be difficult to obtain statistically significant results. Furthermore, any sampling or measurement error that exists in the calculation of the *I*, *FBFE_Share*, *FBUSE_Share*, and *USBFE_Share* variables, as well as the assignment of wages to physicians, is likely to be more problematic in the fixed effects model than in other models. Aydemir and Borjas (2006) posit that it is precisely this measurement error that causes attenuation bias in studies of the impact of immigration on wages. Specifically, they report that the "inclusion of these fixed effects implies that there is very little identifying variation left in the variable that captures the immigrant supply shift, permitting the sampling error in the immigrant share to play a disproportionately large role. As a result, even very small amounts of sampling error get magnified and easily dominate the remaining variation in the immigrant share." Indeed, the three fixed-effects specifications of the model (3)(a), (3)(b) and (3)(c) provide no evidence that changes in the share of immigrant physicians have any significant effect on average physician wages, once time-invariant area-specific factors that effect wages are accounted for.

The second set of results reported in Table 27 is those of the first-difference regressions. Because unobservable factors that affect wages are likely to be correlated over time, serial correlation of the error term is likely to be present (this has been accounted for by using robust standard errors). In the presence of serial correlation of the error term, the first-difference model is more efficient than the fixed effects model. Thus, it is likely the better model for measuring the impact of immigration on wages *within* an area in this case.

The first specification which allows per capita physician supply to vary indicates that, in the short run, immigration of foreign physicians actually has a positive impact on average area wages. Specifically, a one percentage point increase in the share of immigrant physicians in an area is associated with a 0.1859% increase in the average physician wage in the area. This result can be explained as follows: as previously discussed, wages of physicians, like all wages, are likely to be "sticky", and even more so than wages in other professions due to payment mechanisms involving third party payors. Suppose the supply of physicians in an area increases due to immigration. To the extent that physicians are paid based on a fee-for-service mechanism, physician salaries will not be affected until third party payors such as Medicare or insurance companies realize that the physician supply has shifted and that they can lower reimbursement rates without jeopardizing their contracts with the providers. In the meantime, if the immigrant physicians are not the lowest paid doctors in the area, there presence could actually increase the average physician wage in the area in the short run. In the long run, wages will adjust to the supply shift as expected and be reduced.

The results of part (4)(b) include the physician supply control and show that the short-run positive impacts of immigration on wages would be lower if supply were held constant, although this effect is not statistically significant. There is thus some inconclusive evidence that, even in the short-run, the wage impacts of immigration are diluted by local physician labor movement. The results of part (4)(c), which break down the impact of immigration by location of medical school, are in agreement with the results of (4)(a) and (4)(b). The short-run impact of changes in the share of foreign-born immigrants in an area on average local wages is predicted to be positive, whether the immigrant physician was educated abroad or in the U.S. The positive wage impact is stronger for the foreign-born and foreign-educated, and is statistically significant at the 10% level, while the small positive effect of foreign-born, U.S.-educated physicians is not statistically significant. Specifically, a one percentage point increase in the share of foreign-born, foreign-educated physicians in an area is expected to increase average physician wages in the area by 0.1776% in the short-run. The result that foreign-born, foreign educated physicians have a larger positive impact on wages than their U.S.-educated immigrant physician counterparts can be explained in the same way as the earlier 2SLS results where these physicians had a less negative long-run impact on wages than their U.S.-educated counterparts.

As was the case in all prior regressions, migration of U.S.-born physicians has the most negative effect on average area wages. It seems that, whether in the short-run or long-run, these physicians are paid the lowest of any of the four categories of physicians.

The signs and magnitudes of all of the other control variables included in the first-difference regressions are as expected and consistent with the results of the OLS and 2SLS regressions reported in Table 26.

10.4: Two-Stage Least Squares First Difference Results

The final specification of the model involves incorporating the instrumental variables described earlier to control for endogeneity that is not completely accounted for by the first-difference approach. The results of this specification of the model are reported in Table 28.

Table 28
2SLS First-Difference Estimates of the Relationship between Immigration and Physician Wages

Dependent Variable: Change in Natural Log of Physician Wages: Δ ln*w*

Independent Variable	(5)(a)		(5)(b)		(5)(c)	
Δ I Immigration Share	0.1590		0.0653			
	(.1086)		*(.1134)*			
Δ FBFE_Share					0.0751	
					(.1456)	
Δ FBUSE_Share					0.3992	
					(.4028)	
Δ Male	0.2593	***	0.2406	**	0.2410	**
	(.0965)		*(.0999)*		*(.0982)*	
Δ Age	0.0483	**	0.0154		0.0154	
	(.0218)		*(.0192)*		*(.0192)*	
Δ Age^2	-0.0006	**	-0.0002		-0.0002	
	(.0002)		*(.0002)*		*(.0002)*	
Δ MedB	1.0149	***	0.5438	***	0.5259	*
	(.2281)		*(.1790)*		*(.3057)*	
Δ S			-0.5500	***	-0.5517	***
			(.1192)		*(.1211)*	
First-Stage					51.52	
F-Test of Instrument	74.29		59.99		25.65	
# of obs	482		395		395	
R-Squared	0.1292		0.1107		0.1113	

**p*<.10, ***p*<.05, ****p*<.01 All coefficients reported with robust standard errors.
Note: All regressions have fewer observations than Part (4) above due to lack of data on the IV. Part (5)(a) has more observations than (5)(b) and (5)(c) due to lack of data on the S variable.

The results of the first-stage regression analyses indicate that the instruments are highly significant in predicting immigrant share after controlling for the other exogenous regressors. The F-test of joint significance further indicates that the instruments are highly correlated with the measures of immigration employed in this analysis and thus meet the first criterion of an acceptable IV. These first-stage results are reported in the appendix in Table A5. Following Altonji and Card (1991) and Friedberg and Hunt (1995), the instruments are not likely to be correlated with future *changes* in wages.

The estimated short-run marginal effects of changes in the share of immigrant physicians on average area wages, after controlling for endogenous location choice, are similar to the first-difference estimates without the instrumental variable but are smaller in magnitude. This provides additional evidence that immigrant physicians do in fact choose to locate in areas with higher wages. However, none of these estimates are statistically significant. There is evidence that had the immigrant physician not chosen to move to the highest paying area, there would have been no significant short-run effect on wages at all.

10.5: Analyses with Specialty Controls

It is possible that the short-run positive and long-run negative effects of physician immigration could be attributable to specialty choice. In particular, if foreign physicians are more prevalently represented in lower paying specialties, this would explain their long-run negative impact on average area wages. The following analyses incorporate controls for specialty choice for each of the models previously presented. The results of the OLS regressions with time fixed effects and the 2SLS regressions are presented in Table 29. The base specialty category for comparison purposes is "Other Specialty" which, as defined in Chapter 8.2, is the average wage of all physicians in a given area. These results compare to those previously reported without specialty controls in Table 26.

Table 29
OLS and 2SLS Estimates of the Relationship between Immigration and Physician Wages with Specialty Controls

Dependent Variable: Natural Log of Physician Wages: ln w

	(6) OLS w/ Time Fixed Effects			(7) 2SLS w/ Time Fixed Effects		
Independent Variable	(a)	(b)	(c)	(a)	(b)	(c)
I = Immigrant Share	-0.0232 ***	-0.0769 ***		-0.1728 ***	-0.1759 ***	
	(.0028)	*(.0041)*		*(.0052)*	*(.0054)*	
FBFE_Share			0.0517 ***			-0.0557 ***
			(.0054)			*(.0062)*
FBUSE_Share			-0.1811 ***			-0.5319 ***
			(.0133)			*(.0227)*
USBFE_Share			-1.230 ***			
			(.0250)			
Male	0.0050 ***	0.0048 ***	0.0041 ***	0.0043 ***	0.0039 ***	0.0039 ***
	(.0010)	*(.0010)*	*(.0010)*	*(.0009)*	*(.0009)*	*(.0009)*
Age	0.0008 ***	0.0008 ***	0.0010 ***	0.0003	0.0006 ***	0.0006 ***
	(.0002)	*(.0002)*	*(.0002)*	*(.0002)*	*(.0002)*	*(.0002)*
Age^2	-0.0000 ***	-0.0000 ***	-0.0000 ***	-0.0000 **	-0.0000 ***	-0.0000 ***
	(.0000)	*(.0000)*	*(.0000)*	*(.0000)*	*(.0000)*	*(.0000)*
MedB	0.5083 ***	0.5256 ***	0.6933 ***	0.4051 ***	0.5419 ***	0.2964 ***
	(.0101)	*(.0156)*	*(.0174)*	*(.0104)*	*(.0139)*	*(.0196)*
S = Physician Stock		-0.4569 ***	-0.5062 ***		-0.4722 ***	-0.4784 ***
		(.0080)	*(.0084)*		*(.0081)*	*(.0082)*
Anesthesiology	0.0507 ***	0.0503 ***	0.0500 ***	0.0479 ***	0.0487 ***	0.0492 ***
	(.0020)	*(.0022)*	*(.0022)*	*(.0019)*	*(.0021)*	*(.0021)*
Family/General	-0.0834 ***	-0.0859 ***	-0.0848 ***	-0.0796 ***	-0.0812 ***	-0.0810 ***
	(.0014)	*(.0016)*	*(.0015)*	*(.0012)*	*(.0014)*	*(.0014)*
OBGYN	0.0760 ***	0.0738 ***	0.0751 ***	0.0775 ***	0.0760 ***	0.0760 ***
	(.0017)	*(.0019)*	*(.0017)*	*(.0015)*	*(.0016)*	*(.0016)*
Pediatrics	-0.0792 ***	-0.0852 ***	0.0824 ***	-0.0761 ***	-0.0826 ***	-0.0828 ***
	(.0017)	*(.0018)*	*(.0017)*	*(.0015)*	*(.0016)*	*(.0016)*
Psychiatry	-0.0814 ***	-0.0860 ***	-0.0847 ***	-0.0820 ***	-0.0879 ***	-0.0874 ***
	(.0019)	*(.0020)*	*(.0020)*	*(.0017)*	*(.0019)*	*(.0019)*
Surgery	0.1148 ***	0.1135 ***	0.1120 ***	0.1116 ***	0.1119 ***	0.1123 ***
	(.0010)	*(.0011)*	*(.0010)*	*(.0009)*	*(.0009)*	*(.0010)*
Internal Medicine	0.0118 ***	0.0133 ***	0.0144 ***	0.0141 ***	0.0140 ***	0.0138 ***
	(.0013)	*(.0013)*	*(.0013)*	*(.0011)*	*(.0012)*	*(.0012)*
First-Stage						29,240
F-Test of Instrument				68,151	95,898	23,472
# of obs	161,811	129,375	129,375	159,448	128,074	128,074
R-Squared	0.5726	0.5875	0.6268	0.6311	0.6373	0.6365

**p<.10, **p<.05, ***p<.01 All coefficients reported with robust standard errors.*

Note Parts (6)(b), (6)(c), (7)(b) and (7)(c) have fewer observations due to lack of data on the physician stock variable. Part (7) has fewer observations than Part (6) due to lack of data on the instrumental variable.

The results reported in Table 29 as to the impact of physician immigration on local wages are almost identical to those reported earlier in Table 26 without the specialty controls. The small negative impacts of immigration on local wages remain highly significant even when specialty is controlled for. Thus, the negative impact of an increase in the share of immigrant physicians on local area wages cannot be attributed to specialty choice. These results provide evidence that immigration of physicians lowers the average physician wage in an area, most likely because they are willing to accept a lower wage than physicians already practicing in the area. Specifically, the OLS results in part (6)(a) average wage of physicians in areas with a one percentage point larger share of immigrant physicians is expected to be 0.0232% lower on average, and this lower wage is not attributable to foreign physicians specializing in lower paying fields. This effect is significant at the 1% level.

Because the effect becomes even more negative when physician supply is held constant, one can further infer that foreign-born physicians must be paid less, on average, than *native-born* physicians. If the immigrant share increases but per capita physician supply is held constant, the share of native-born physicians in an area must decrease. The larger negative coefficients in both specifications of the 2SLS model, (7)(a) and (7)(b), continue to provide evidence that although foreign-born physicians are willing to accept less than the average area wage, they are still not the lowest paid of all physicians in the area, on average. The 2SLS results suggest that the negative impacts of immigration would have been even larger, on the level of about 0.17% for a one percentage point increase in immigrant share, if the lowest paid physicians in the area had not responded to the influx of immigration by moving away. There is evidence provided throughout this study that the lowest paid of all physicians are the U.S.-born, foreign-educated. The results of the 2SLS regressions also continue to provide evidence that foreign-born physicians are drawn to areas where wages are already higher, on average.

The regression results controlling for location of education in parts (6)(c) and (7)(c) are also consistent with those reported in Table 26. Even after controlling for specialty, the impact of immigration of foreign-born, foreign-educated physicians initially appears positive, but, after controlling for endogenous location choice, is small and negative but highly significant. The effects of immigration of foreign-born, U.S.-educated physicians remain more negative than the effects of the foreign-born, foreign-educated physicians and the magnitudes of the coefficients are similar to those reported without specialty controls. The negative effects of immigration, and the larger negative effects of an increase in the share of foreign-born, U.S.-educated physicians in an area, are therefore *not* attributable to specialty choice.

After adding controls for specialty, the positive coefficients on the male dummy variable, although small to begin with, become even smaller in magnitude, and remain highly significant. Once specialty choice is controlled for, men earn about 0.4% higher wages than women, on average, as compared to about 3.0% higher wages reported in Table 26 without specialty controls. Thus, much of the wage inequality between men and women can be attributed to the fact that women are more likely to specialize in lower paying fields.

The results of the OLS regressions with area fixed effects and the first-difference analyses, with specialty controls included, are reported in Table 30.

Table 30

Fixed Effects and First-Difference Estimates of the Relationship between Immigration and Physician Wages with Specialty Controls

Dependent Variable:	ln w			Δln w		
	(8) OLS w/ Time and Area Fixed Effects			(9) First-Difference		
Independent Variable	(a)	(b)	(c)	(a)	(b)	(c)
I = Immigrant Share	-0.0758	0 0419		0.1279 *	0.0583	
	(.1140)	*(.1034)*		*(.0687)*	*(.0700)*	
FBFE_Share			0.1004			0.1308
			(.1245)			*(.0921)*
FBUSE_Share			-0.1100			-0.0007
			(.1824)			*(.1641)*
USBFE_Share			-0.1913			-0.7953 **
			(.2527)			*(.3796)*
Male	0.0154	0 0819	0.0870	-0.0045	0.0970	0.1118
	(.1089)	*(.1129)*	*(.1115)*	*(.1122)*	*(.1137)*	*(.1039)*
Age	-0.0120	-0.0152	-0.0170	0.0682 ***	0.0152	0.227
	(.0237)	*(.0223)*	*(.0224)*	*(.0243)*	*(.0222)*	*(.0221)*
Age^2	0.0001	0 0001	0.0001	-0.0008 ***	-0.0002	-0.0003
	(.0002)	*(.0002)*	*(.0002)*	*(.0002)*	*(.0002)*	*(.0002)*
MedB	0.2036	0 3999	0.3979	0.7608 ***	0.3071	0.5081 ***
	(.6482)	*(.6323)*	*(.6358)*	*(.2259)*	*(.2112)*	*(.1969)*
S = Physician Stock		-0.2403	-0.2424		-0.6512 ***	-0.7423
		(.1789)	*(.1810)*		*(.1251)*	*(.1413)*
Anesthesiology	-0.0911	-0.1289	-0.1230	0.1281	0.0493	0.0282
	(.1900)	*(.1780)*	*(.1777)*	*(.2042)*	*(.1974)*	*(.2066)*
Family/General	-0.0996	-0.1078	-0.0971	-0.1271	-0.0622	-0.0859
	(.1680)	*(.1429)*	*(.1436)*	*(.1226)*	*(.1159)*	*(.1158)*
OBGYN	0.1863	0.2557	0.2620	0.0036	0.3091	0.4060 **
	(.1947)	*(.1911)*	*(.1912)*	*(.2126)*	*(.2146)*	*(.1973)*
Pediatrics	-0.1284	-0.0226	-0.0157	-0.4201 **	-0.0765	0.0334
	(.1653)	*(.1651)*	*(.1638)*	*(.1971)*	*(.1729)*	*(.1593)*
Psychiatry	-0.3023	-0.1087	-0.1009	-0.7930 ***	-0.6100 **	-0.5408 ***
	(.1984)	*(.2107)*	*(.2119)*	*(.2523)*	*(.2414)*	*(.2092)*
Surgery	0.1167	0.2595	0.2622 **	0.2315	0.2631	0.1947
	(.1321)	*(.1219)*	*(.1232)*	*(.1480)*	*(.1405)*	*(.1324)*
Internal Medicine	-0.1412	-0.1102	-0.1131	-0.0010	0.0546	0.0859
	(.1656)	*(.1768)*	*(.1760)*	*(.1830)*	*(.1645)*	*(.1610)*
# of obs	599	533	533	487	398	398
R-Squared	0.8850	0.9004	0.9007	0.1667	0.1288	0.1831
Adj. R-Squared	0.8512	.08675	0.8673			

**p<.10, **p<.05, ***p<.01 All coefficients reported with robust standard errors.*

Note Parts (8)(b), (8)(c), (9)(b) and (9)(c) have fewer observations due to lack of data on the physician stock variable.
First-Difference Regressions represent a balanced panel and therefore have fewer observations than OLS Regressions.

With regard to both the fixed effects and first-difference regressions, it is important to note that, as before with the *male* dummy variable, collapsing the data at the area and year level transforms the dummy variables for each specialty code into the proportion of area physicians in each year that specialize in the given field. Therefore, these variables are not dropped from the regression analyses. The results of the regressions with area fixed effects are problematic, as before. The probable explanation for the insignificant results and attenuation bias is discussed in Chapter 10.3.

The signs of the coefficients on the immigrant share variables in the first-difference analyses (9)(a) and (9)(b) are the same as in the first-difference regressions (4)(a) and (4)(b) without specialty controls, but the magnitudes of the coefficients are smaller. This suggests that some of the short-run positive effects on average area wages resulting from a change in the immigrant physician share within an area can be explained by specialty: the foreign-born physicians moving into the area tend to specialize in higher paying fields. However, the positive effect without controlling for physician supply is still significant at the 10% level: a one percentage point increase in the share of immigrant physicians in an area is associated with a 0.1279% increase in average physician wages in that area, even after controlling for the effect of physician specialty. The effect becomes even smaller and insignificant one changes in physician supply are controlled for, evidence that, even in the short-run, some of the lowest paid physicians may be leaving the area in response to the immigrant inflow.

After controlling for both physician specialty and foreign medical education, the only group of physicians whose migration has a significant impact on area wages in the short-run is the U.S.-born, foreign-educated group. A one percentage point increase in the share of area physicians who are U.S.-born and educated abroad is predicted to reduce the average area wage by 0.7953%. This result is significant at the 5% level and the magnitude is similar to the first-difference result without specialty controls. Thus, one may conclude that this group of physicians tends to be paid the least, regardless of their specialty.

The results of the first-difference regressions including specialty controls and the instrumental variables to address the potential endogeneity problems are reported in Table 31. The results of the first-stage regressions are reported in the appendix in Table A7. Consistent with earlier results, even after including specialty controls the instruments are highly significant in predicting changes in the immigrant stock.

Table 31
2SLS First-Difference Estimates of the Relationship between Immigration and Physician Wages with Specialty Controls

Dependent Variable: Change in Natural Log of Physician Wages: Δ ln*w*

Independent Variable	(10)(a)		(10)(b)		(10)(c)
Δ I Immigration Stock	0.1673		0.0793		
	(.1134)		*(.1150)*		
Δ FBFE_Share					0.1024
					(.1510)
Δ FBUSE_Share					0.0201
					(.4073)
Δ Male	0.1114		0.1807	*	0.1818
	(.1049)		*(.1062)*		*(.1047)*
Δ Age	0.0450	**	0.0053		0.0053
	(.0220)		*(.0205)*		*(.0205)*
Δ Age^2	-0.0005	**	-0.0001		-0.0001
	(.0002)		*(.0002)*		*(.0002)*
Δ MedB	0.9718	***	0.5205	***	0.4789
	(.1987)		*(.1670)*		*(.2944)*
Δ S			-0.5946	***	-0.5978
			(.1181)		*(.1197)*
Δ Anesthesiology	0.0202		-0.0250		-0.0231
	(.1932)		*(.1893)*		*(.1903)*
Δ Family/General	-0.0272		0.0225		0.0246
	(.1106)		*(.0982)*		*(.0998)*
Δ OBGYN	0.1835		0.4746	***	0.4759
	(.1825)		*(.1726)*		*(.1727)*
Δ Pediatrics	-0.3098	*	0.0240		0.0201
	(.1837)		*(.1536)*		*(.1533)*
Δ Psychiatry	-0.6129	***	-0.4015	**	-0.3921
	(.2212)		*(.1953)*		*(.1982)*
Δ Surgery	0.1077		0.1637		0.1666
	(.1307)		*(.1217)*		*(.1222)*
Δ Internal Medicine	-0.1180		-0.0252		-0.0254
	(.1730)		*(.1487)*		*(.1489)*
First-Stage					50.58
F-Test of Instrument	65.31		56.67		26.99
# of obs	482		395		395
R-Squared	0.1670		0.1529		0.1535

**p<.10, **p<.05, ***p<.01 All coefficients reported with robust standard errors.*
Note: All regressions have fewer observations than Part (9) above due to lack of data on the IV.
Part (10)(a) has more observations than (10)(b) and (10)(c) due to lack of data on the S variable.

The results of the 2SLS first-difference analyses with specialty controls are similar to those without specialty controls reported earlier in Table 28. None of the estimates of the impact of changes in immigration on changes in average area wages are statistically significant. The positive effect of immigration that remained even in the presence of the specialty controls becomes insignificant once the instrument is included to control for endogenous location choice. These results provide further evidence that had the immigrant physician not chosen to move to the highest paying area, there would have been no significant short-run effect on wages at all.

11: Conclusions of Study based on Regression Analyses

This study of immigrant and native physicians has been able to provide evidence that, in the short-run, the wage impacts of physician immigration tend to be positive, because physician wages are sticky, because immigrants tend not to be the lowest paid physicians in an area and because they tend to settle in areas where wages are higher, on average. The short-run positive effects of immigration on wages are somewhat, but not completely, explained by specialty choice, with immigrant physicians tending to specialize in somewhat higher paying fields.

In the long run, however, immigration tends to have a negative impact on area wages. This study has been able to provide evidence that immigrant physicians are drawn to areas where wages tend to be higher. There is also evidence that the negative effect of immigration on wages is mitigated by outward migration of lower paid local physicians in response to the lower wages caused by the influx of foreign physicians. The long-run negative effects of immigration are not explained by specialty choice. Therefore, immigrants seem to be willing to accept a lower than average wage. The negative effect of immigration on average wages tends to be relatively small, with a one percentage point increase in the share of foreign-born physicians having a less than 0.2% effect on average area wages by all measures.

In addition, analyzing the wage impacts of physician immigration reveals that foreign-educated immigrant physicians tend to have a more positive short-run effect on wages and a less negative long-run effect on wages, while the opposite is true for foreign-born, U.S.-educated physicians. Because foreign-born, U.S.-educated immigrants are more likely to have lived in the United States longer and less likely to have to overcome difficult immigration hurdles, such as visa requirements and migration costs associated with moving an already established family to a new country, likely at an older age, they are less likely to be favorably selected.

Simply analyzing the data in terms of descriptive statistics also reveals that immigrant physicians are more likely than their native counterparts to work in larger cities as opposed to rural areas. Younger doctors are even more likely to live in larger MSAs, while older physicians are more likely than younger physicians to practice in rural areas.

The results of all regression analyses performed in this study show that male physicians are likely to earn more than female physicians, although the difference becomes minimal after controlling for specialty choice. The number of women entering the medical profession has been increasing every year. The regressions also show that physician wages increase with age but at a decreasing rate, in agreement with labor economic theory.

The analysis consistently predicts that physicians who practice in areas where a larger percentage of patients are covered by Medicare Part B are likely to earn higher wages. This is likely due to area-specific factors such as age of population and disability status that are likely to increase demand. This result could also be explained by a higher probability that physicians will actually be paid when patients are covered by Medicare compared with self-pay and uninsured patients.

The conclusions about the impact of immigration on wages drawn from this study are consistent with many of the earlier studies on the topic. In fact, the majority of research in this area has concluded that immigration tends to have a very small negative effect on wages. Even studies that specifically address the issue of high-skilled immigration have, in general, found a negative impact of immigration on wages. Borjas (2003) concluded that immigration has a negative effect on wages of college graduates. Borjas (2005) and Borjas (2006) found a small negative impact of immigration of foreign students on earnings of doctorates in the science and engineering fields; the magnitude of the impact found in his studies is somewhat larger than that found in this analysis.

Earlier studies have also found evidence of outward migration of natives in response to immigration. Specifically, Butcher and Card (1991) concluded that the potential impacts of immigration are diminished due to outflow migration of natives, while Frey (1994) found that during the 1980s, large numbers of native whites moved away from immigrant-heavy destinations such as Los Angeles and New York.

The results of the first-difference approach are qualitatively in agreement with those of Borjas, Freeman and Katz (1996), who found a small positive (almost zero) impact of changes in immigration on wages at the MSA level.

Card (2001) employed an instrumental variable approach similar to that used in this study and found a systematically negative impact of immigration on wages. His study, however, focused primarily on low-skilled workers. As is the case in this study, Orrenius and Zavodny (2007) found a systematically more negative effect of immigration on wages when employing the two-stage least squares method as opposed to the ordinary least squares analysis.

Chapter 12: Healthcare and Immigration Policy Implications

The results of this analysis have different policy implications depending on the goals of policy makers. If the goal of policy makers is to address an alleged shortage of physicians, this can be achieved by either increasing the number of U.S. medical school graduates by subsidizing the cost of constructing new medical school as well as the cost of attendance for prospective students or by encouraging immigration of foreign-born physicians through less restrictive visa requirements and supporting programs that make the immigration process easier for foreign-born physicians by reducing costs and easing the adjustment process. This study has shown that immigrant physicians tend to lower the average wage of physicians; this may or may not be in agreement with policymakers' objectives. To the extent that lower physician wages trickle-down to consumers in the form of lower charges for physician services, this could be beneficial to society. However, native physicians will likely suffer a reduction in their wage in the long run due not only to the increase in supply caused by immigration but because the immigrants are willing to work for lower wages, on average, than their native-born counterparts. The results of this study reveal that the negative impacts of immigration are actually largest for foreign-born, U.S.-educated physicians. Therefore, if reducing physician wages, and potentially the cost of physician care, is the goal of policymakers then this is more likely to be accomplished by implementing programs that encourage foreign-born students to attend U.S. medical schools. However, if the goal is to increase the supply of physicians while maintaining the current physician wages, it would be advisable to instead encourage immigration of foreign-physicians who already have their degrees by relaxing current visa restrictions.

If the goal of policy makers is specifically to increase the supply of primary care physicians, this study has shown that foreign-educated physicians and women are more likely to specialize in general practice than native-born male physicians. Thus, policy makers may wish to implement programs to encourage U.S. women to enter the medical profession and/or make it easier for foreign medical graduates to practice in the U.S. As previously discussed, the impact of immigration of foreign medical graduates, whether born in the U.S. or a foreign country, on local area wages is negative; again, this may or may not be in agreement with policy makers objectives. In addition to the potential reduction in the cost of physician services, a negative wage impact, theoretically, causes an immigration surplus by increasing area employment.

As to increasing the number of physicians, whether primary care or specialist, in the Health Professional Shortage Areas and Medically Underserved Areas, there is not enough evidence at this point to say whether this can be achieved through immigration; more information is needed for further study. This study has shown that immigrant physicians are less likely than native physicians to work in rural areas, which are traditionally thought of as being medically underserved. However, there are many areas in MSAs, for example inner city neighborhoods, that are actually classified as HPSAs and MUAs. Immigrants tend to locate in areas where wages are higher, on average. It seems reasonable to assume that wages in HPSAs and MUAs are lower than in more desirable locales. However, the study is unable to determine whether wages are higher or lower, on average, in these areas or whether immigrant physicians who practice in large

MSAs are practicing in the Health Professional Shortage Areas or Medically Underserved Areas. The AMA Physician Masterfile contains data on physician city, county, state, and even zip code. The Health Professional Shortage Areas and Medically Underserved Areas, however, are defined by census tract. There is no readily available database, to this researcher's knowledge, that allows census tracts to be cross-referenced with zip code such that physicians who are practicing in an underserved area can be identified. This task could likely be accomplished using geocoding data that maps zip codes and census tracts. Such a study would prove extremely useful and is an important area for future research.

Finally, it is important to note that the wage impacts of any of any policy that affects the supply of physicians through immigration will not immediately take effect. The results of the first-difference analyses show that an increase in immigration of foreign physicians is likely to have a small positive impact on average physician wages in the short-run; however, as wages adjust to the supply shock over time, the effect on wages becomes negative.

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Appendices

Table A1
Physicians by Country of Birth

BIRTH COUNTRY	FREQUENCY	% OF FOREIGN-BORN PHYSICIANS
UNITED STATES	126,355	
INDIA	8,352	18.8%
PHILIPPINES	3,905	8.8%
CANADA	2,105	4.7%
SOUTH KOREA	1,703	3.8%
PAKISTAN	1,523	3.4%
IRAN	1,486	3.3%
CHINA	1,343	3.0%
CUBA	1,252	2.8%
GERMANY	1,139	2.6%
UNITED KINGDOM	1,123	2.5%
VIETNAM	999	2.2%
TAIWAN	908	2.0%
EGYPT	823	1.8%
MEXICO	639	1.4%
SYRIA	601	1.4%
POLAND	593	1.3%
COLOMBIA	537	1.2%
ISRAEL	516	1.2%
ARGENTINA	484	1.1%
NIGERIA	473	1.1%
HONG KONG	471	1.1%
JAPAN	459	1.0%
SOUTH AFRICA	449	1.0%
ROMANIA	438	1.0%
ITALY	430	1.0%
LEBANON	416	0.9%
PERU	403	0.9%
JAMAICA	376	0.8%
HAITI	373	0.8%
THAILAND	360	0.8%
DOMINICAN REPUBLIC	354	0.8%
RUSSIA	329	0.7%
GREECE	323	0.7%

Table A1 (Continued)
Physicians by Country of Birth

BIRTH COUNTRY	FREQUENCY	% OF FOREIGN-BORN PHYSICIANS
SPAIN	293	0.7%
UKRAINE	285	0.6%
TURKEY	281	0.6%
IRELAND	278	0.6%
HUNGARY	254	0.6%
BRAZIL	241	0.5%
BURMA	232	0.5%
FRANCE	232	0.5%
SRI LANKA	214	0.5%
USSR	204	0.5%
LATVIA	202	0.5%
BANGLADESH	192	0.4%
JORDAN	191	0.4%
IRAQ	182	0.4%
AUSTRALIA	180	0.4%
VENEZUELA	164	0.4%
GHANA	163	0.4%
TRINIDAD AND TOBAGO	160	0.4%
CZECH REPUBLIC	156	0.4%
KENYA	154	0.3%
PANAMA	147	0.3%
NETHERLANDS	146	0.3%
GUYANA	143	0.3%
CHILE	142	0.3%
AUSTRIA	137	0.3%
ETHIOPIA	133	0.3%
MALAYSIA	131	0.3%
ECUADOR	119	0.3%
SWITZERLAND	119	0.3%
INDONESIA	117	0.3%
NICARAGUA	114	0.3%
BOLIVIA	109	0.2%
GUATEMALA	103	0.2%
SWEDEN	100	0.2%
BELGIUM	99	0.2%

Table A1 (Continued)
Physicians by Country of Birth

BIRTH COUNTRY	FREQUENCY	% OF FOREIGN-BORN PHYSICIANS
BULGARIA	90	0.2%
EL SALVADOR	83	0.2%
UGANDA	82	0.2%
SINGAPORE	79	0.2%
TANZANIA	75	0.2%
AFGHANISTAN	65	0.1%
NEW ZEALAND	63	0.1%
YUGOSLAVIA	61	0.1%
SERBIA	60	0.1%
CROATIA	57	0.1%
HONDURAS	51	0.1%
DENMARK	50	0.1%
PORTUGAL	49	0.1%
LITHUANIA	48	0.1%
COSTA RICA	47	0.1%
BARBADOS	44	0.1%
BELARUS	43	0.1%
URUGUAY	42	0.1%
PARAGUAY	41	0.1%
KUWAIT	39	0.1%
UZBEKISTAN	38	0.1%
NORWAY	36	0.1%
SAUDI ARABIA	36	0.1%
ZIMBABWE	36	0.1%
CYPRUS	35	0.1%
FINLAND	35	0.1%
ZAMBIA	34	0.1%
MOROCCO	33	0.1%
CAMBODIA	31	0.1%
BAHAMAS	30	0.1%
BOSNIA AND HERZEGOVINA	30	0.1%
NEPAL	30	0.1%
ARMENIA	28	0.1%
SUDAN	27	0.1%
CZECHOSKLOVAKIA	25	0.1%

Table A1 (Continued)
Physicians by Country of Birth

BIRTH COUNTRY	FREQUENCY	% OF FOREIGN-BORN PHYSICIANS
GRENADA	25	0.1%
ICELAND	25	0.1%
CAMEROON	24	0.1%
LIBYA	24	0.1%
COLUMBIA	23	0.1%
LIBERIA	22	0.0%
MOLDOVA	22	0.0%
TUNISIA	20	0.0%
CZECHOSLOVAKIA	19	0.0%
GUAM	19	0.0%
AZERBAIJAN	18	0.0%
BERMUDA	18	0.0%
SLOVAKIA	18	0.0%
ESTONIA	17	0.0%
ZAIRE	17	0.0%
ALGERIA	16	0.0%
FIJI	15	0.0%
GEORGIA	15	0.0%
LAOS	15	0.0%
SIERRA LEONE	15	0.0%
MACEDONIA	14	0.0%
ST KITT	14	0.0%
UNITED ARAB EMIRATES	13	0.0%
MALAWI	12	0.0%
ALBANIA	11	0.0%
BELIZE	11	0.0%
MALTA	11	0.0%
YUGO	11	0.0%
ARUBA	10	0.0%
MAURITIUS	9	0.0%
SLOVENIA	9	0.0%
SOMALIA	9	0.0%
ANTIGUA AND BARBUDA	9	0.0%
BAHRAIN	8	0.0%
ST LUCIA	8	0.0%

Table A1 (Continued)
Physicians by Country of Birth

BIRTH COUNTRY	FREQUENCY	% OF FOREIGN-BORN PHYSICIANS
SURINAME	8	0.0%
BRUNEI	7	0.0%
KAZAKHSTAN	7	0.0%
KYRGYZSTAN	6	0.0%
NORTH KOREA	6	0.0%
MOZAMBIQUE	5	0.0%
VINCENT AND THE GRENADINES	5	0.0%
CAPE VERDE	4	0.0%
CONGO	4	0.0%
MACAU	4	0.0%
NETHERLANDS ANTILLES	4	0.0%
NIGER	4	0.0%
RWANDA	4	0.0%
INDIES	3	0.0%
LUXEMBOURG	3	0.0%
MARSHALL ISLANDS	3	0.0%
QATAR	3	0.0%
SENEGAL	3	0.0%
YEMEN	3	0.0%
ANGOLA	2	0.0%
BURKINA FASO	2	0.0%
GUINEA	2	0.0%
MONTSERRAT	2	0.0%
OMAN	2	0.0%
REPUBLIC OF KIRIBATI	2	0.0%
SAMOA	2	0.0%
ZANZIBAR	2	0.0%
ANGUILLA	1	0.0%
BOTSWANA	1	0.0%
COTE D'IVOIRE	1	0.0%
DJIBOUTI	1	0.0%
EAST TIMOR	1	0.0%
GABON	1	0.0%
LESOTHO	1	0.0%

Table A1 (Continued)
Physicians by Country of Birth

BIRTH COUNTRY	FREQUENCY	% OF FOREIGN-BORN PHYSICIANS
MADAGASCAR	1	0.0%
MALDIVES	1	0.0%
MONTENEGRO	1	0.0%
NAMIBIA	1	0.0%
PALAU	1	0.0%
PAPUA NEW GUINEA	1	0.0%
REUNION	1	0.0%
SWAZILAND	1	0.0%
TAJIKISTAN	1	0.0%
TOGO	1	0.0%
TONGA	1	0.0%
TURKS AND CAICOS	1	0.0%
OTHER FOREIGN	381	0.8%
TOTAL	**170,858**	

Table A2 Foreign-Born Physicians by MSA		
MSA DESCRIPTION	# OF FOREIGN-BORN PHYSICIANS	% OF TOTAL FOREIGN-BORN PHYSICIANS
New York, NY	3,669	8.2%
Los Angeles/Long Beach, CA	2,380	5.3%
Chicago-Naperville-Joliet, IL Metropolitan Division	2,139	4.8%
Boston-Cambridge-Quincy, MA NECTA Division	1,317	3.0%
Washington, DC--MD--VA MSA	1,315	3.0%
Detroit-Livonia-Dearborn, MI Metropolitan Division	1,064	2.4%
Nassau-Suffolk, NY MSA	1,056	2.4%
Philadelphia, PA-NJ PMSA	1,047	2.4%
Miami, FL	985	2.2%
Houston, TX	941	2.1%
Orange County, CA	777	1.7%
Baltimore, MD MSA	679	1.5%
Cleveland-Elyria-Mentor, OH	641	1.4%
Newark, NJ	512	1.2%
St. Louis, MO--IL MSA	511	1.1%
Riverside-San Bernardino, CA PMSA	506	1.1%
Bergen-Passaic, NJ MSA	505	1.1%
Atlanta, GA MSA	504	1.1%
San Francisco, CA PMSA	490	1.1%
Dallas-Plano-Irving, TX Metropolitan Division	483	1.1%
Pittsburgh, PA MSA	480	1.1%
San Jose, CA PMSA	465	1.0%
Tampa--St. Petersburg--Clearwater, FL MSA	441	1.0%
San Diego, CA MSA	404	0.9%
Phoenix, AZ MSA	401	0.9%
Oakland, CA PMSA	398	0.9%
Seattle-Bellevue-Everett, WA PMSA	367	0.8%
Middlesex-Somerset-Hunterdon, NJ MSA	344	0.8%
Fort Lauderdale-Pompano Beach-Deerfield Beach, FL	336	0.8%
Buffalo-Niagara Falls, NY	278	0.6%
Orlando, FL MSA	274	0.6%
Minneapolis--St. Paul, MN—WI MSA	273	0.6%
Raleigh-Durham-Chapel Hill, NC	260	0.6%
Milwaukee/Waukesha, WI	256	0.6%
Sacramento, CA MSA	252	0.6%
Hartford, CT	251	0.6%
Monmouth-Ocean, NJ MSA	248	0.6%
Jacksonville, FL MSA	237	0.5%
San Antonio, TX MSA	235	0.5%
Cincinnati, OH-KY-IN PMSA	226	0.5%
New Orleans, LA MSA	225	0.5%
Las Vegas, NV MSA	217	0.5%

Table A2 (Continued)
Foreign-Born Physicians by MSA

MSA DESCRIPTION	# OF FOREIGN-BORN PHYSICIANS	% OF TOTAL FOREIGN-BORN PHYSICIANS
Indianapolis, IN MSA	216	0.5%
West Palm Beach--Boca Raton--Delray Beach, FL MSA	213	0.5%
Portland-Vancouver, OR-WA PMSA	211	0.5%
Norfolk--Virginia Beach--Newport News, VA MSA	199	0.4%
Columbus, OH MSA	185	0.4%
Rochester, NY MSA	182	0.4%
San Juan-Bayamon, PR MSA	179	0.4%
Ann Arbor, MI	178	0.4%
Providence-Fall River-Warwick, RI-MA MSA	177	0.4%
Kansas City, MO--KS MSA	174	0.4%
Denver-Aurora, CO	172	0.4%
Bridgeport, CT	171	0.4%
New Haven--Meriden, CT MSA	171	0.4%
Dayton--Springfield, OH MSA	169	0.4%
Richmond--Petersburg, VA MSA	167	0.4%
Honolulu, HI MSA	166	0.4%
Rochester, MN	166	0.4%
Nashville, TN MSA	162	0.4%
Louisville, KY--IN MSA	157	0.4%
Albany--Schenectady--Troy, NY MSA	155	0.3%
Syracuse, NY MSA	152	0.3%
Fresno, CA MSA	147	0.3%
Jersey City, NJ MSA	143	0.3%
Oklahoma City, OK MSA	143	0.3%
Fort Worth-Arlington, TX Metropolitan Division	135	0.3%
Memphis, TN--AR--MS MSA	135	0.3%
Birmingham, AL MSA	134	0.3%
Gary, IN	122	0.3%
Tucson, AZ MSA	122	0.3%
Austin, TX MSA	115	0.3%
Toledo, OH MSA	111	0.2%
Wilmington-Newark, DE-MD	105	0.2%
Trenton, NJ MSA	104	0.2%
Youngstown--Warren, OH MSA	104	0.2%
Charlotte--Gastonia--Rock Hill, NC--SC MSA	102	0.2%
Flint, MI MSA	99	0.2%
Bakersfield, CA MSA	97	0.2%
Albuquerque, NM MSA	95	0.2%
Harrisburg--Lebanon--Carlisle, PA MSA	93	0.2%
Akron, OH	90	0.2%
Salt Lake City--Ogden, UT MSA	88	0.2%
Greensboro--Winston-Salem--High Point, NC MSA	85	0.2%

Table A2 (Continued)
Foreign-Born Physicians by MSA

MSA DESCRIPTION	# OF FOREIGN-BORN PHYSICIANS	% OF TOTAL FOREIGN-BORN PHYSICIANS
Lexington-Fayette, KY MSA	85	0.2%
El Paso, TX MSA	84	0.2%
Sarasota, FL MSA	84	0.2%
Allentown--Bethlehem--Easton, PA--NJ MSA	83	0.2%
Mcallen--Edinburg--Mission, TX MSA	82	0.2%
Omaha, NE--IA MSA	81	0.2%
Ventura, CA MSA	81	0.2%
Iowa City, IA MSA	80	0.2%
Gainesville, FL MSA	79	0.2%
Galveston/Texas City, TX	78	0.2%
Scranton--Wilkes-Barre, PA MSA	75	0.2%
Worcester, MA MSA	75	0.2%
Tacoma, WA PMSA	73	0.2%
Little Rock--North Little Rock, AR MSA	71	0.2%
Newburgh, NY/PA	71	0.2%
Dutchess County, NY MSA	69	0.2%
Grand Rapids, MI MSA	68	0.2%
Stockton, CA MSA	68	0.2%
Augusta, GA--SC MSA	67	0.2%
Lansing--East Lansing, MI MSA	67	0.2%
Melbourne--Titusville--Palm Bay, FL MSA	67	0.2%
Saginaw--Bay City--Midland, MI MSA	66	0.1%
Shreveport, LA MSA	65	0.1%
Charlottesville, VA MSA	64	0.1%
Corpus Christi, TX MSA	64	0.1%
Charleston, SC MSA	63	0.1%
Daytona Beach, FL MSA	63	0.1%
Madison, WI MSA	63	0.1%
Tulsa, OK MSA	61	0.1%
Wichita, KS MSA	60	0.1%
Vallejo-Fairfield-Napa, CA MSA	59	0.1%
Beaumont--Port Arthur, TX MSA	58	0.1%
Columbia, MO MSA	58	0.1%
Lakeland--Winter Haven, FL MSA	57	0.1%
Binghamton, NY MSA	56	0.1%
Jackson, MS MSA	56	0.1%
Fort Myers--Cape Coral, FL MSA	52	0.1%
Lubbock, TX MSA	52	0.1%
Santa Barbara--Santa Maria--Lompoc, CA MSA	52	0.1%
Springfield, IL MSA	52	0.1%
Atlantic City, NJ MSA	51	0.1%
Canton, OH MSA	50	0.1%

Table A2 (Continued)
Foreign-Born Physicians by MSA

MSA DESCRIPTION	# OF FOREIGN-BORN PHYSICIANS	% OF TOTAL FOREIGN-BORN PHYSICIANS
Charleston, WV MSA	50	0.1%
Utica--Rome, NY MSA	49	0.1%
Knoxville, TN MSA	48	0.1%
Peoria, IL MSA	48	0.1%
Modesto, CA MSA	47	0.1%
Tallahassee, FL MSA	47	0.1%
Kalamazoo, MI MSA	46	0.1%
Greenville--Spartanburg, SC MSA	45	0.1%
Huntington--Ashland, WV--KY--OH MSA	45	0.1%
Columbia, SC MSA	44	0.1%
Johnson City--Kingsport--Bristol, TN--VA MSA	44	0.1%
Punta Gorda, FL MSA	44	0.1%
Mobile, AL MSA	43	0.1%
Naples, FL MSA	42	0.1%
Odessa, TX	42	0.1%
Brownsville--Harlingen, TX MSA	41	0.1%
Champaign-Urbana, IL	41	0.1%
Fayetteville, NC MSA	41	0.1%
Baton Rouge, LA MSA	40	0.1%
Chattanooga, TN--GA MSA	40	0.1%
Evansville, IN--KY MSA	39	0.1%
Fort Pierce, FL MSA	39	0.1%
Fort Wayne, IN MSA	39	0.1%
Greenville, NC MSA	38	0.1%
Rockford, IL MSA	38	0.1%
Macon--Warner Robins, GA MSA	37	0.1%
Santa Rosa, CA MSA	37	0.1%
Erie, PA MSA	36	0.1%
Brazoria, TX MSA	35	0.1%
Davenport--Rock Island--Moline, IA--IL MSA	35	0.1%
Lowell, MA-NH MSA	35	0.1%
Reading, PA MSA	35	0.1%
Ocala, FL MSA	34	0.1%
Spokane, WA MSA	34	0.1%
Killeen--Temple, TX MSA	33	0.1%
Pensacola, FL MSA	33	0.1%
Johnstown, PA	32	0.1%
Portland, ME MSA	32	0.1%
Amarillo, TX MSA	31	0.1%
Appleton--Oshkosh--Neenah, WI MSA	31	0.1%
Des Moines, IA MSA	31	0.1%
Montgomery, AL MSA	31	0.1%

Table A2 (Continued)
Foreign-Born Physicians by MSA

MSA DESCRIPTION	# OF FOREIGN-BORN PHYSICIANS	% OF TOTAL FOREIGN-BORN PHYSICIANS
Roanoke, VA MSA	31	0.1%
Stamford-Norwalk, CT MSA	31	0.1%
Visalia--Tulare--Porterville, CA MSA	31	0.1%
South Bend--Mishawaka, IN MSA	30	0.1%
Columbus, GA--AL MSA	29	0.1%
Wheeling, WV--OH MSA	29	0.1%
Reno, NV MSA	28	0.1%
San Luis Obispo-Atascadero-Paso Robles, CA MSA	28	0.1%
Savannah, GA MSA	28	0.1%
Yolo, CA MSA	28	0.1%
Huntsville, AL MSA	27	0.1%
Burlington, VT MSA	26	0.1%
Monroe, LA MSA	26	0.1%
Ponce, PR MSA	25	0.1%
Salinas--Seaside--Monterey, CA MSA	24	0.1%
Topeka, KS MSA	24	0.1%
Tyler, TX MSA	24	0.1%
Wichita Falls, TX MSA	24	0.1%
York, PA MSA	24	0.1%
Alexandria, LA MSA	22	0.0%
Altoona, PA MSA	22	0.0%
Chico, CA MSA	22	0.0%
Springfield, MO MSA	22	0.0%
Springfield, MA MSA	22	0.0%
Terre Haute, IN MSA	22	0.0%
Bangor, ME MSA	21	0.0%
Clarksville--Hopkinsville, TN--KY MSA	21	0.0%
Hagerstown, MD MSA	21	0.0%
Lancaster, PA MSA	21	0.0%
Olympia, WA MSA	21	0.0%
Fargo--Moorhead, ND--MN MSA	20	0.0%
Lafayette, LA MSA	20	0.0%
Lima, OH MSA	20	0.0%
Mayaguez, PR	20	0.0%
Merced, CA MSA	20	0.0%
Wilmington, NC MSA	20	0.0%
Colorado Springs, CO MSA	19	0.0%
Laredo, TX MSA	19	0.0%
Mansfield, OH MSA	19	0.0%
Parkersburg--Marietta, WV--OH MSA	19	0.0%
Sioux Falls, SD MSA	19	0.0%
Vineland-Millville-Bridgeton, NJ MSA	19	0.0%

Table A2 (Continued)
Foreign-Born Physicians by MSA

MSA DESCRIPTION	# OF FOREIGN-BORN PHYSICIANS	% OF TOTAL FOREIGN-BORN PHYSICIANS
Albany, GA MSA	18	0.0%
Biloxi--Gulfport, MS MSA	18	0.0%
Boise City, ID MSA	18	0.0%
Lawton, OK	18	0.0%
Redding, CA MSA	18	0.0%
Richland-Kennewick-Pasco, WA MSA	18	0.0%
Tuscaloosa, AL MSA	18	0.0%
Victoria, TX MSA	18	0.0%
Waco, TX MSA	18	0.0%
Yuma, AZ MSA	18	0.0%
Cumberland, MD--WV MSA	17	0.0%
Hamilton/Middletown, OH	17	0.0%
Kankakee, IL MSA	17	0.0%
Portsmouth-Rochester, NH-ME PMSA	17	0.0%
Salem, OR MSA	17	0.0%
Dover, DE MSA	16	0.0%
Eugene--Springfield, OR MSA	16	0.0%
Lafayette--West Lafayette, IN MSA	16	0.0%
Panama City, FL MSA	16	0.0%
Pittsfield, MA MSA	16	0.0%
Santa Cruz-Watsonville, CA MSA	16	0.0%
Anchorage, AK MSA	15	0.0%
Bismarck, ND MSA	15	0.0%
Bloomington--Normal, IL MSA	15	0.0%
Boulder/Longmont, CO	15	0.0%
Fort Smith, AR--OK MSA	15	0.0%
Racine, WI PMSA	15	0.0%
Sharon, PA	15	0.0%
Barnstable-Yarmouth, MA MSA	14	0.0%
Bellingham, WA MSA	14	0.0%
Grand Forks, ND/MN	14	0.0%
Green Bay, WI MSA	14	0.0%
Hickory--Morganton, NC MSA	14	0.0%
Lake Charles, LA MSA	14	0.0%
Steubenville--Weirton, OH--WV MSA	14	0.0%
Yuba City, CA MSA	14	0.0%
Arecibo, PR MSA	13	0.0%
Danville, VA MSA	13	0.0%
Duluth, MN--WI MSA	13	0.0%
Eau Claire, WI MSA	13	0.0%
Elmira, NY	13	0.0%
Jackson, MI	13	0.0%

Table A2 (Continued)
Foreign-Born Physicians by MSA

MSA DESCRIPTION	# OF FOREIGN-BORN PHYSICIANS	% OF TOTAL FOREIGN-BORN PHYSICIANS
Janesville--Beloit, WI MSA	13	0.0%
Lincoln, NE MSA	13	0.0%
Waterloo--Cedar Falls, IA MSA	13	0.0%
Abilene, TX MSA	12	0.0%
Benton Harbor, MI MSA	12	0.0%
Caguas, PR MSA	12	0.0%
Fort Walton Beach, FL MSA	12	0.0%
Jackson, TN MSA	12	0.0%
Asheville, NC MSA	11	0.0%
Athens, GA MSA	11	0.0%
Bremerton, WA PMSA	11	0.0%
Bryan--College Station, TX MSA	11	0.0%
Gadsden, AL	11	0.0%
Goldsboro, NC MSA	11	0.0%
Hattiesburg, MS	11	0.0%
Kenosha, WI PMSA	11	0.0%
Auburn-Opelika, AL MSA	10	0.0%
Billings, MT MSA	10	0.0%
Cedar Rapids, IA MSA	10	0.0%
Florence, SC MSA	10	0.0%
Fort Collins--Loveland, CO MSA	10	0.0%
Glens Falls, NY	10	0.0%
Pueblo, CO MSA	10	0.0%
Santa Fe, NM MSA	10	0.0%
Yakima, WA MSA	10	0.0%
Dothan, AL MSA	9	0.0%
Jacksonville, NC MSA	9	0.0%
Kokomo, IN MSA	9	0.0%
La Crosse, WI/MN	9	0.0%
Lewiston--Auburn, ME MSA	9	0.0%
Manchester, NH MSA	9	0.0%
Muncie, IN MSA	9	0.0%
New London--Norwich, CT--RI MSA	9	0.0%
St. Joseph, MO MSA	9	0.0%
Sherman-Denison, TX MSA	9	0.0%
Sioux City, IA--NE MSA	9	0.0%
Elkhart--Goshen, IN MSA	8	0.0%
Jamestown, NY	8	0.0%
Las Cruces, NM MSA	8	0.0%
Myrtle Beach, SC MSA	8	0.0%
Owensboro, KY MSA	8	0.0%
Rocky Mount, NC MSA	8	0.0%

Table A2 (Continued)
Foreign-Born Physicians by MSA

MSA DESCRIPTION	# OF FOREIGN-BORN PHYSICIANS	% OF TOTAL FOREIGN-BORN PHYSICIANS
Williamsport, PA MSA	8	0.0%
Anniston, AL MSA	7	0.0%
Dubuque, IA	7	0.0%
Florence, AL MSA	7	0.0%
Houma--Thibodaux, LA MSA	7	0.0%
Missoula, MT	7	0.0%
Provo--Orem, UT MSA	7	0.0%
Decatur, IL	6	0.0%
Fayetteville--Springdale, AR MSA	6	0.0%
Greeley, CO MSA	6	0.0%
Longview--Marshall, TX MSA	6	0.0%
Lynchburg, VA MSA	6	0.0%
State College, PA MSA	6	0.0%
Wausau, WI MSA	6	0.0%
Aguadilla, PR MSA	5	0.0%
Bloomington, IN MSA	5	0.0%
Joplin, MO MSA	5	0.0%
Medford, OR MSA	5	0.0%
Rapid City, SD MSA	5	0.0%
St. Cloud, MN MSA	5	0.0%
San Angelo, TX	5	0.0%
Sheboygan, WI MSA	5	0.0%
Texarkana, TX-Texarkana, AR MSA	5	0.0%
Corvallis, OR MSA	4	0.0%
Flagstaff, AZ/UT	4	0.0%
Jonesboro, AR	4	0.0%
Cheyenne, WY MSA	3	0.0%
Decatur, AL MSA	3	0.0%
Pine Bluff, AR MSA	3	0.0%
Sumter, SC MSA	3	0.0%
Enid, OK	2	0.0%
Great Falls, MT	2	0.0%
Casper, WY	1	0.0%
Lawrence, KS MSA	1	0.0%
Pocatello, ID MSA	1	0.0%
Rural/No MSA	3325	7.5%

Table A3
Sex of Physicians by Place of Birth and Year

U.S.-Born Physicians

	1997	%	1999	%	2001	%	2003	%	2005	%	2007	%
F	4,712	22%	4,823	23%	5,073	24%	5,523	26%	5,751	28%	5,859	29%
M	16,785	78%	16,514	77%	16,088	76%	15,757	74%	14,995	72%	14,473	71%
	21,497		21,337		21,161		21,280		20,746		20,332	

Foreign-Born Physicians

	1997	%	1999	%	2001	%	2003	%	2005	%	2007	%
F	1,981	27%	2,220	29%	2,229	29%	2,231	30%	2,230	31%	2,102	30%
M	5,440	73%	5,514	71%	5,429	71%	5,290	70%	4,951	69%	4,886	70%
	7,421		7,734		7,658		7,521		7,181		6,988	

Total (All Physicians)

	1997	%	1999	%	2001	%	2003	%	2005	%	2007	%
F	6,693	23%	7,043	24%	7,302	25%	7,754	27%	7,981	29%	8,061	29%
M	22,225	77%	22,028	76%	21,517	75%	21,047	73%	19,946	71%	19,359	71%
	28,918		29,071		28,819		28,801		27,927		27,320	

Table A4

2SLS Estimates of the Relationship between Immigration and Physician Wages:

First Stage Regression Results

Dependent Variable:	I = Immigration Share				FB FE Share		FB USE Share	
Independent Variable	(2)(a)		(2)(b)		(2)(c)			
Male	-0.0045	***	-0.0042	***	-0.0039	***	-0.0009	***
	(.0006)		*(.0005)*		*(.0004)*		*(.0002)*	
Age	-0.0010	***	-0.0008	***	-0.0003	***	-0.0003	***
	(.0001)		*(.0001)*		*(.0001)*		*(.0000)*	
Age^2	0.0000	***	0.0000	***	0.0000	***	0.0000	***
	(.0000)		*(.0000)*		*(.0000)*		*(.0000)*	
MedB	0.5634	***	0.8965	***	0.5921	***	-0.1881	***
	(.0151)		*(.0101)*		*(.0090)*		*(.0042)*	
S = Physician Stock			0.0857	***	0.1214	***	0.0010	
			(.0025)		*(.0020)*		*(.0006)*	
FB90	1.012	***	1.0126	***	-0.4970	***	0.4694	***
	(.0039)		*(.0033)*		*(.0071)*		*(.0033)*	
FE_IV					3.3796	***	-0.5766	***
					(.0248)		*(.0078)*	
F-Test for Instruments	68,737	***	96,185	***	29,492	***	23,569	***
# of obs	159,448		128,074		128,074		128,074	
Prob>F	0.00		0.00		0.00		0.00	
R-Squared	.2934		.4800		.5755		.5292	
Adj. R-Squared	.2933		.4799		.5755		.5292	

**p<.10, **p<.05, ***p<.01 All coefficients reported with robust standard errors.*

Note: All regressions have fewer observations than Part (1) due to lack of data on the FB90 variable.

Part (2)(a) has more observations than (2)(b) and (2)(c) due to lack of data on the physician stock variable.

Table A5
2SLS First-Difference Estimates of the Relationship between Immigration and Physician Wages:
First Stage Regression Results

Dependent Variable:	ΔI = Immigration Share				ΔFB FE Share		ΔFB USE Share	
Independent Variable	(5)(a)		(5)(b)		(5)(c)			
Δ Male	-0.3114	***	-0.3874	***	-0.3296	***	-0.0880	***
	(.0750)		*(.0834)*		*(.0684)*		*(.0316)*	
Δ Age	-0.0438	***	-0.0553	***	-0.0328	**	-0.0176	***
	(.0156)		*(.0177)*		*(.0145)*		(.0062)	
Δ Age^2	0.0007	***	0.0008	***	0.0005	***	0.0002	***
	(.0002)		*(.0002)*		*(.0002)*		*(.0001)*	
Δ MedB	0.3473	***	0.2736	*	0.5891	***	-0.4105	***
	(.1321)		*(.1520)*		*(.1265)*		*(.0584)*	
Δ S Physician Stock			0.0703		0.1247	**	-0.0344	
			(.1050)		*(.0609)*		*(.0520)*	
FB90	0.7365	***	0.6924	***	-0.2951	***	0.3472	***
	(.0854)		*(.0894)*		*(.1069)*		*(.0572)*	
FE_IV					2.3406	***	-0.4554	***
					(.2860)		*(.1392)*	
F-Test for Instruments	74.29	***	59.99	***	51.52	***	25.65	***
# of obs	482		395		395		395	
Prob>F	0.00		0.00		0.00		0.00	
R-Squared	0.4412		0.4415		0.4796		0.3918	
Adj. R-Squared	0.4353		0.4329		0.4702		0.3808	

**p<.10, **p<.05, ***p<.01 All coefficients reported with robust standard errors.*
Note: All regressions have fewer observations than Part (4) due to lack of data on the FB90 variable.
Part (5)(a) has more observations than (5)(b) and (5)(c) due to lack of data on the physician stock variable.

Table A6
2SLS Estimates of the Relationship between Immigration and Physician Wages with Specialty Controls:
First Stage Regression Results

Dependent Variable:	I = Immigration Share				FBFE_Share		FBUSE_Share	
Independent Variable	(7)(a)		(7)(b)		(7)(c)			
Male	-0.0041	***	-0.0039	***	-0.0038	***	-0.0010	***
	(.0006)		*(.0005)*		*(.0004)*		*(.0002)*	
Age	-0.0011	***	-0.0009	***	-0.0003	***	-0.0003	***
	(.0001)		*(.0001)*		*(.0001)*		*(.0000)*	
Age^2	0.0000	***	0.0000	***	0.0000	***	0.0000	***
	(.0000)		*(.0000)*		*(.0000)*		*(.0000)*	
MedB	0.5733	***	0.8949	***	0.5907	***	-0.1883	***
	(.0150)		*(.0102)*		*(.0090)*		*(.0042)*	
S = Physician Stock			0.0849	***	0.1208	***	0.0009	
			(.0025)		*(.0020)*		*(.0006)*	
Anesthesiology	-0.0031	**	-0.0032	***	-0.0005		-0.0003	
	(.0012)		*(.0010)*		*(.0008)*		*(.0004)*	
Family/General	-0.0187	***	-0.0074	***	-0.0056	***	-0.0015	***
	(.0010)		*(.0007)*		*(.0006)*		*(.0003)*	
OBGYN	-0.0025	**	-0.0019	*	-0.0004		-0.0005	
	(.0013)		*(.0010)*		*(.0008)*		*(.0003)*	
Pediatrics	-0.0003		-0.0011		*-0.0003*		-0.0006	**
	(.0010)		*(.0008)*		*(.0006)*		*(.0003)*	
Psychiatry	-0.0024	**	-0.0017	*	-0.0006		0.0003	
	(.0011)		*(.0009)*		*(.0007)*		*(.0003)*	
Surgery	-0.0069	***	-0.0052	***	-0.0024	***	-0.0007	***
	(.0009)		*(.0007)*		*(.0005)*		*(.0002)*	
Internal Medicine	0.0060	***	0.0023	***	0.0032	***	-0.0000	
	(.0009)		*(.0007)*		*(.0005)*		*(.0002)*	
FB90	1.0076	***	1.0109	***	-0.4985	***	0.4691	***
	(.0039)		*(.0033)*		*(.0071)*		*(.0033)*	
FE_IV					3.3795	***	-0.5766	***
					(.0247)		*(.0078)*	
F-Test for Instruments	68,151	***	95,898	***	29,240	***	23,472	***
# of obs	159,448		128,074		128,074		128,074	
R-Squared	0.2963		0.4807		0.5763		0.5294	
Adj. R-Squared	0.2962		0.4807		0.5762		0.5293	

**p<.10, **p<.05, ***p<.01 All coefficients reported with robust standard errors.*

Note: All regressions have fewer observations than Part (6) due to lack of data on the FB90 variable.
Part (7)(a) has more observations than (7)(b) and (7)(c) due to lack of data on the physician stock variable.

Table A7

2SLS First-Difference Estimates of the Relationship between Immigration and Physician Wages with Specialty Controls:
First Stage Regression Results

Dependent Variable:	ΔI = Immigration Share		ΔFB FE Share	ΔFB USE Share
Independent Variable	(10)(a)	(10)(b)	(10)(c)	
Δ Male	-0.3791 ***	-0.4615 ***	-0.3803 ***	-0.1093 ***
	(.0778)	*(.0863)*	*(.0714)*	*(.0341)*
Δ Age	-0.0475 ***	-0.0638 ***	-0.0378 ***	-0.0196 ***
	(.0153)	*(.0175)*	*(.0145)*	(.0064)
Δ Age^2	0.0007 ***	0.0009 ***	0.0006 ***	0.0002 ***
	(.0002)	*(.0002)*	*(.0002)*	*(.0001)*
Δ MedB	0.3151 **	0.3171 **	0.5863 ***	-0.3876 ***
	(.1362)	*(.1572)*	*(.1342)*	*(.0536)*
Δ S Physician Stock		0.0371	0.0864	-0.0328
		(.1218)	*(.0757)*	*(.0536)*
Δ Anesthesiology	0.3782 **	*0.3801* **	0.1988	0.1401 **
	(.1573)	*(.1784)*	*(.1438)*	*(.0619)*
Δ Family/General	-0.0327	*0.1092*	-0.0010	0.0674 *
	(.0868)	*(.0932)*	*(.0737)*	*(.0387)*
Δ OBGYN	-0.0697	0.0515	0.0786	0.0191
	(.1479)	*(.1651)*	*(.1303)*	*(.0642)*
Δ Pediatrics	0.0088	0.1078	0.0529	-0.0022
	(.1225)	*(.1319)*	*(.1080)*	*(.0578)*
Δ Psychiatry	-0.5499 ***	-0.5261 ***	-0.4954 ***	-0.0333
	(.1210)	*(.1402)*	*(.1148)*	*(.0586)*
Δ Surgery	-.0460	-0.0071	-0.0276	0.0302
	(.1045)	*(.1155)*	*(.0900)*	*(.0442)*
Δ Internal Medicine	0.2783 **	0.3362 ***	0.2384 **	0.0936 **
	(.1153)	*(.1245)*	*(.0992)*	*(.0459)*
FB90	0.7065 ***	0.6828 ***	-0.3124 ***	0.3532 ***
	(.0874)	*(.0907)*	*(.1063)*	*(.0572)*
FE_IV			2.3527 ***	-0.4734 ***
			(.2862)	*(.1425)*
F-Test for Instruments	65.31 ***	56.67 ***	50.58 ***	26.99 ***
# of obs	482	395	395	395
R-Squared	0.4808	0.4804	0.5170	0.4081
Adj. R-Squared	0.4676	0.4627	0.4993	0.3863

**p<.10, **p<.05, ***p<.01 All coefficients reported with robust standard errors.*
Note: All regressions have fewer observations than Part (9) due to lack of data on the FB90 variable.
Part (10)(a) has more observations than (10)(b) and (10)(c) due to lack of data on the physician stock variable.

About the Author

A National Merit Scholar, Finnie B. Cook graduated summa cum laude from the University of Florida, earning a B.S.B.A. with a major in International Economics and a minor in German in 2003. She completed an undergraduate thesis on the topic of price changes in Germany after conversion from the Deutschmark to the Euro under the supervision of Dr. Denslow. In 2007, she earned an M.A. in Business Economics from the University of South Florida, was accepted into the USF College of Business Ph.D. program and was awarded a graduate fellowship for her first year of doctoral study. Her fields of study included health economics, international/development economics, econometrics, and international affairs.

As an undergraduate, Ms. Cook was employed as a teaching assistant by the UF Department of Statistics. She has been employed as an economist with the Tampa consulting firm Deiter, Stephens, & Durham since 2004.