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Foreign Nurse Importation to the United States and the Supply of Native Registered Nurses

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Abstract:

Importing foreign nurses has been used as a strategy to ease nursing shortages in the United States. The effectiveness of this policy critically depends on the long-run response of native-born nurses. We examine how the immigration of foreign-born registered nurses (RNs) affects the occupational choice and long-run employment decisions of native RNs. Using a variety of empirical strategies that exploit the geographical distribution of immigrant nurses across U.S. cities, we find evidence of large displacement effects—over a 10-year period, for every foreign nurse that migrates to a city, between one and two fewer native nurses are employed in that city. We find similar results at the state level using data on individuals taking the nursing board exam—an increase in the flow of foreign nurses significantly reduces the number of natives sitting for licensure exams in the states that are more dependent on foreign-born nurses compared to those states that are less dependent on foreign nurses. Using data on self-reported workplace satisfaction among a sample of California nurses, we find evidence suggesting that some of the displacement effects could be driven by a decline in the perceived quality of the workplace environment.

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1 Introduction

Registered nurses (RNs) are the single largest group of healthcare professionals in the United States and their occupational demand is expected to grow at unprecedented levels over the next 10 to 15 years. The latest U.S. Bureau of Labor Statistics Occupational Outlook Handbook (2012) estimates that the employment of registered nurses will grow 19 percent from 2012 to 2020, much faster than the average for all occupations (11 percent). Several demographic factors contribute to this prediction — the aging and growth of the U.S. population, an expected shortage of primary care physicians, and technological advances. These projections are likely to underestimate the demand for RNs as these estimates do not incorporate the passage of the Affordable Care Act which is expected to expand health insurance coverage to 32 million Americans. Moreover, thousands of RNs are likely to retire in the next decade (in 2010 close to 30 percent of native-born nurses were 55 years of age or older).

Over the last decade, the supply of nurses appears to have responded to this increased demand — between 2005 and 2010, the supply of registered nurses experienced its largest expansion since 1970. Nevertheless, this increase is expected to be short-lived as much of the increased supply was triggered by nurses who due to the recession re-entered the labor force. As the economy recovers, these nurses are expected to reduce their work hours or return to non-nursing jobs (Staiger, Auerbach, and Buerhaus 2012). Nurse shortages are likely to have serious implications for the quality of U.S. healthcare — higher patient loads have been associated with more medical errors, longer hospitalizations, lower patient satisfaction, and increases in the mortality rate.[1] Therefore, strategies are needed to ensure that the size of the nursing workforce in the United States is large enough to meet the healthcare demands in the near future. One strategy that has been actively pursued in the U.S. labor market is the hiring of foreign-born RNs.[2] Whether this strategy is effective at addressing and preventing nurse shortages is a contentious issue. While hospitals strongly support and lobby for migration policies that facilitate the importation of foreign-born healthcare professionals, arguing that they provide critical temporary relief in times of acute shortages, the American Nurses Association (ANA) strongly opposes this practice on the grounds that "the influx of foreign-educated nurses only serves to further delay debate and action on the serious workplace issues that continue to drive American nurses away from the profession" (ANA, 2008). If the ANA's

[1] See Buerhaus, Staiger, and Auerbach (2009) and Tulenko (2012) for thorough reviews of the literature.

[2] Several U.S. immigration laws have been implemented in the past few decades to facilitate the hiring of foreign nurses. For example, to address the nurse shortage of the late 1980s, Congress passed the Immigration Nursing Relief Act of 1989, which created the H1-A nonimmigrant visa category for nurses. There were no limits placed on the number of visas that could be issued. The Act expired in 1995 and the Congress decided against extending it. More recently, in 2005 President Bush signed into law the Emergency Supplemental Appropriations Package which enabled 50,000 unused employment-based immigrant visas to be allocated to registered nurses, physical therapists, and their families.

argument is a correct assessment, then what is considered to be an effective policy in the short run might not be the best strategy in the long run. This paper's goal is to evaluate the impact of foreign nurse importation on the long-run supply of registered nurses.[3] In particular, we explore if the importation of foreign nurses has affected the employment of native-born U.S. nurses and the number of native-born U.S. citizens deciding to pursue a nursing career.[4]

The question of how immigration affects U.S. native workers has long been of interest to labor economists. Several dozen papers have been written on this topic.[5] Nevertheless, besides the fact that there remains no strong consensus as to whether immigration has any negative labor market effects on competing native workers, most studies have focused on broad groups of the U.S. population and it is not clear whether the results of these studies can be extrapolated to particular occupations, such as nursing.[6] The impact of immigration is likely to be occupation-specific and to depend, among other things, on the degree of substitution (or complementarity) between native and immigrant workers, and on the existence of economies of agglomeration in the relevant production function. For example, many recent studies have found no displacement effects, or even that the inflow of foreign scientists and engineers has a positive effect on the number of natives working in the STEM fields (Kerr and Lincoln 2010; Hunt and Gauthier-Loiselle 2010).[7]

We use several datasets and empirical strategies to exploit the large geographic variation in immigrant concentration in the U.S. labor market for nurses to identify how foreign nurse importation has affected native nurses along various dimensions. We start by exploring the effects of foreign

[3] Ideally, we would also like to study the impact of foreign nurse migration on the short-run supply of nurses. However, such analysis is precluded due to data limitations. In particular, the Census which arguably has the best counts of foreign and native nurses at the city or state level is conducted only every ten years. The annual American Community Survey only begins in 2000 and does not have geographical identifiers at the city level until 2005. The sample size of the Current Population Survey (CPS) makes it difficult to study a single occupation at the state or city level - the number of foreign and native nurses by state or city is too small for meaningful analysis. Although the National Sample Survey of Registered Nurses (NSSRN) is conducted every four years and has a large sample of nurses, there is severe undercounting of foreign nurses making it difficult to compute reliable short-run changes in the supply of foreign nurses over time. For example, the estimated shares of foreign nurses in the NSSRN are about half of those estimated using the Census data. Furthermore, the NSSRN indicates little change in the number of foreign-educated nurses between 2000 and 2004, despite evidence from the nursing licensure examinations (NCLEX) of more than a tripling in the number of foreign-educated nurses who passed the licensing exam over the same period, most of whom presumably immigrated (Aiken 2007).

[4] Throughout the paper, our use of the term "nurses" refer specifically to registered nurses.

[5] See for example, Borjas (2003, 2006), Card (2001, 2005), and Wozniak and Murray (2012).

[6] A small number of papers have looked at the effect of foreign nurse immigration on native U.S. nurses (Schumacher 2011 and Kaestner and Kaushal 2012). Unlike previous work that tends to focus on the wage impact of immigration, our focus is on displacement effects. We also use different data sources and empirical strategies to estimate the displacement effects and to understand the channels through which displacement occurs.

[7] On the other hand, Federman, Harrington and Krynski (2006) study how the influx of Vietnamese manicurists in California impacts upon natives and find that for every five Vietnamese who enter the market, two non-Vietnamese manicurists were displaced.

nurse migration on the aggregate number of natives employed as RNs. Using data from the 1980, 1990, and 2000 Census and the 2010 American Community Survey, we follow Card's (2001) cross-area approach and relate 10-year changes in the number of native nurses per capita in a city to 10-year changes in the number of foreign-born nurses per capita. To instrument for foreign nurse flows into a city, we use the historical distribution of other highly skilled immigrants across cities in the United States to allocate the national flow of foreign-born nurses to each city. We find large displacement effects — for every foreign-born nurse that migrates to a U.S. city there are between one and two fewer native RNs observed working in the city. The estimated negative effects are robust to the estimation technique used (OLS or IV, although IV estimates are about two to three times as large) and to a large set of controls, including state-specific shocks and proxy variables for demand and supply determinants of the size of the U.S. nursing workforce. Furthermore, we also find large displacement effects when we use a second approach to gauge the impact foreign nurses have on native-born nurses. Following Borjas (2003), we exploit variation in immigrant concentration at a finer level by dividing a city's native nursing labor force into different experience groups in order to examine how changes over time in immigrant concentration within a city across experience groups differentially affects native nurses with different experience levels within this same city. This approach is complementary to the spatial correlations approach, as using experience levels allow us to control for unobserved shocks that vary by city across time. As expected, if there is at least some degree of substitution between nurses of different experience levels, the estimated effects are smaller than those obtained from using the cross-area approach, but the effects remain sizable — for each foreign nurse of a given experience level who enters a city, there are approximately 0.9 fewer natives of the same experience level working as RNs in the same city. Although large, our displacement estimates are not implausible if there are productivity differences between native and foreign nurses. In Cortes and Pan (2013) we provide strong evidence that foreign nurses — in particular Filipinos — are on average more productive than native nurses.

Having established that importing foreign-born RNs results in large displacement effects on the aggregate native U.S. nursing workforce, we explore which groups are most affected by foreign nurse inflows and the channels through which this displacement effect takes place. We find displacement effects for all age groups and education levels (bachelor's or associate degree), with the exception of nurses with an advanced degree. Examining internal migration flows suggests that the displacement effects are not driven by native nurses selectively avoiding or moving away from cities with high-immigrant populations. We also find little evidence that this displacement occurs due to more native nurses becoming unemployed or exiting the labor force. Overall, this finding suggests that the displacement effects observed are likely to be due to native RNs switching occupations or fewer potential nurses in a city choosing to enter the nursing profession.

To directly test for the possibility that foreign nurse migration might affect the number of natives choosing a nursing career, we utilize annual data on the number of individuals taking the National

Council Licensure Examination (NCLEX) from 1983 to 2010. Because data for the number of native takers is available at the state level but data on foreign-educated exam takers is only available at the national level, we use a reduced-form approach. We test whether increases in the aggregate (national) flow of foreign RNs are associated with fewer natives joining the occupation four years later (the time it typically takes to obtain a bachelor's degree in nursing)[8] in states that are historically dependent on foreign-born nurses relative to less-dependent states (Kerr and Lincoln 2010). Once again we find strong negative effects, with magnitudes comparable to those obtained using the first two approaches.

In the remainder of the paper, we examine what might be driving these large displacement effects. Are foreign-trained nurses driving down wages down to the degree that native-born nurses prefer to switch occupations? Or has the inflow of foreign nurses directly affected the quality of the work environment, or indirectly, by lowering the incentives to improve working conditions? Has the influx of foreign nurses reduced the need to make the reforms necessary to expand the capacity of U.S. nursing schools?[9] Although we cannot directly test the relevance of each of these channels, we provide some suggestive evidence for each of these potential factors.

We find little evidence of declining wages in response to the influx of foreign nurses. One possibility that might explain the large quantity effects but limited wage effects might be the institutional features of the nursing labor market. Many economists regard the U.S. nursing sector as one with considerable market power and wage rigidity (for example, see Burkett 2005; Currie, Farsi, and MacLeod 2005; and Staiger, Spetz, and Phibbs 2010). The presence of monopsony power and wage rigidity may limit the scope for observable wage declines. Nevertheless, it is possible that wage effects may be observed along other dimensions not captured in our data such as work conditions, other forms of workplace benefits and non-wage compensation. We provide some evidence that one such dimension — working conditions — may have been affected by the influx of foreign nurses.

Several studies and surveys have found that the satisfaction derived from a job and the quality of the work environment are important factors affecting the labor supply decision of existing RNs, perhaps even more so than wage levels.[10] To the extent that foreign nurses reduce employers' incentives to improve working conditions or directly impact the quality of co-worker interactions within a workplace, their presence in the U.S. labor market for nurses might affect the number of

[8] We also conduct robustness checks with two-year lags to allow for the possibility that it can take as little as two years to complete an associate's degree. The results are very similar.

[9] There is widespread agreement that the primary bottleneck for the expansion of the native nurse supply, at least during the last decade, has been capacity constraints in U.S. nursing schools (Joynt and Kimball 2008).

[10] Shields and Ward (2001) find that that job satisfaction is the single most important determinant of intentions to quit among nurses employed by the National Health Service in the United Kingdom. Based on a thorough review of the literature on the determinants of the labor supply of nurses, Shields (2004) concludes that the wage elasticity of labor supply is very inelastic and that improving the nonmonetary aspects of the job might be important for increasing the labor supply.

natives choosing to enter or remain in the nursing profession. To test for the second possibility, we use data from the 2006 and 2010 Survey of Registered Nurses conducted by the California Board of Registered Nursing. This survey includes questions on nurses' satisfaction with several aspects of their most recent nursing position. Exploiting cross-sectional variation at the county level in the inflow of foreign nurses during that four-year period, we find that a higher concentration of foreign nurses in a county increases the probability that a native RN reports being relatively dissatisfied with the level of support and the quality of teamwork with other RNs with whom the individual works. The fact that the results are robust to controlling for other ratings such as the adequacy of the number and skill level of RNs at the facility where the native nurse works, and that we find effects of the opposite sign for the level of satisfaction reported by foreign nurses, suggests that that our results are not merely picking up unobserved shocks to the nursing workforce in a California county.

Taken together, our findings suggest that while importing foreign nurses might be an effective short-run strategy to address nursing shortages in the United States, it might have the unintended consequence of significantly reducing the long-run supply of native nurses. If most of the displacement effects occur as a result of reduced incentives to invest in improving working conditions or expanding the capacity of U.S. nursing schools, then a possible solution could be to combine an immigration policy that facilitates the hiring of foreign nurses in order to provide temporary relief with explicit stipulations requiring employers to invest in initiatives to retain native nurses. For instance, under the H-1B program, employers requesting H-1B visas for highly skilled temporary workers are required to pay a fee that is then used to fund grants for skills training and scholarships for native workers in STEM fields (Ruiz and Wilson 2013). A similar policy could be implemented for filing fees paid to bring in foreign RNs — these fees could be used to fund training and/or retention programs for native U.S. nurses.

2 Data and Descriptive Statistics

We use the 1980, 1990, and 2000 U.S. Censuses and the 2010 American Community Survey three-year aggregate (2008–2010) as our main data sources. The average sample size per year is about 100,000 nurses. We focus on workers aged 25 to 64 years who reported being an RN as their occupation. Table 1 presents descriptive statistics of RN's demographic and labor supply characteristics by foreign-born status and their evolution over time.[11] As observed, foreign-born nurses

[11] When using the Census and the ACS, we concentrate on foreign born nurses instead of foreign educated nurses given that these data sets do not include information on the country of education. Although we could potentially use the year of immigration variable to construct a proxy, the measurement error is likely to be large, especially for 1980 and 1990 when this variable is aggregated in five year periods. We do focus on foreign educated nurses when utilizing the NCLEX data and the California Survey of Registered Nurses.

have steadily increased their share in the U.S. nursing workforce, from representing 9 percent of RNs in 1980 to 14 percent in 2010.[12] The demographic characteristics of the two groups are relatively similar with both composed mostly of married females and experiencing significant aging. More pronounced differences are observed with respect to education levels, job characteristics, and labor supply outcomes. Whereas close to 70 percent of foreign-born RNs have at least a bachelor's degree, in 2010 about half of native-born RNs have an associate degree or diploma.[13] Foreign nurses are substantially more likely to work in hospitals and much less likely to work in physicians' offices. Natives nurses are about 50 percent less likely to do shift work[14] and 50 percent more likely to make this work part-time; as shown in Cortes and Pan (2013), these differences are not fully explained by their higher likelihood of working in hospitals and nursing homes. Finally, foreign-born nurses earn on average about 15 percent more than native-born RNs. Regressions presented in Cortes and Pan (2013) show that only about two-thirds of the wage premium can be explained by detailed geographic location, education and observable job characteristics, suggesting that foreign-born nurses might be more skilled than native-born nurses.

Our empirical strategies exploit the large concentration of foreign nurses in particular areas of the United States. Table 2 presents the share of foreign-born nurses for the largest U.S. cities for each census decade observed from 1980 to 2010.[15] In 2010, the top three cities in descending order of concentration, where more than half of all RNs were foreign-born, were Miami, New York, and Los Angeles. In contrast, in cities like Pittsburgh and St. Louis, less than 5 percent of all registered nurses were born outside the United States. Cities with large numbers of foreign nurses typically have a large representation of immigrants in their overall population as well — the correlation between the overall share of immigrants in a city and the share of registered nurses is over 0.9. However, the concentration of foreign-born nurses in the top cities is even larger; the average foreign-born share in the nursing labor force in the top five cities is 50 percent, whereas it is only 37 percent in the overall population. Figure 1 shows the variation in the share of foreign-born RNs and the number of foreign-born RNs per capita across cities from 1980 to 2010. There is also substantial cross-city variation in the composition of foreign nurses by the country of origin as shown in Appendix Table 1, despite the clear predominance of nurses from the Philippines at the national level.[16] Our empirical strategy will exploit part of this variation in country of origin

[12] These numbers are very similar to the foreign-born share in the overall U.S. population which was 8 percent in 1980 and 16 percent in 2010.

[13] A bachelor's degree takes four years to complete, whereas an associate degree or a diploma between two and three years. All, however, fullfill the educational requirement to become a registered nurse, provided that the person passes the NCLEX. Note that foreigners are more likely to have a bachelor's degree, in part, because in some of the sending countries, the Philippines in particular, there are no associate degree or diploma programs.

[14] We define a nurse as doing shift work if she reported leaving home for work anytime between 5 pm and 4 am.

[15] A very similar ranking of cities is observed for the number of foreign nurses per capita, the variable we are going to use in our regressions. The correlation between these two measures is 0.96.

[16] In Cortes and Pan (2013) we present changes over time in the country of origin composition of the foreign

across cities among foreign nurses.

3 Empirical Strategy and Results

We start our analysis by examining how the inflow of foreign nurses has affected the aggregate supply of native nurses. We present two complementary approaches, which differ in the type of variation used and how we address the omitted variable problems.

3.1 Spatial Correlations Approach

Our first approach exploits variation in the concentration of foreign nurses across U.S. cities and over time to identify the causal effects of the inflow of foreign-born nurses on the number of native nurses working in a city (Card 2001, 2005).[17] A city in our analysis corresponds to a metropolitan statistical area (MSA) as defined by the U.S. Census Bureau. As the geographic boundaries of MSAs change somewhat over time, we utilize the crosswalk by Card and Lewis (2007) that uses state and county groups to create consistent MSAs from 1980 to 2010. Our empirical specification is as follows:

$$\frac{Native\ Nurses}{Population}_{ijt} = \alpha + \beta \left(\frac{Foreign\ Nurses}{Population} \right)_{ijt} + \gamma X_{ijt} + \theta_{jt} + \lambda_i + \tau_t + \epsilon_{it}, \qquad (1)$$

where i refers to the city, j the region[18], and t the time period (t =1980, 1990, 2000, and 2010). For our main dependent and independent variables, we focus on the number of full-time employed (FTE) native and foreign RNs per capita in a city for each census year. Full-time employment is computed as the sum of workers working at least 35 hours per week plus one-half of workers working less than 35 hours per week.[19] X_{it} is a vector of time-varying city level controls, θ_{jt} is a vector of region*year fixed effects, λ_i is a vector of city fixed effects and τ_t is a vector of time period

nurse population in the US and discuss the origins of those changes. In particular, we focus on the causes of the predominance of nurses from the Philippines.

[17] There are several reasons we use cities as the main unit of analysis rather than states. First, there is significant variation in foreign nurse concentration across cities within a state. Second, using cities as the economic unit allows us to control for state-level shocks, which is particularly important in this setting given that the nursing occupation is regulated by state agencies. Third, we expect relatively low geographic mobility in the nursing population, as most RNs are married women. In Appendix Table 10 and 11, we estimate the city-level models using state-level data and the effects are qualitatively similar.

[18] We use the nine region classification defined by the U.S. Census.

[19] This adjustment takes into account the fact that native-born nurses are more likely to be employed part-time as compared to foreign-born nurses. Estimates using the count of the number of native nurses per capita as a dependent variable are qualitatively similar and generally slightly larger in magnitude (results available on request).

fixed effects. The vector X_{it} includes a cubic polynomial in city population and proxies for demand and supply determinants. The demand determinants include the share of the city population over 65 years of age, the log of average hourly wages as a proxy for the city's income level, and the number of physicians per 1,000 population. Variables to capture the supply side of the native nursing labor market include the share of the city population aged 25 to 34 years, 35 to 44 years, 45 to 54 years, and 55 to 64 years, the share of females in professional occupations,[20] the labor force participation of skilled married women, the log average hourly wage of skilled women employed outside of nursing, and the share of whites in the population.[21] Finally, in some specifications, we also include flexible state*year fixed effects to better account for unobserved demand and supply factors that vary across locality and time. In particular, given that state nursing boards are responsible for regulating nursing practices in the United States, the inclusion of state*year fixed effects enables us to control for changes in licensing requirements, minimum nurse staffing ratios, and so on over time. The summary statistics for this sample are presented in Appendix Table 2.

The OLS estimation of β is likely to be biased, since changes in the number of foreign nurses in a city are probably not orthogonal to unobserved demand and supply shocks to the native nurse labor market as represented by the error term ϵ_{it}. $\widehat{\beta}_{ols}$ will overestimate the true β if a positive demand shock makes employers want to hire more RNs, both foreign and native. On the other hand, $\widehat{\beta}_{ols}$ will underestimate the true β if an increase in the inflow of foreign nurses is caused by a decline in the number of native nurses willing to work in the city. To account for the potential endogeneity of foreign-born nurses in a U.S. city, we adopt an instrument common in the immigration literature that uses the historical distribution of migrants across U.S. cities (Card 2001).

The instrument exploits the tendency of immigrants to settle in cities with large enclaves of immigrants from the same country. The idea is that prospective immigrants choose locations on the basis of the strength of immigrant networks (Munshi 2003). The instrument uses the 1980 distribution of skilled immigrants from a given country across U.S. cities to allocate the new waves of foreign nurses from that country to a given city. For example, if one-third of skilled Filipino immigrants in 1980 were living in Miami and a quarter were living in Los Angeles, the instrument allocates one-third of all Philippine-born nurses in each time period (1980, 1990, 2000, and 2010) to Miami and a quarter to Los Angeles. Note that we chose specifically to use the 1980 distribution of skilled immigrants (defined as those with some college or more) as opposed to the historical distribution of immigrant nurses, as it is likely to be the case that the distribution of skilled immigrants is more exogenous to persistent shocks to the local nursing labor market than the latter.[22]

[20] Buerhaus, Staiger, and Auerbach (2009) suggest that the expansion of career opportunities for women in traditionally male-dominated fields could be one of the main causes of the declining interest in nursing among natives.

[21] Whites are typically over-represented in nursing.

[22] In results not reported here, we also construct a similar instrument using the 1980 geographic distribution of foreign-born nurses — the results are similar and available upon request.

Formally, the instrument for apportioning the number of foreign nurses in city i and decade t can be written as:

$$\sum_{c} \frac{Skilled\ Immigrants_{ci,1980}}{Skilled\ \ Immigrants_{c,1980}} * Foreign\ RNs_{ct,-i}, \tag{2}$$

where i denotes the city, c is the country of origin and t is the time period.[23] $\frac{Skilled\ Immigrants_{ci,1980}}{Skilled\ \ Immigrants_{c,1980}}$ represents the fraction of skilled immigrants from country c who were living in city i, and $Foreign\ RNs_{ct,-i}$ stands for the *total* number of foreign-born nurses immigrating from country c to the United States in decade t, net of the contribution of city i to this total.

Most of the specifications include city and region*year (or state*year) fixed effects. Therefore, the instrument will help in identifying the causal effect of the displacement of native nurses under the following conditions:

1. The unobserved factors that determine that more skilled immigrants decide to locate in city i instead of city i' in 1980 are uncorrelated with changes in the demand for nurses between the 1980s and through the 2000s. To ameliorate this concern, we use the distribution of skilled immigrants, *excluding* immigrants who are RNs. As mentioned before, this distribution is likely to be more exogenous to persistent shocks to the local nursing labor market than the historical distribution of immigrant nurses.

2. The national flow of foreign nurses in a given decade (the second term in the interaction) is exogenous to differential shocks to U.S. cities within a given region or state. This is particularly relevant for large cities, where it is possible that the aggregate national foreign nurse flow at time t may be correlated with local conditions at the city level. To circumvent this concern, we omit the contribution of city i to the national foreign-nurse inflow in each time period when constructing the instrument for each city.

The estimates for the first-stage regression of the foreign-born nurse population per 1,000 inhabitants in a city on the instrument (predicted number of foreign-born nurses in a city per 1,000 inhabitants) are reported in Appendix Table 3. The coefficient on the instrument indicates that as the predicted number of foreign-born nurses in a city increases by 10, this increase is associated with an inflow of two to four foreign-born nurses to the city. The first-stage regression is highly statistically significant and is robust to the introduction of different sets of controls and fixed effects for region*year and state*year (columns (1) to (4)), to excluding cities located in California

[23] We restrict the set of countries to those that account for the large majority of immigrant nurses. These countries include Canada, China, Cuba, England, Germany, Haiti, Jamaica, India, Ireland, Japan, Mexico, the Philippines, South Korea, Thailand, and Trinidad and Tobago. Together, these countries account for 70 percent of all foreign-born nurses in the United States from 1980 to 2010.

(column 5), and to excluding the top three U.S. cities for immigrants in each year (column 6).[24] The cluster-robust F-statistic is close to or larger than 10 in all specifications and we can safely reject the null hypothesis of weak identification.[25]

Panel A in Table 3 reports the OLS estimates for the displacement regressions for the 1980–2010 time period (the first six columns) and the 1990–2010 time period (the last six columns). All regressions are weighted by the city's population and standard errors are clustered at the city level. For the 1980–2010 time period, the OLS estimates are all negative and the magnitudes range from –0.3 to –0.7 in our preferred specifications. This indicates that for every 10 foreign-born nurses that enter a city, between three to seven native nurses are displaced. The results continue to be economically significant even when we focus on the 1990–2010 time period, although the estimates tend to be somewhat smaller. As discussed above, even with the large number of controls and time-varying fixed effects that we employ in the OLS regressions in Panel A, there are two potential issues with interpreting these estimates as the causal effect that foreign-born nurses have on native nurse displacement. First, measurement error in the stock of foreign-born nurses in a city will tend to attenuate the OLS estimates (Aydemir and Borjas 2011). This is a particularly large concern in our setting as we focus on a single occupation and there are relatively few nurses at the city-level (particularly among smaller cities). Furthermore, the large number of fixed effects in some of the OLS regressions may exacerbate the measurement error. Second, the OLS estimates are likely to be confounded by demand or supply shocks to the native nursing market.

To circumvent these issues, we turn to the instrumental variable models. Table 3, Panel B reports the 2SLS estimates where we instrument for the number of foreign-born nurses as a fraction of a city's population using the modified Card (2001) instrument (see equation (2)) based on the historical distribution of high-skill immigrants in 1980. The IV estimates are considerably larger than the OLS estimates and are highly statistically significant for both the 1980–2010 period and 1990–2010 period — the magnitudes imply that for each one foreign-born RN who enters a city, approximately 1.6 to 2 native RNs are displaced. This suggests that the OLS estimates are confounded by positive demand shocks and/or attenuation bias due to measurement error. Reassuringly, the 2SLS estimates do not change much with the inclusion of additional controls and fixed effects for region*year and state*year. The stability of the 2SLS estimates across the various specifications suggests that the instrument is unlikely to be confounded by unobserved demand and supply shocks. Furthermore, the fact that the results are similar when we restrict the sample to the 1990 to 2010 time period also ameliorates concerns that the results obtained using the 1980 to 2010 time period are driven by the use of the 1980 data in constructing the instrument that

[24] The top immigrant cities that appear at least once among the top three immigrant cities in each census year include Bergen-Passaic, NJ; Brazoria, TX; Fort Lauderdale, FL; Jersey City, NJ; Miami, FL; New York, NY, and San Francisco, CA.

[25] We use the Angrist-Pischke F-statistic reported by the stata command ivreg2.

predicts immigrant inflows. Given the similarity in the results across the two time periods, in the remainder of the paper's analysis we choose to include the 1980 time period, as it provides us with a larger sample size and smaller standard errors.

Finally, as a "falsification "test of whether the estimates are picking up the true displacement effects of foreign nurses on native nurses or unobserved shocks that are correlated with the instrument, we re-estimate our results using primary-school teachers — a profession that experiences supply shocks similar to the nursing profession but that has very few foreign-trained teachers.[26] The results for the displacement regressions that use native primary school teachers per capita as the outcome variable are reported in Appendix Table 4. Contrary to the results reported in Table 3, we see that in both the OLS and 2SLS specifications, the inflows of foreign-born nurses are not significantly related to the employment of primary school teachers. This suggests that our displacement estimates are not merely picking up unobserved shocks (common to the labor market for teachers) that are correlated with immigrant nurse inflows and native nurse outflows.[27]

3.2 Variation in Experience within Cities

We present an alternative strategy to measure the long-run native displacement effects of hiring foreign nurses. We follow Borjas (2003, 2006) in using work experience as a determinant of skill level and exploiting variation through time in the immigrant concentration within a city across experience groups. This approach's main assumption is that workers who have different levels of experience are imperfect substitutes and thus an inflow of foreign nurses of a particular experience group should have a larger effect on the group of native-born nurses with the same level of experience. The advantage of this strategy is that it allows us to control for city-level shocks to the nurse labor market by including city*year fixed effects in the econometric specification. The identification assumption, therefore, is that the experience distribution of the foreign nursing flow is orthogonal to shocks to specific experience groups within a given city's nursing labor market. This might not be an unreasonable assumption given that employers have limited choice with respect to the experience level of the foreign nurses whom they hire, as most foreign nurses who migrate to the United States are between 25 to 35 years of age.[28] Our empirical specification is the following:

[26] Foreigners account for at most 5 percent of primary school teachers employed in the United States compared to 15 percent of RNs.

[27] It is possible that the estimates of the "falsification "test could pick up a causal effect of immigrant nurses on teachers if prospective native nurses decide to become teachers in response to immigrant inflows — however, we do not expect this effect to dominate as both teaching and nursing require professional degrees.

[28] Using confidential data from the Philippines Overseas Employment Administration (POEA), which includes all temporary contracts of nurses migrating to the United States, we calculate that 75 percent of nurses migrate when they are 35 years-old or younger, and 90 percent when they are younger than 40.

$$\frac{Native\ RNs_{ijt}}{Population_{it}} = \alpha + \beta * \frac{Foreign\ RNs_{ijt}}{Population_{it}} + \lambda_i + \theta_j + \tau_t + \pi_{ij} + \sigma_{it} + \phi_{jt} + \epsilon_{ijt}, \qquad (3)$$

where i stands for city, j for experience group, and t for the decade/time period. $\frac{Native\_RNs_{ijt}}{Population_{it}}$ is the normalized number of full-time equivalent native RNs of experience level j, in city i in period t, and $\frac{Foreign\ RNs_{ijt}}{Population_{it}}$ is similarly defined. σ_{it} controls for city level shocks, π_{ij} for time-invariant differences in the size of the native nurse population at the city*age level, and ϕ_{jt} for national level shocks to different experience groups.

There are several limitations to using this approach. First, the Census does not directly observe work experience. We use information on age, education, and foreign-born status to construct a measure of potential experience to proxy for work experience. In particular, we use the National Sample Survey of Registered Nurses, which has information on age at graduation to construct a proxy for the likely age of entrance to the labor force by education level and citizenship. Our measure incorporates the fact that native RNs who have an associate degree, on average, started their nursing education later than those with a bachelor's degree, such that even though the associate degree takes half the time to complete, age at graduation is significantly higher (26 versus 22 years). Foreign nurses' average age at graduation, in contrast, does not depend on the type of degree.[29],[30]

A second issue with this approach is that the sample sizes do not allow us to further divide the experience groups by education levels as in Borjas (2003), so we are implicitly assuming that RNs with different levels of education are substitutable. This might be a reasonable assumption for RNs with a bachelor's degree or an associate degree, but is more problematic for nurses with a graduate degree who might be specialists in a specific area (for example, midwives). Therefore, we also show specifications that omit nurses with a graduate degree from the sample. As we will see, the results do not change in any significant way.

Finally, there is no straightforward way to construct the experience groups. The most natural approach would be to split the RN population into segments of similar length, for example: 0 to 10 years of experience, 11 to 20 years, 21 to 30 years, and 31 plus years. However, for this estimation strategy to work, there should be clear differences in labor market performance by experience group; furthermore, immigrants should perform most similarly to natives with the same experience level. To explore if this is indeed the case for the RN workforce in the United States, in Appendix Table 5 we compare the wage distribution of immigrants and natives by experience group. More specifically, we look at the share of the relevant group belonging to each quartile of the aggregate hourly wage distribution (net of city fixed effects), using the 2000 Census data.

[29] Refer to the Data Appendix for a more detailed explanation of how we use the NSSRNs to construct a proxy for age of entry to the labor market.

[30] Another source of measurement error when using this proxy is that many female nurses have likely spent some time away from the labor force or do not work full time. Unfortunately, we have no way of correcting for this.

One observation stands out: there are marked differences between the wage distribution of nurses with low experience levels and the rest of the groups, but much smaller differences when more experienced groups are compared.[31] Additionally, at least for one immigrant group with 21–30 years of experience, the most similar native wage distribution belongs to a different experience range (31+ years). Given this characterization, we divide nurses into only two groups: the very young (or the least experienced) and the remainder.[32]

Table 4 presents the OLS estimation of equation (3) under different specifications and samples.[33] All the regressions are weighted by the city's population and the standard errors are clustered at the city level. The estimates indicate a negative and statistically significant effect of the number of foreign nurses on the number of native nurses in a given experience group — this result is robust to restricting the sample to cities with information for all years and experience groups (column (2)), to excluding nurses with a graduate degree (column (3)), to excluding the state of California and the top cities for migrant nurses (columns (4) and (5)), and to alternative ways of allocating foreign nurses into the experience groups (columns (6) and (7)). The magnitude of the estimated displacement effects suggest that for every 10 foreign-born nurses with a given experience level that migrate to a U.S. city, we observe almost nine fewer natives with the same experience level working as RNs in the same city. The size of the displacement effects estimated for nurses is similar to those estimated for the general population by Borjas (2006). His results imply that 6.1 fewer native workers choose to reside in a particular metropolitan area for every 10 additional immigrants who enter that locality and who possess the same education and experience level.

Note that the displacement effects estimated by using the variation in immigrant flows to experience groups within cities are smaller than those estimated using variation at the city level. This result is to be expected assuming there is some degree of substitution between RNs of different experience groups. The potential negative effects on the other groups is absorbed by the city*year fixed effects.

[31] This observation is consistent with findings by Hirsch and Schumacher (2012) and Cortes and Pan (2013) that there is a very compressed wage distribution among RNs.

[32] Estimates are similar and statistically significant, though smaller by about 20 percent, when the sample is divided in three experience groups: 1–10 years, 11–20 years, and 21+ years.

[33] Borjas' (2006) main specification differs from ours in the choice of the dependent and key explanatory variables. His dependent variable is the log of the size of the native population in a given city and skill group, and he uses the share of foreign workers as a measure of the size of the immigrant shock. Peri and Sparber (2011) showed that this specification is biased toward identifying displacement. In Appendix Table 6, we present results using this specification. The coefficients are all negative, highly statistically significant, and imply larger displacement effects than those estimated using our preferred specification. Note that the coefficients in the table are not directly comparable to those in Table 4, they need to be multiplied by $\frac{1}{(1+\frac{F}{N})^2}$ =0.8 (Borjas 2006).

3.3 Which Native-Born RNs Are Being Displaced?

Having established that there are large displacement effects on the aggregate native nursing workforce in the United States, we examine which groups of RNs are most affected by foreign nurse inflows. Panel A and Panel B of Table 5 present the displacement effects for native nurses with different age ranges and education levels, respectively. For these specifications, we focus on the 2SLS estimates, using the same instrument as used in the baseline displacement regressions reported in Table 3. We find that foreign RNs affected native RNs in every age group, with the largest negative effects observed among older nurses aged 45 to 54 years. Although these results might seem counterintuitive given that foreign RNs are likely to be younger nurses, the nursing profession is characterized by very low returns to experience (see discussion in section 3.2). This implies that there is likely to be a relatively high degree of substitution across the different experience groups. Moreover, the labor supply of older nurses is likely to be more sensitive to the quality of the work environment and working conditions.[34] Section 5.2 has a more detailed discussion about the possibility that the presence of foreign nurses affects the quality of the work environment.

With respect to education levels, we find large displacement effects for native RNs with an associate's degree or a bachelor's degree, and much smaller and nonsignificant effects for RNs with a graduate degree. This result is not surprising given that nurses with a graduate degree are typically specialists who are not in direct competition with foreign-born nurses who typically have a bachelor's degree or an associate's degree. Although foreign nurses are more likely to have a bachelor's degree as compared to native nurses, most RN positions can be filled by nurses with either education level.[35]

3.4 Where Do Displaced Native RNs Go?

We examine whether displacement occurs because native nurses are more likely to become unemployed, drop out of the labor force, or migrate internally. In Appendix Table 7, we present the OLS and 2SLS estimates of the regression conducted on the number of native nurses per capita who report being unemployed (or not in the labor force) compared to the number of foreign-born nurses per capita. We find no evidence that cities with higher foreign nurse immigration are associated with a higher incidence of unemployment or exits from the labor force among native nurses. Note that one caveat of this analysis is that the Census only captures the occupation code of an

[34] A study of nurses aged 50 years and older in the United Kingdom found that "that stress and the associated burnout were major influences on decision making with regard to employment over the age of 50." It also identified more flexible work hours as being a key factor in encouraging older nurses to remain in or return to work (Watson, Manthorpe, and Andrews 2003).

[35] For example, in the 1990 Nursing Personnel Survey conducted by the American Hospital Association, less than 2 percent of hospitals reported requiring a bachelor's degree for staff nurses.

individual (based on his/her last job) who has not been currently employed in the previous five years. Individuals whose last held a job more than five years ago are not assigned an occupation code.

Next, we explore the possibility that native RNs migrate internally in response to foreign nurse migration to a particular city. There are two possibilities — in response to an influx of foreign nurses, native RNs could be less likely to migrate to the city (inflow) or they could be more likely to migrate out of the city (outflow). Unfortunately, the Census data has a number of limitations that do not allow us to fully characterize the inflows and outflows of native-born RNs over a 10-year period as the census only asks for a respondent's city of residence during the previous five years. Furthermore, this question was only asked in 1980, 1990, and 2000.[36] Starting from 2001, the ACS only asks about internal migration in the past year. With these caveats in mind, Appendix Table 8 presents the estimates of the effect of foreign nurses on the inflow (columns (1) and (2)), outflow (columns (3) and (4)) and net inflow (columns (5) and (6)) of native nurses from 1980 to 2000. We find little evidence that foreign nurse migration significantly affected the displacement of native nurses through internal migration — the estimates from our preferred specification reported in the last column of Appendix Table 8 indicate that foreign nurse migration has a close to zero and nonsignificant effect on net inflows into a city. This result is in contrast to Borjas (2006), who finds that immigration is associated with higher out-migration rates and lower in-imigration rates. This difference is likely explained by the fact that a majority of native-born RNs are married women and are the secondary earners in the household.

Overall, these findings suggest that the displacement effects within a city are largely driven by existing native nurses switching occupations or from potential candidates choosing not to enter the nursing profession.

4 Effects on Natives Entering the Nursing Profession

In the previous section we found that foreign nurses reduce the number of young native nurses. This result suggests that the inflow of foreign-born nurses might affect not only the employment and labor supply decisions of existing RNs, but also the number of natives entering the profession. In this section we test for this possibility more directly by utilizing annual state-level data on the number of U.S.-educated nurses who from 1983 to 2010 took the National Council Licensure Examination

[36] The other limitation is that we are not provided with smaller geographic units for the migration variables; hence, we are not able to construct the consistent cities using the Card and Lewis (2007) crosswalk for the 1980 to 2000 sample. Our analysis is thus based on the census MSA variable, *METAREAD*.

(NCLEX); passing this exam is a requirement to be licensed as a RN.[37] One constraint that this data poses for our analysis is that the data on foreign-educated exam takers are only available at the national level — therefore, in this section, we will focus on reduced-form specifications.[38]

Our empirical strategy, inspired by Kerr and Lincoln (2010), tests whether increases in the aggregate (national) inflow of foreign nurses (normalized by the country's population) are associated with fewer natives joining the occupations four years later in states that historically have been very dependent on foreign-born nurses relative to states less dependent on foreign RNs. To measure a state's historical dependency on foreign nurses, we use data from the 1980 Census to construct the share of registered foreign-born nurses at the state level.[39] For ease of interpretation, we normalize the dependency measure to have unit standard deviation. Our empirical specification takes the following form:

$$\frac{Native\ Takers}{Population}_{st} = \alpha + \beta * Dependency_{1980,s} * \frac{Foreign\ Educated\ Passers}{Population}_{t-4} + \pi_s + \theta_t + \delta_{rt} + X_{st} + \varepsilon_{st}, \tag{4}$$

where s is for state, r is for region and t for year. The regressions include state fixed effects (π_s), year fixed effects (θ_t), region*year fixed effects (δ_{rt}), and a set of state-level time-varying controls (X_{st}).[40]

To evaluate the potential issues with this approach it is important to understand where the variation in both terms on the interaction comes from. Figure 2 shows yearly data on the number of native- and foreign-educated NCLEX takers from 1983 to 2010. A significant share of the variation observed in the number of foreign nurses taking the NCLEX has been the result of nurse specific U.S. immigration laws, such as the 1989 Nurse Relief Act, which created a non-immigrant visa category

[37] The data was obtained from the Nursing Board's annual publications and is disaggregated only up to the state level.

[38] The number of foreign nurses passing the NCLEX is considered a good proxy for the actual inflow of foreign nurses to the United States. In order to take the exam, the candidate has to have applied for a nursing license in one of the states. This usually requires having obtained a VisaScreen certificate from the Commision on Graduates of Foreign Nursing Schools, which checks that the nurse has a valid license from her country of residence, has passed the TOEFL, and has passed a qualifying exam. For most foreign-educated nurses the process is sponsored by the potential U.S. employer or by a recruiting agency (CGFNS, Nichols, and Davis 2009).

[39] The results are almost identical when as a dependency measure we use the number of foreign-born nurses per 1,000 people in the state, constructed using the 1980 Census.

[40] Note that we use foreign-educated nurses who pass the NCLEX as our key explanatory variable, but use native NCLEX takers as our dependent variable. The pass rates of foreign-educated nurses is not very high (about a 35 percent average across years) so many of those who take the exam never end up working as RNs in the United States. On the other hand, we are interested in the number of natives who graduated from a nursing program (a prerequisite to register for the NCLEX) and not necessarily in the number who passed the exam. Note, however, that the pass rates for natives are extremely high, so results using those who passed the NCLEX are very similar.

(the H1A) exclusively for nurses with no limits placed on the number of nurses who could enter the United States. As observed in Figure 2, while the law was in effect, the share of foreign-educated nurses taking the NCLEX increased significantly; once the law expired, the share dropped by a large amount. The spike in 2006–2007 is also the result of an immigration policy enacted in 2005 that released 50,000 Green Cards to be allocated exclusively to foreign-born nurses and their families. To the extent that the passage of these laws resulted from heavy lobbying by employers in states that are highly dependent on foreign nurses, the interaction term might be proxying for demand or supply shocks experienced by these states. To partially address this issue, we present specifications which omit the five states that in 1980 depended more heavily on foreign nurses (California, Florida, Illinois, New Jersey, and New York). To further check that our results are not driven by the most dependent states and that these same effects are also observed for states lower on the dependency distribution, we estimate a model similar to equation(4), but that replaces the interaction term with quintile dummies that interact with the aggregate flow measure:

$$\begin{aligned}\frac{Native\ Takers}{Population}_{st} = \alpha &+ \beta_1 * I(Top\ quintile)_{1980,s} * \frac{Foreign-Educated\ Passers}{Population}_{t-4} \\ &+ \beta_2 * I(Second\ quintile)_{1980,s} * \frac{Foreign-Educated\ Passers}{Population}_{t-4} \\ &+ \beta_3 * I(Third\ quintile)_{1980,s} * \frac{Foreign-Educated\ Passers}{Population}_{t-4} \\ &+ \beta_4 * I(Fourth\ quintile)_{1980,s} * \frac{Foreign-Educated\ Passers}{Population}_{t-4} + \pi_s + \theta_t + \delta_{rt} + \varepsilon_{st}\end{aligned} \tag{5}$$

.

In equation (5) states in the bottom quintile of the dependency distribution serve as the reference group.

Even if the flow is orthogonal to state-specific shocks, one might be concerned that these states that are heavily dependent on foreign nurses are different from less-dependent states in other dimensions that make them subject to different shocks or to exhibit different trends. One important confounding issue is the expansion of managed care organizations during the 1990s and the large state variation in the speed of adopting this new form of health care delivery. Some of the states characterized by high dependency on foreign nurses also were early adopters of managed care, California in particular. As Buerhaus, Staiger, and Auerbach (2009) show, in the first half of the 1990s, growth in the employment of RNs was significantly lower in states with a high concentration of health maintenance organization (HMO). To deal with this issue, we present specifications that we include interactions of a dummy for early adopter states with year fixed effects. An early adopter is defined as being one of the 10 top states in the percentage of population enrolled in a HMO by

1994.[41]

In addition, we also control for other variables that might be correlated with a state's historical dependence on foreign RNs and that are likely to affect our results. Using CPS data we construct the following variables and include a four-year lag for each variable in our model: the share of whites in the population, the age composition of the population (the shares aged 0–19 years, 20–39 years, and 40–59 years), a cubic of the state's population size, the share of females in professional occupations, and the relative wage of nurses versus other workers with at least some college education. Finally, by including region*year fixed effects in the specification, our analysis compares states that are arguably more similar and more likely to be subject to common shocks.

The estimates of equations (4) and (5) are reported in Table 6. All the regressions are weighted by the state's population and standard errors are clustered at the state level. We focus on results using a four-year lag, but in Appendix Table 9 we present results using different lags. Our estimate of the reduced-form effect (β) is always negative, statistically significant, and robust to the inclusion of a variety of controls. The magnitude of the coefficient in our preferred specification (column (3)) suggests that increasing the number of foreign-educated nurses passing the NCLEX per capita by 10 at the national level is associated with approximately seven fewer natives taking the exam four years later for each standard deviation of growth in state dependency on foreign-born RNs. As suggested by column (4), which excludes the top five states, the effect is not driven by the most dependent states. Reassuringly, all the coefficients in the quintile specifications are negative (the reference group is the bottom quintile), with the effects generally decreasing in magnitude as we move down in the dependency distribution. An increase in one foreign-educated nurse per capita at the aggregate level reduces the number of native nurses taking the NCLEX in states with the highest dependency by about 2.7, and (quintiles 2 and 3) by about 1.4 in states with medium-level dependency relative to the effect on the bottom quintile. The coefficient on the interaction of the fourth quintile with the aggregate flow is negative and the magnitude is not small, but we cannot reject that it is equal to zero.

Finally, we test whether the results are driven by the supply or demand for admissions to U.S. nursing schools. Many experts agree that in recent years, the main bottleneck to expanding the size of the native-born nursing workforce is the capacity of U.S. nursing schools.[42] To the extent

[41] The percent enrolled in HMO by state was taken from Buerhaus, Staiger, and Auerbach (2009) Table 5-1. Results are robust to changing the definition of an early adopter to being in the top five, or the top 17 states (the definition used by Buerhaus, Staiger, and Auerbach (2009)) in the percentage of population enrolled in a HMO.

[42] At least since the early 2000s a significant number of qualified applicants have been turned away from nursing programs. In 2002, for example, 45.8 percent of qualified applicants in California were not accepted to associate degree in nursing (ADN) programs. See link: http://bhpr.hrsa.gov/healthworkforce/reports/nursingedu5states.pdf. At the national level, data for 2011 shows that 51 percent of qualified applicants to ADN programs and 36 percent of qualified applicants to bachelors degree in nursing (BDN) programs were turned away because of capacity constraints. The American Association of Colleges of Nursing (AACN) survey of nursing schools reveals that lack of faculty (61.5

that the availability of foreign nurses reduces the incentives of states to invest in expanding the capacity of nursing schools and of hospitals to step in by sponsoring nursing programs and increasing their availability for clinical rotations, the immigration of foreign RNs to the United States might negatively affect the number of native nurses entering the profession. To test for this possibility, in column (5), we focus on 2001–2010, the most recent period, where the number of nursing school graduates is likely to be determined by the supply of places in U.S. nursing schools and not by the demand for RNs. Restricting the time period to the last decade does not appear to change the results significantly, which suggests that reductions in the supply of nursing school slots might be an important mechanism through which foreign nurse importation affects the supply of native nurses.

A series of robustness tests are presented in Appendix Table 9. Column (1) reproduces our preferred specification. Column (2) shows the unweighted estimation of equation (4). Columns (3) to (8) consider different lags. The results from using a two- or a three-year lag are similar (albeit slightly smaller) to using a four-year lag, but this result is expected given that it takes between two and four years to become a nurse. The effects are larger when focusing on a five-year lag, but much smaller and not statistically significant when we use a six-year lag. The fact that there is little correlation between the number of native nurses taking the NCLEX in a given year and the flow of foreign nurses in the same year or the year before is reassuring (see columns (7) and (8)).

5 Interpretation

How can we explain the large displacement effects that we find? In this section, we explore two likely channels through which foreign nurse inflows might have reduced the long-run supply of native nurses. We begin by discussing the potential role of wages in explaining our results. We next turn to the working environment.

5.1 Wages

In this section, we show that despite the large displacement effects, we find little evidence of a decline in the observed wages of native nurses. Tables 7 and 8 present the results of the wage regressions using the same empirical approaches as sections 3.1 and 3.2. We fail to find any significant negative (or positive) effect of foreign-educated nurses on the wages of native-born RNs. In contrast to the displacement results, all of our coefficients are positive, small, and not statistically significant.

While these results seem to suggest that wages are not the main mechanism driving our large

percent) and lack of clinical sites (60.8 percent) are the most common major barriers to expanding enrollment.

displacement results, there are a few caveats that are worth pointing out regarding our wage analysis. The first is that the labor supply of nurses depends on the real wage, where the real wage reflects the value of the entire package at the job, not just the monetary compensation. For us to have observed such large displacement effects, it seems that immigration must have lowered the real wage. Nevertheless, many economists regard the nursing sector as a sector characterized by considerable market power (Sullivan 1989; Currie, Farsi, and MacLeod 2005; and Staiger, Spetz, and Phibbs 2010) and wage rigidity (Krall 1995 and Burkett 2005). These institutional factors are likely to limit the scope for actual observable wage declines. For example, Staiger, Spetz, and Phibbs (2010) use an exogenous change in wages at Veterans Administration (VA) hospitals and estimate that the labor supply to individual hospitals is quite inelastic, with short-run elasticity around 0.1. They also find that non-VA hospitals responded to the VA wage change by changing their own wages, suggesting that hospitals have considerable wage-setting power.[43] Apart from the monopsony model, Burkett (2005) argues that wage rigidity may be a feature of nursing markets due to fairness considerations. In the healthcare sector, Krall (1995) notes that changes in customary wage differentials across groups of nursing personnel (e.g. RNs, licensed practical nurses, nursing aides, etc) could create dissension and undermine cooperation. She argues that hospitals in the United States were able to maintain relative wage differences between groups of nursing personnel while at the same time successfully raising the relative use of RNs through non-wage inducements and manipulations of the supply of RNs. Similar concerns could potentially limit the scope of wage declines among native-born nurses in cities that are more heavily dependent on immigrant nurses.

Nevertheless, it is possible that wage effects may be observed on other dimensions not captured in our data, such as work conditions, other forms of workplace benefits, and non-wage compensation. In the next section, we explore how one such dimension — working conditions — may have changed in response to the influx of foreign nurses.

An alternative wage-based explanation is that foreign nurse immigration could be associated with native nurse displacement by encouraging hospitals and other healthcare providers to reduce quality by substituting low-paid immigrant nurses for high-paid native nurses (Kaestner and Kaushal 2012). In Cortes and Pan (2013), we examine this issue using Census data from 1970–2010 and wages as a measure of skill and find a positive wage premium for nurses educated in the Philippines (the top-sending foreign country), but not for foreign nurses educated elsewhere. We also provide suggestive evidence that the wage premium reflects actual qualitative differences among foreign and native nurses. This finding provides some evidence that the quality of the U.S. nursing force has not declined with the importation of foreign nurses, which suggests that the displacement results are not driven by employers substituting lower-quality (and low-wage) immigrant nurses for more highly paid native nurses.

[43] Other papers such as Hirsch and Schumacher (1995) and Matsudaira (2014) suggest that the empirical evidence on monopsony in the nursing labor market is more mixed.

5.2 Working Conditions

Several studies and surveys have found that the satisfaction derived from working and the quality of the work environment are important factors affecting the labor supply decision of existing RNs, perhaps even more so than wage levels. For example, Shields and Ward (2001) find that workloads, relationships with colleagues, and promotion and training opportunities are all important determinants of the decision to leave the nursing profession. A 2008 survey of 10,000 nurses conducted by the American Nurses Association (ANA) found that more than 50 percent of nurses were considering leaving their current job, and that nearly a quarter of all nurses were considering leaving the profession altogether. Sixty percent reported that they knew nurses on their unit who had left due to concerns about working conditions.[44] Based on a survey of close to 9,000 nurses working in Florida hospitals, Neff and Harman (2013) found that the quality of the practice environment is positively associated with job satisfaction and negatively associated with the probability that a nurse reported that she was planning to leave her current employer within a year.

The hiring of foreign nurses can directly impact the quality of working conditions by making it more difficult or less enjoyable to interact with foreign-born co-workers due to language barriers or cultural differences. Foreign nurse importation might also indirectly impact the work environment by reducing employers' incentives to improve the work environment in order to retain native nurses.[45] Although we lack data to test for such indirect effects, we will provide some evidence on the direct effects in the next section.

5.2.1 Foreign RNs and Interactions with Native RNs

In this section, we explore whether an increase in the number of foreign RNs might affect the quality of co-worker interactions within a workplace. For example, native nurses might find it difficult or less enjoyable to interact with foreign co-workers due to language or cultural differences[46] (Leonard and Levine 2006). To examine the effects of foreign nurse importation on the quality of co-worker interactions we use data from the 2006 and 2010 Survey of Registered Nurses conducted by the

[44] http://www.nursingworld.org/DocumentVault/GOVA/Federal/Testimonies/Testimony061208.pdf

[45] Part of the rationale comes from the perception that foreign-educated nurses are less sensitive to working conditions. Neff and Harman (2013) find that U.S.-educated hospital nurses are indeed more likely to report being dissatisfied with their job, but do find not significant differences between native and foreign nurses in reporting high burnout or in describing the work environment in their hospital as fair or poor.

[46] Many hospitals in California have established an English-only policy in the workplace. In September 2012 a central California hospital with an English-only language policy had to pay a $1 million settlement in a harassment and discrimination case that alleged the hospital created a hostile work environment for Filipino staff members. Link: http://www.businessweek.com/ap/2012-09-17/filipinos-win-settlement-in-english-only-case.

California Board of Registered Nursing.[47] The sample size is relatively large at approximately 5,000 nurses for each survey year. The survey is designed to provide a description of licensed registered nurses in California and to examine changes over time, the survey includes rich information about the respondents' job and demographic characteristics. Most importantly for the purpose of our analysis, the survey includes a section on the respondents' opinion about their most recent nursing position. The section asks the respondents to rate their satisfaction based on 29 different job characteristics. The rating scale takes values from 1 to 5 (with 5 being the highest satisfaction level).[48] Here, we focus on the two factors that relate to the respondents' reported relationship with other nurses: (1) the support from other nurses worked with and (2) teamwork between co-workers and yourself. For each of these factors, we construct two variables — the first is the deviation of the score on the particular dimension from the average answer for the other 28 different characteristics. The second is a dummy variable equal to one if the nurse gave the highest possible score to the particular factor. To identify the relationship between the concentration of foreign-born nurses and the reported satisfaction with co-workers, as in the previous analysis, we exploit cross-regional variation in the share of foreign-educated nurses. In this analysis, we use the county as the unit of analysis (there are 58 counties in California). More specifically, our empirical specification is as follows:[49]

$$Rating_{ict} = \alpha + \beta * Share\ Foreign\ Educated_{ct} + \pi_c + \theta_t + \delta_{rt} + \eta * X_{ict} + \varepsilon_{ict}, \tag{6}$$

where i is for individual, c is for county, t for year, and r for region.

We exploit two sources of variation, first, the variation across counties (specifications not including county fixed effects) and second, within-county variation across time (specifications including county fixed effects, π_c). In the specifications that include county fixed effects, we also include region*year fixed effects (δ_{rt}), where the region is a broader geographical division than county (the individual California counties are grouped into eight regions).[50] X_{ict} represents a vector of detailed individual-level demographic and job characteristics: race, gender, education level, children, experience, tenure, job setting, position, and dummies for working part-time or over-time. All the regressions include year fixed effects (θ_t).[51]

[47] The survey was conducted in 1990, 1993, 1997, 2004, 2006, 2008 and 2010, but only the last three waves of the survey are publicly available. We concentrate on 2006 and 2010 because there was a significant inflow of foreign-educated nurses during this four-year period, when the foreign share increased from 13 percent to 17 percent.

[48] More precisely, the rating scale is as follows: 1=very dissatisfied, 2=dissatisfied, 3=neither satisfied nor dissatisfied, 4=satisfied, 5=very satisfied.

[49] We prefer to use shares of foreign-born nurses as our main explanatory variable instead of ratios to population, given that the surveys do not include weights to scale up the size of the nurse population.

[50] The regions include the northern California counties, Sacramento, San Francisco, Central Valley, Central Coast, Los Angeles, Inland Empire, and the Border Counties.

[51] The summary statistics for this sample are presented in Appendix Table 12.

Unfortunately, data limitations do not allow us to construct an instrument for *Share Foreign Educated*$_{ct}$.[52] However, we address the likely endogeneity of the immigration concentration variable in several ways. First, by focusing on the deviation from the mean, we are partially addressing the possibility that foreign nurses are hired by counties facing general discontent among native-born healthcare professionals or a healthcare system in crisis. Moreover, we control for the ratings given to two other dimensions related to nursing staff co-workers that might be correlated to shocks that led to an increase in the share of foreign nurses in a county: (1) the adequacy of the RN skill level where you work and (2) the adequacy of the number of RNs on staff where you work. Finally, we estimate equation (6) separately for native-born and foreign-educated nurses. Arguably, if the share of foreigners is picking up an unobserved shock to the nursing population in a county, it is likely that the coefficient would have the same sign for natives and for foreigners. If, on the other hand, we find that the share of foreign nurses affects natives and foreigners in opposite ways, this provides suggestive evidence of a causal effect.

Panels A and B of Table 9 present the results for native RNs and foreign-educated RNs, respectively. For native respondents, all but one of the estimated coefficients on the share of foreign RNs are negative. By contrast, for foreign nurses, the coefficients are generally positive. For the ratings given for the question "support from other nurses working with you,"the cross-sectional specification indicates a negative and statistically significant relationship between the share of nurses who are foreign and the degree of satisfaction reported by native nurses in this regard. The magnitude of the estimates suggest that increasing the share of foreign nurses in a county by 0.1 (roughly corresponding to a 25 percentile increase) decreases the level of job satisfaction by 10 to 15 percent of the population mean. When county fixed effects are added, the estimates using deviations from the mean are close to zero and are no longer significant, whereas the estimates using a measure that captures a "high-degree" of satisfaction continue to be negative, albeit not significant. The results for the satisfaction level with "teamwork between coworkers and yourself" are more robust and indicate a strong negative relationship between the share of foreign nurses and the job satisfaction of native-born nurses. The relationship is even stronger when county fixed effects are included in the model. The magnitude of the county fixed effects are slightly larger compared to the previous question on support from co-workers. While the estimates for the ratings given by foreign nurses are generally positive and large, these are imprecisely estimated. The large standard errors are likely due to the significantly fewer observations in the sample of foreign-educated nurses.

Overall, these results provide suggestive evidence that in California counties with more foreign-educated RNs, native RNs are less satisfied with the degree of support and teamwork from their coworkers. These results hold even when we look within counties over time — native nurses in counties that experienced a larger increase in the share of foreign nurses are more likely to report

[52] The Census only identifies about half of all California counties.

a decline in their levels of job satisfaction relative to counties that experienced a smaller increase in the foreign share. This suggests that one potential reason why native RNs may exit the profession in response to foreign nurse importation could be due to the deterioration in the workplace environment resulting from the composition of their co-workers.[53]

6 Conclusion

As healthcare becomes an even larger component of the U.S. economy, there is a pressing need to find long-term solutions to the recurring shortage of healthcare workers. This paper explores the long-run consequences of hiring foreign nurses, a practice used extensively in the United States to combat nursing shortages, even though it is typically argued for on the grounds that this is a temporary policy solution.

In this paper, we make use of a variety of empirical strategies and datasets to show that the importation of foreign nurses has large displacement effects on the labor supply of native nurses. We estimate that for every foreign nurse who migrates to a U.S. city, between 1–2 native RNs are displaced. These findings are corroborated by data on who takes the nursing board exams — we find evidence that an increase in the flow of foreign nurses to a state reduces the number of prospective native nurses sitting for the NCLEX. Turning to the possible factors that might drive the displacement of native nurses, we find little evidence that the displacement effects are driven by falling wages. We find some suggestive evidence that foreign nurse migration may impact the perceived quality of the workplace environment — native RNs in California counties with a larger share of foreign nurses are more likely to report being dissatisfied with the level of support they receive from other nurses and the quality of teamwork with their co-workers.

Our finding that foreign nurse migration has large displacement effects on the native nurse population stands in contrast to the results from recent studies that focus on other skilled occupations. Kerr and Lincoln (2010) examine the short-run effects of changes in the H-1B visa program and find limited evidence that immigrants in science and engineering reduce native employment. If anything, they find that small crowding-in effects on native employment and patenting may exist. Hunt and Gauthier-Loiselle (2010) examine long-run changes in high-skill immigration and the effects on patenting and find similar crowding-in effects.[54] Nevertheless, there are key differences

[53] Unlike us, Neff and Harman (2013) do not find a significant association between the share of foreign-educated nurses working in the nurse's hospital and her job satisfaction or intention to leave. Note however, that their analysis is purely cross-sectional, their measures are not directly related to co-worker interactions, and they do not split the sample between native and foreign-educated nurses.

[54] Borjas (2007) also finds that, as a whole, foreign students do not crowd out native students from graduate programs. However, he also finds that the influx of foreign students into a particular field has an adverse effect on the earnings of native doctorates in the field (Borjas 2009).

between science and engineering (SE) occupations and nursing that could potentially account for the difference in the effects of immigration on native labor supply. For example, there is likely to be much larger externalities and economies of agglomeration in research and development as compared to nursing.[55] These findings underscore the importance of taking into account occupation-specific factors in understanding the potentially heterogeneous effects of immigration on native labor supply.

Our findings that there are large displacement effects on the native nurse population suggest that relying heavily on foreign nurses to fill the gap in the U.S. healthcare workforce is a potentially counterproductive policy in the longer run. To the extent that foreign nurse importation lowers the incentives to invest in the retention and production of native nurses, a comprehensive policy that facilitates the hiring of foreign nurses in regions and during the periods of immediate and acute need, yet provides incentives to states and employers to invest in expanding the native workforce, might be the best way forward. A similar policy currently exists under the H-1B program. Employers requesting H-1B visas for highly skilled temporary workers are required to pay a fee that is then used to fund grants for skills training and scholarships for native workers in STEM fields (Ruiz and Wilson 2013).

Data Appendix

Construction of the Age of Entry in the Labor Market

We use the National Sample Survey of Registered Nurses (NSSRN) to compute the median age of entry to the labor market by type of nursing degree. It has been documented that nurses who choose to pursue a bachelor's degree or diploma are significantly younger than those who choose an associate's degree (Buerhaus, Staiger, and Auerbach, 2009). So even if an associate's degree takes only two years to obtain, the median age of graduation (26 years) is significantly higher than the same age for earning a bachelor's degree (22 years) or for a diploma (21 years). This pattern holds true only for natives; there is no variation in the graduation age by degree type for foreign-educated nurses (21 years old), with the exception of those who have a graduate degree (26 years for both native nurses and foreign-educated nurses). We use the median ages of graduation computed from the closest NSSRN to estimate the potential experience of nurses in each of the Census. Unfortunately, however, starting with the 2000 Census we cannot separately identify those with an associate degree from those with a diploma.[56] We thus use the closest data year in the NSSRN to construct a weighted average of age of entry for nurses with a AD or a diploma.

[55] The SE workforce is also less likely to be affected by the same sort of capacity constraints that affect the production of native nurses and issues in retaining native nurses in the profession due to poor workplace conditions.

[56] We identify nurses with a diploma in the 1980 Census as those workers who report having three years of college. In 1990 having a diploma is equivalent to having an associate's degree from an occupational program.

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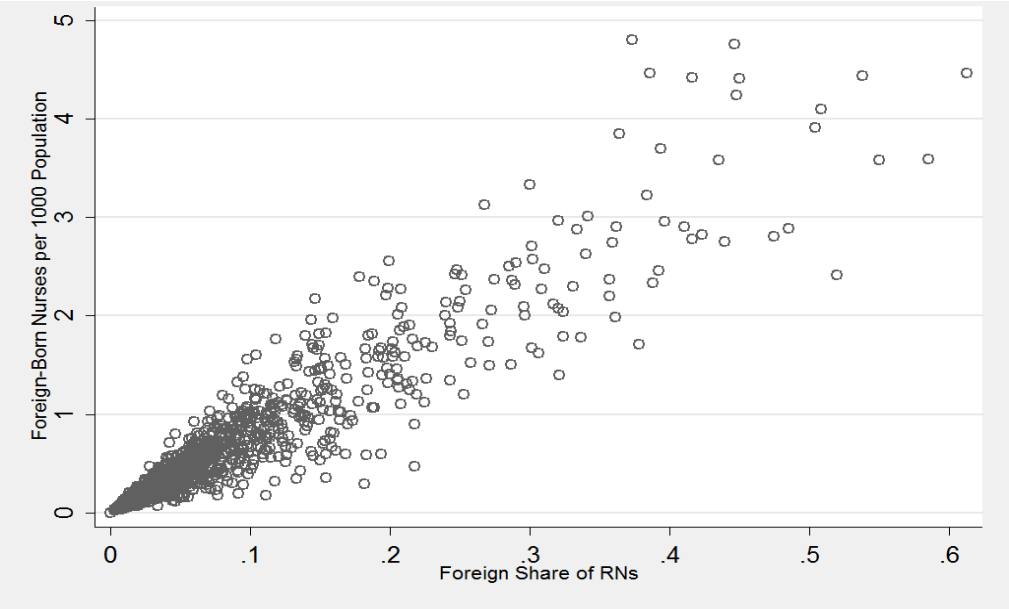
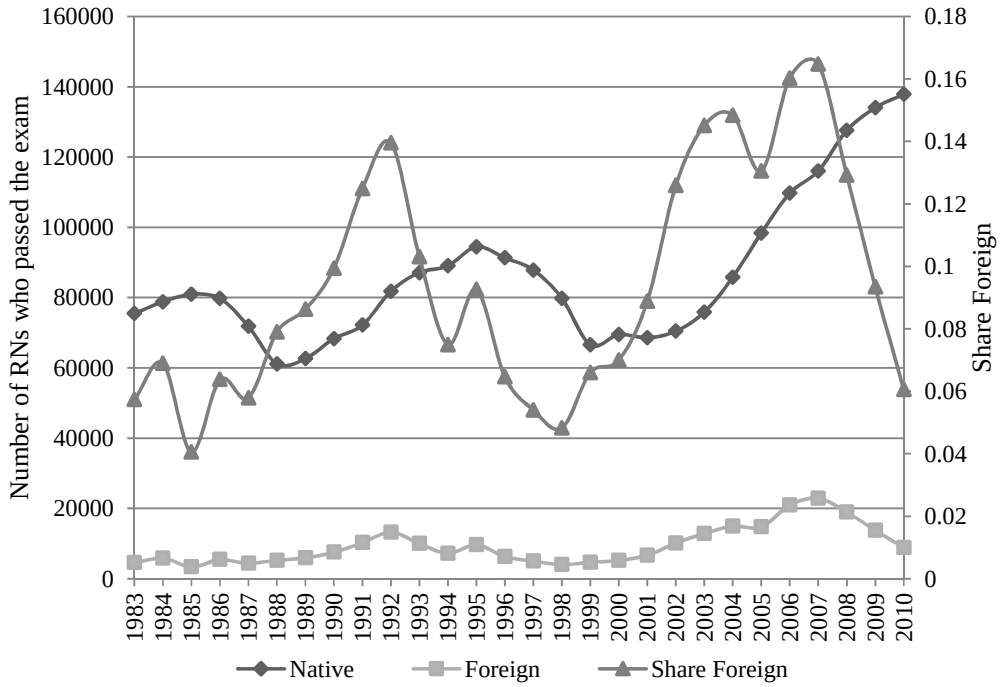
Figure 1. Cross-City Variation in Foreign-Born Nurses (1980 to 2010)



Source: Authors' own calculations based on cross-city variation in the share of foreign RNs.
Note: The data is from the 1980, 1990, 2000 Census and 2010 ACS. Each dot represents a city in each time period.

Figure 2. Flow of Nurses by Foreign Status and NCLEX Passers



Source: Authors' own calculations based on the share of foreign RNs and number of RNs who passed the exam.

Note: The data is from the National Council Licensure Examination (NCLEX) statistics.

Table 1. Demographic and Labor Supply Characteristics of U.S. Stock of Registered Nurses

	Native-Born RNs				Foreign-Born RNs			
Year	1980	1990	2000	2010	1980	1990	2000	2010
Share					0.09	0.09	0.12	0.14
Age in years	40.25	40.71	43.53	45.40	39.44	41.08	42.74	44.41
Female	0.96	0.95	0.93	0.92	0.95	0.94	0.90	0.87
Single	0.12	0.12	0.11	0.12	0.18	0.15	0.14	0.14
Child age 0-5	0.19	0.21	0.15	0.14	0.25	0.20	0.18	0.17
Child age 0-18	0.62	0.61	0.58	0.54	0.59	0.61	0.62	0.62
Bachelors/BSN	0.21	0.31	0.37	0.41	0.27	0.42	0.50	0.56
Graduate Deg.	0.10	0.13	0.14	0.12	0.22	0.14	0.13	0.13
Hospital	0.67	0.67	0.61	0.61	0.79	0.77	0.68	0.68
Nursing Home	0.08	0.08	0.08	0.07	0.07	0.06	0.11	0.09
Physicians Off.	0.06	0.07	0.07	0.05	0.03	0.04	0.03	0.02
Other Health	0.04	0.07	0.12	0.15	0.02	0.05	0.09	0.13
LFP	0.84	0.90	0.89	0.93	0.88	0.92	0.85	0.95
Shift Work		0.14	0.13	0.15		0.20	0.20	0.23
< 35 hrs/week	0.22	0.23	0.22	0.21	0.14	0.15	0.14	0.14
35-40 hrs/week	0.43	0.41	0.52	0.55	0.56	0.52	0.62	0.65
41-59	0.10	0.16	0.14	0.14	0.08	0.14	0.11	0.11
60+ hours	0.02	0.04	0.03	0.03	0.04	0.05	0.06	0.05
Hourly wage*	12.30	15.45	16.92	18.75	13.59	17.67	19.60	21.48
(1990 dollars)	(8.42)	(8.10)	(9.52)	(9.65)	(8.61)	(9.65)	(11.42)	(11.15)
Number of Obs.	56,480	85,245	103,926	75,599	5,410	8,320	14,040	12,450

Note: The data is from the U.S. Census and American Community Survey. The sample includes all people ages 25-64 years who reported being a registered nurse for their occupation. The variable we use to construct the shift dummy was not included in the 1980 Census. *The standard deviation is reported in parentheses.

Table 2. Ranked Share of Foreign-Born RNs in the U.S. Workforce, Largest MSAs

	1980	1990	2000	2010
Miami, FL	0.26	0.41	0.58	0.59
Los Angeles, CA	0.27	0.36	0.49	0.55
New York, NY	0.36	0.36	0.50	0.52
San Francisco, CA	0.14	0.22	0.30	0.42
Anaheim - Santa Ana, CA	0.15	0.22	0.33	0.40
Riverside - San Bernardino, CA	0.11	0.18	0.29	0.39
Newark, NJ	0.21	0.19	0.29	0.33
San Diego, CA	0.17	0.18	0.27	0.32
Houston, TX	0.16	0.18	0.23	0.31
Washington DC	0.11	0.14	0.23	0.30
Chicago, IL	0.21	0.19	0.24	0.27
Nassau, NY	0.11	0.14	0.19	0.25
Dallas, TX	0.10	0.12	0.18	0.22
Seattle, WA	0.11	0.12	0.18	0.21
Atlanta, GA	0.05	0.08	0.12	0.21
Baltimore, MD	0.07	0.05	0.10	0.18
Tampa, FL	0.05	0.08	0.15	0.16
Phoenix, AR	0.05	0.05	0.10	0.15
Boston, MA	0.06	0.08	0.13	0.13
Philadelphia, PA	0.07	0.07	0.09	0.12
Detroit, MI	0.11	0.09	0.13	0.11
Minneapolis,	0.03	0.03	0.05	0.07
St. Louis, MO	0.03	0.03	0.04	0.03
Pittsburgh, PA	0.02	0.01	0.02	0.02

Note: These cities were selected if they had a population of at least two million in 2000. This table was constructed using Census and ACS data. The sample is restricted to individuals aged 25-64 years who reported registered nurse as their occupation.

Table 3. Displacement Effects of Foreign-Born RNs on Native U.S. RNs: Cross-City Approach

	Dependent Variable: Native Nurses (FTE)/Population											
	I. 1980-2010						II. 1990-2010					
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
	A. OLS											
Foreign-Born Nurses (FTE)/Pop	-0.979***	-0.660***	-0.581***	-0.340*	-0.590***	-0.527***	-0.684***	-0.538***	-0.342**	-0.132	-0.384**	-0.382**
	[0.141]	[0.145]	[0.141]	[0.175]	[0.155]	[0.129]	[0.148]	[0.149]	[0.149]	[0.175]	[0.169]	[0.157]
Observations	1,140	1,140	1,140	1,140	1,052	1,112	855	855	855	855	789	834
R-Squared	0.892	0.916	0.936	0.952	0.928	0.935	0.914	0.929	0.945	0.958	0.930	0.940
	B. 2SLS (Instrument - Predicted Foreign-Born Nurses/Pop)											
Foreign-Born Nurses (FTE)/Pop	-2.475***	-1.974***	-1.879***	-2.318***	-2.413***	-2.174***	-2.151***	-1.829***	-1.683**	-1.624	-3.254***	-2.336***
	[0.278]	[0.345]	[0.373]	[0.767]	[0.682]	[0.566]	[0.506]	[0.589]	[0.766]	[1.177]	[1.099]	[0.839]
Observations	1,140	1,140	1,140	1,140	1,052	1,112	855	855	855	855	789	834
R-Squared	0.844	0.889	0.915	0.920	0.884	0.909	0.879	0.907	0.926	0.942	0.829	0.906
Population (Cubic Polynomial)	X	X	X	X	X	X	X	X	X	X	X	X
Demand-Side Controls:												
Share of City Pop > 65 years		X	X	X	X	X		X	X	X	X	X
Log (Average Hourly Wages)		X	X	X	X	X		X	X	X	X	X
Physicians per 1,000 Population		X	X	X	X	X		X	X	X	X	X
Supply-Side Controls:												
Share of City Pop aged 25-34, 35-44, 45-54, 55-64 years		X	X	X	X	X		X	X	X	X	X
Share of Females in Professional Jobs		X	X	X	X	X		X	X	X	X	X
LFP of Married Skilled Women		X	X	X	X	X		X	X	X	X	X
Log (Avg Hourly Wage of Skilled Women)		X	X	X	X	X		X	X	X	X	X
Share of Whites in the Population		X	X	X	X	X		X	X	X	X	X
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region X Year FE	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
State X Year FE	No	No	No	Yes	No	No	No	No	No	Yes	No	No
Excludes California	No	No	No	No	Yes	No	No	No	No	No	Yes	No
Excludes Top Immigrant Cities	No	No	No	No	No	Yes	No	No	No	No	No	Yes

Note: The data is from the 1980, 1990, and 2000 U.S. Census and the 2010 American Community Survey. The dependent variable is the number of native nurses aged 25-64 years in a city as a fraction of the city's population. The key independent variable is the number of full-time employed foreign-born nurses age 25-64 years in a city as a fraction of the city's population. For the 2SLS regressions, the foreign-born nurses/population is instrumented using the predicted foreign-born nurses/pop constructed by using the historical distribution of high-skilled immigrants across cities in 1980 to allocate the national flow of nurses to each city (net of the contribution of each city to the national flow). All specifications are weighted by the city population. Standard errors in parentheses are clustered at the city level. The symbol * means significant at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level.

Table 4. Displacement Effects of Foreign-Born RNs on Native U.S. RNs: Variation at the City X Year X Experience level

	Dependent Variable: FTE Native Nurses / Population						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FTE Foreign Nurses / Population	-0.9589145	-0.9716633	-0.9832469	-0.8004735	-1.044773	-1.073357	-1.125216
	(0.279)***	(0.271)***	(0.257)***	(0.244)***	(0.378)***	(0.313)***	(0.332)***
Experience/Age	Exp	Exp	Exp	Exp	Exp	Age	Age
Includes Nurses Grad Degree	Yes	Yes	No	No	No	Yes	No
Excludes California	No	No	No	Yes	No	No	No
Excludes Top Immigrant Cities	No	No	No	No	Yes	No	No
Controls							
Experience/Age FE	X	X	X	X	X	X	X
City FE	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X
City X Exp FE	X	X	X	X	X	X	X
City X Year FE	X	X	X	X	X	X	X
Exp X Year FE	X	X	X	X	X	X	X
Sample	All	Limited	All	All	All	All	All
No. Cities	175	78	166	155	159	195	187
No. Observations	1087	624	1016	938	964	1238	1155

Note: The data is from the 1980, 1990, and 2000 U.S. Census and the 2010 American Community Survey. The limited sample includes cities that have information for all years, and all experience groups. All regressions include as control the share of the relevant experience (age) group in the city's population and are weighted by population size. Standard errors clustered at the city level are reported in parenthesis. The symbol * denotes significant at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level. Only *** is used in this table.

Table 5. Estimates of Displacement Effects of Foreign-Born RNs on Native RNs by Age and Education Group

	Dependent Variable: Native Nurses (FTE)/Pop							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	A. 2SLS Estimates by Age Group:							
	Age 25 to 34		Age 35 to 44		Age 45 to 54		Age 55 to 64	
Foreign-Born Nurses (FTE)/Pop	-0.338***	-0.510**	-0.458***	-0.477**	-0.705***	-0.975***	-0.379***	-0.356*
	[0.115]	[0.245]	[0.127]	[0.202]	[0.144]	[0.314]	[0.124]	[0.201]
R-Squared	0.839	0.861	0.880	0.906	0.890	0.892	0.865	0.900
Observations	1,140	1,140	1,140	1,140	1,140	1,140	1,140	1,140
	B. 2SLS Estimates by Education Group:							
	2-3 years of college		Bachelor's		> 4 years of college			
Foreign-Born Nurses (FTE)/Pop	-0.891***	-1.123***	-0.793***	-0.884**	-0.115	-0.166		
	[0.208]	[0.328]	[0.213]	[0.429]	[0.081]	[0.147]		
R-Squared	0.848	0.867	0.900	0.921	0.812	0.862		
Observations	1,140	1,140	1,140	1,140	1,140	1,140		
Controls	See Table 3, Column (3)							
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region X Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State X Year FE	No	Yes	No	Yes	No	Yes	No	Yes

Note: The data is from the 1980, 1990, and 2000 U.S. Census and the 2010 American Community Survey. The controls included are the same as that in Table 3. The dependent variable is the number of full-time employed native nurses in the respective age and education group in a city as a fraction of the population in a city. The key independent variable is the number of foreign-born nurses aged 25-64 years in a city as a fraction of the population in a city. The foreign-born nurses/population is instrumented using the predicted foreign-born nurses/pop constructed by using the historical distribution of high-skilled immigrants across cities in 1980 to allocate the national flow of nurses to each city (net of the contribution of each city to the national flow). All specifications are weighted by the city population. Standard errors in parentheses are clustered at the city level. The symbol * is significant at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level.

Table 6. Reduced-Form Effects of Foreign-Educated Flow of RNs on the Number of New Native RNs

	Dependent Variable: Native Exam Takers / Population $_{s,t}$				
	(1)	(2)	(3)	(4)	(5)
	I. Linear Effects				
Dependency Variable$_{s, 1980}$*(Foreign Passers/Population)$_{t-j}$	-0.5241086	-0.6266837	-0.6517873	-1.051503	-0.4619449
	(0.143)***	(0.191)***	(0.226)***	(0.535)*	(0.174)**
	II. Quintiles Specification				
Dummy Top Quartile $_{s, 1980}$*(Foreign Passers/Population)$_{t-j}$	-2.403972	-2.737985	-2.697426	-3.231752	-1.932483
	(0.660)***	(0.821)***	(0.868)***	(1.120)***	(0.633)***
Dummy Second Quartile $_{s, 1980}$*(Foreign Passers/Population)$_{t-j}$	-1.34851	-1.627361	-1.634489	-1.266523	-0.7215264
	(0.635)**	(0.739)**	(0.806)**	(0.816)	(0.620)
Dummy Third Quartile $_{s, 1980}$*(Foreign Passers/Population)$_{t-j}$	-1.480608	-1.29112	-1.335627	-1.139857	-1.527372
	(0.802)*	(0.808)	(0.856)	(0.947)	(0.634)**
Dummy Fourth Quartile $_{s, 1980}$*(Foreign Passers/Population)$_{t-j}$	-0.9979346	-1.041003	-0.9330889	-1.165993	-0.7398677
	(0.741)	(0.796)	(0.822)	(0.968)	(0.765)
Lag (j)	4 years	4 years	4 years	4 years	4 years
State FE	X	X	X	X	X
Year FE	X	X	X	X	X
Region X Year FE	X	X	X	X	X
State level time-varying controls		X	X	X	X
HMO Early Adopter X year FE			X	X	X
Excludes	-	-		Top 5 states	
Period	1990-2010	1990-2010	1990-2010	1990-2010	2001-2010
No. Observations	1,071	1,071	1,071	966	510

Note: The data is from NCLEX statistics from 1986-2010. All specifications are weighted by the state's population. Standard errors are clustered at the state level. The dependency variable (share foreign born in 1980) is normalized to have unit standard deviation before interacting. The regions refer to the nine regions defined by the Census. The state level time-varying controls are: lag of a cubic polynomial in state population, lag of the relative wage of nurses versus workers with at least some college, lag of share of the population aged 0-19, 20-39, and 40-59 years, lag of share of whites in the population, lag of share of females in professional occupations. HMO Early Adopter is defined as being a top 10 state in the percentage of population enrolled in a HMO in 1994: District of Columbia, California, Massachusetts, Oregon, Colorado, Arkansas, Hawaii, New York, Maryland, and Winconsin. The top five states are: California, New York, Illinois, New Jersey, and Florida. The symbol * is significant at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level.

Table 7. Wage Effects of Foreign-Born RNs on Native RNs Using Cross-City Approach

	Dependent Variable: Mean Log Hourly Wages of Native Nurses					
	(1)	(2)	(3)	(4)	(5)	(6)
	A. OLS					
(Foreign-Born Nurses (FTE)/Pop)*1000	0.050***	0.028***	0.015	-0.005	0.006	0.013
	[0.015]	[0.011]	[0.011]	[0.013]	[0.011]	[0.009]
Observations	1,140	1,140	1,140	1,140	1,052	1,112
R-Squared	0.946	0.964	0.971	0.979	0.971	0.969
	B. 2SLS (Instrument - Predicted Foreign-Born Nurses/Pop)					
(Foreign-Born Nurses (FTE)/Pop)*1000	0.105***	0.069**	0.049	0.082	-0.026	0.008
	[0.036]	[0.027]	[0.037]	[0.073]	[0.025]	[0.030]
Observations	1,140	1,140	1,140	1,140	1,052	1,112
R-Squared	0.940	0.961	0.970	0.973	0.969	0.969
Population (cubic polynomial)	X	X	X	X	X	X
Demand-Side Controls:						
Share of City Pop > 65 years		X	X	X	X	X
Share of City Pop aged 20 to 29, 30 to 39, 40 to 49, and 50 to 59 years		X	X	X	X	X
Log (Average Hourly Wages)		X	X	X	X	X
Physicians per 1,000 Population		X	X	X	X	X
Supply-Side Controls:						
Share of City Pop aged 25-34, 35-44, 45-54, and 55-64 years		X	X	X	X	X
Share of Females in Professional Jobs		X	X	X	X	X
LFP of Married Skilled Women		X	X	X	X	X
Log (Average Hourly Wage of Skilled Women)		X	X	X	X	X
Share of Whites in the Population		X	X	X	X	X
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Region X Year FE	No	No	Yes	Yes	Yes	Yes
State X Year FE	No	No	No	Yes	No	No
Excludes California	No	No	No	No	Yes	No
Excludes Top Immigrant Cities	No	No	No	No	No	Yes

Note: The data is from the 1980, 1990, and 2000 U.S. Census and the 2010 American Community Survey. The dependent variable is the average log hourly wages of native nurses in a city. The key independent variable is the number of foreign-born nurses aged 25-64 years in a city as a fraction of the population in a city. For the 2SLS regressions, the foreign-born nurses/population is instrumented using the predicted foreign-born nurses/pop constructed by using the historical distribution of high-skilled immigrants across cities in 1980 to allocate the national flow of nurses to each city (net of the contribution of each city to the national flow). All specifications are weighted by the city population. Standard errors in parentheses are clustered at the city level. The symbol * denotes significant at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level. Only *** is used in this table.

Table 8. Wage Effects of Foreign-Born RNs Using Variation at the City X Year X Experience Level

	Dependent Variable: Mean Log Hourly Wages of Native RNs						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FTE Foreign RNs *1000 / Population	0.011	0.010	0.006	0.014	-0.009	0.022	0.023
	(0.019)	(0.018)	(0.023)	(0.025)	(0.025)	(0.014)	(0.018)
Experience/Age	Exp	Exp	Exp	Exp	Exp	Age	Age
Includes Nurses Grad Degree	Yes	Yes	No	No	No	Yes	No
Excludes California	No	No	No	Yes	No	No	No
Excludes Top Immigrant Cities	No	No	No	No	Yes	No	No
Controls							
Experience/Age FE	X	X	X	X	X	X	X
City FE	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X
City X Exp FE	X	X	X	X	X	X	X
City X Year FE	X	X	X	X	X	X	X
Exp X Year FE	X	X	X	X	X	X	X
Sample	All	Limited	All	All	All	All	All
No. Cities	175	78	166	155	159	195	187
No. Observations	1,087	624	1,016	938	964	1,238	1,155

Note: The data is from the 1980, 1990, and 2000 U.S. Census and the 2010 ACS. The limited sample includes cities that have information for all years, all experience groups. All regressions include as control the share of the relevant experience (age) group in the city's population and are weighted by population size. Standard errors in parentheses are clustered at the city level. The symbol * denotes signficant at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level.

Table 9. Share of Foreign-Educated RNs and Native RN Satisfaction with Co-Workers

Panel A. Sample: Native Nurses

	Support from Other Nurses Working with You								Teamwork between Coworkers and Yourself							
	Deviation from Mean				Dummy =1 if Very Satisfied				Deviation from Mean				Dummy =1 if Very Satisfied			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Share Foreign-Educated	-0.440	-0.490	0.004	-0.060	-0.156	-0.126	-0.464	-0.389	-0.299	-0.285	-0.727	-0.721	-0.107	-0.037	-0.702	-0.529
	(0.104)***	(0.104)***	(0.429)	(0.460)	(0.065)**	(0.068)*	(0.293)	(0.262)	(0.096)***	(0.105)***	(0.327)**	(0.371)*	(0.074)	(0.079)	(0.259)***	(0.243)**
Year FE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
County FE			X	X			X	X			X	X			X	X
Region X Year FE			X	X			X	X			X	X			X	X
Individual Controls	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Other Ratings - Nurse Staff Related		X		X		X		X		X		X		X		X
No. Counties	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
No. Observations	5,773	5,555	5,773	5,555	5,773	5,555	5,773	5,555	5,914	5,598	5,914	5,598	5,914	5,598	5,914	5,598
	Mean	Std. dev	Min	Max	Mean	Std. dev	Min	Max	Mean	Std. dev	Min	Max	Mean	Std. dev	Min	Max
Dep. Var	0.366	0.758	-2.852	3.231	0.402	0.490	0.000	1.000	0.393	0.767	-3.071	3.231	0.425	0.494	0.000	1.000

Panel B. Sample: Foreign Educated Nurses

	Support from Other Nurses Working with You								Teamwork between Coworkers and Yourself							
	Deviation from Mean				Dummy =1 if Very Satisfied				Deviation from Mean				Dummy =1 if Very Satisfied			
Share Foreign-Educated	0.056	0.018	1.882	1.747	0.209	0.179	2.028	1.808	-0.075	-0.065	1.469	1.734	0.088	0.042	1.213	1.150
	(0.279)	(0.302)	(1.253)	(1.235)	(0.185)	(0.151)	(0.643)	(0.535)	(0.243)	(0.270)	(0.940)	(0.922)*	(0.190)	(0.180)	(0.721)*	(0.493)**
Year FE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
County FE			X	X			X	X			X	X			X	X
Region X Year FE			X	X			X	X			X	X			X	X
Individual Controls	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Other Ratings - Nurse Staff Related		X		X		X		X		X		X		X		X
No. Counties	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42
No. Observations	1,124	1,107	1,124	1,107	1,124	1,107	1,124	1,107	1,130	1,108	1,130	1,108	1,130	1,108	1,130	1,108
	Mean	Std. dev	Min	Max	Mean	Std. dev	Min	Max	Mean	Std. dev	Min	Max	Mean	Std. dev	Min	Max
Dep. Var	0.211	0.680	-2.556	2.414	0.219	0.414	0.000	1.000	0.291	0.692	-2.556	3.000	0.271	0.444	0.000	1.000

Note: The data is from the 2006 and 2010 California Survey of Registered Nurses. The eight regions in California include the northern counties, Sacramento, San Francisco, Central Valley, Central Coast, Los Angeles, the Inland Empire, and the Border counties. Individual controls include dummies for job setting (21), position (18), education (4), female, single, child 0-5 years-old, children, black, white, work part-time, work over-time, attending school. Other controls are years of experience and tenure. The "Other Ratings - Nurse Staff Related" include ratings for: (1) Adequacy of RN skill level where you work and (2) Adequacy of the number of RN staff where you work. The symbol * denotes signficant at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level.

Appendix Table 1. Composition of Foreign-Born RNs, U.S. Largest MSAs 1980-2010

		Share of Foreign RNs born in				
	Share Foreign	Philippines	Canada	Jamaica	India	Korea
All MSAs	0.15	0.30	0.07	0.05	0.05	0.03
Miami, FL	0.50	0.12	0.02	0.14	0.01	0.00
New York, NY	0.47	0.20	0.01	0.15	0.07	0.03
Los Angeles, CA	0.43	0.46	0.04	0.01	0.02	0.06
Riverside - San Bernardino, CA	0.30	0.45	0.06	0.01	0.03	0.03
San Francisco, CA	0.29	0.47	0.05	0.01	0.04	0.03
Anaheim - Santa Ana, CA	0.29	0.38	0.07	0.00	0.03	0.08
Newark, NJ	0.28	0.42	0.02	0.06	0.05	0.01
San Diego, CA	0.26	0.60	0.06	0.00	0.01	0.01
Houston, TX	0.26	0.33	0.06	0.02	0.15	0.02
Chicago, IL	0.24	0.47	0.02	0.01	0.08	0.06
Washington DC	0.23	0.18	0.03	0.05	0.05	0.04
Nassau, NY	0.20	0.15	0.04	0.13	0.12	0.03
Dallas, TX	0.19	0.21	0.07	0.00	0.20	0.03
Seattle, WA	0.17	0.23	0.18	-	0.04	0.05
Atlanta, GA	0.16	0.12	0.04	0.14	0.05	0.02
Tampa, FL	0.13	0.17	0.17	0.06	0.06	0.01
Baltimore, MD	0.12	0.27	0.03	0.06	0.05	0.04
Boston, MA	0.12	0.11	0.11	0.03	0.03	0.02
Detroit, MI	0.11	0.40	0.18	0.00	0.09	0.01
Phoenix, AR	0.11	0.25	0.14	0.01	0.06	0.03
Philadelphia, PA	0.10	0.26	0.05	0.04	0.14	0.07
Minneapolis,	0.06	0.12	0.16	0.01	0.06	0.03
St. Louis, MO-LI	0.03	0.21	0.07	0.01	0.04	0.05
Pittsburgh, PA	0.02	0.04	0.19	-	0.05	-

Note: Cities were selected if they had a population of at least two million in 2000. Constructed using the U.S. Census and the American Community Survey data. The sample is restricted to individuals aged 25-64 years who reported registered nurse as their occupation.

Appendix Table 2. Summary Statistics for Spatial Correlations Approach

	1980	1990	2000	2010
Native Nurse (FTE) per 1,000 pop	3.91	5.60	5.77	6.20
% in age range by years:				
25 to 34	0.435	0.345	0.209	0.224
35 to 44	0.250	0.358	0.344	0.244
45 to 54	0.201	0.203	0.329	0.317
55 to 64	0.115	0.094	0.118	0.214
% in education group:				
< 2 years of college	0.184	0.159	0.117	0.068
2 to 3 years of college	0.478	0.380	0.359	0.377
bachelor's degree	0.222	0.326	0.382	0.421
> 4 years of college	0.117	0.135	0.142	0.135
Foreign Nurse (FTE) per 1,000 pop	0.456	0.727	1.02	1.47
City Population	2,117,774	2,309,440	2,552,476	2,705,597
Share of City Pop Aged > 65 years	0.101	0.112	0.113	0.115
Share of Pop Aged 25 to 34 years	0.167	0.180	0.145	0.136
Share of Pop Aged 35 to 44 years	0.115	0.153	0.165	0.138
Share of Pop Aged 45 to 54 years	0.101	0.103	0.133	0.146
Share of Pop Aged 55 to 64 years	0.096	0.084	0.083	0.113
Log (Average Hourly Wages)	2.376	2.430	2.480	2.479
Share of Females in Professional Occupations	0.067	0.118	0.131	0.142
LFP of Married Skilled Women	0.634	0.765	0.753	0.770
Log (Avg. Hourly Wage of Skilled Women)	2.563	2.661	2.722	2.716
Share of Whites in Population Aged 25-64	0.862	0.802	0.745	0.732
Physicians per 1,000 Pop	2.279	2.815	3.091	3.251
Number of Cities	285	285	285	285

Note: The data is from the U.S. Census and the Amerian Community Survey. The unit of observation is a city. The sample is restricted to the set of consistently defined cities across the four time periods.

Appendix Table 3. First-Stage Regressions

	Outcome: Foreign-Born Nurses (FTE)/Population					
	(1)	(2)	(3)	(4)	(5)	(6)
Predicted Foreign-Born Nurses/Pop	0.418***	0.380***	0.338***	0.239***	0.384***	0.344***
	[0.089]	[0.083]	[0.073]	[0.069]	[0.125]	[0.112]
Cluster-robust F-statistic (Angrist-Pischke)	22.15	21.22	21.65	12.18	9.43	9.51
Observations	1,140	1,140	1,140	1,140	1,052	1,112
R-Squared	0.929	0.943	0.953	0.967	0.946	0.942
Population (Cubic Polynomial)	X	X	X	X	X	X
Demand-Side Controls:						
Share of City Pop > 65 years		X	X	X	X	X
Log (Average Hourly Wages)		X	X	X	X	X
Physicians per 1,000 Population		X	X	X	X	X
Supply-Side Controls:						
Share of City Pop Aged 25-34, 35-44, 45-54, and 55-64 years		X	X	X	X	X
Share of Females in Professional Jobs		X	X	X	X	X
LFP of Married Skilled Women		X	X	X	X	X
Log (Average Hourly Wage of Skilled Women)		X	X	X	X	X
Share of Whites in the Population		X	X	X	X	X
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Region X Year FE	No	No	Yes	Yes	Yes	Yes
State X Year FE	No	No	No	Yes	No	No
Excludes California	No	No	No	No	Yes	No
Excludes Top Immigrant Cities	No	No	No	No	No	Yes

Note: The data is from the 1980, 1990, and the 2000 U.S. Census and the 2007 and 2010 American Community Survey. The dependent variable in the first-stage regressions is the number of foreign-born nurses aged 25-64 years in a city as a fraction of the population in a city. The instrument (predicted foreign-born nurses/pop) is constructed by using the historical distribution of high-skilled immigrants across cities in 1980 to allocate the national flow of nurses to each city (net of the contribution of each city to the national flow). All specifications are weighted by the city population. Standard errors in parentheses are clustered at the city level. The symbol * denote significant at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level. Only *** is used in this table.

Appendix Table 4. Placebo Test - Displacement Effects of Foreign-Born RNs on Primary School Teachers

	Outcome: Native Primary School Teachers (FTE)/Population			
	(1)	(2)	(3)	(4)
	A. OLS			
Foreign-Born RNs (FTE)/Pop	-0.052	-0.158	-0.096	-0.277
	[0.173]	[0.161]	[0.154]	[0.204]
R-Squared	0.823	0.843	0.879	0.911
	B. 2SLS (Instrument - Predicted Foreign-Born Nurses/Pop)			
Foreign-Born RNs (FTE)/Pop	-0.408	0.127	0.702*	0.084
	[0.289]	[0.353]	[0.422]	[0.592]
R-Squared	0.820	0.842	0.869	0.910
Observations	1,140	1,140	1,140	1,140
Population (Cubic Polynomial)	X	X	X	X
Demand-Side Controls:				
Share of City Pop > 65 years		X	X	X
Log (Average Hourly Wages)		X	X	X
Physicians per 1,000 Population		X	X	X
Supply-Side Controls:				
Share of City Pop Aged 25-34, 35-44, 45-54, and 55-64 years		X	X	X
Share of Females in Professional Jobs		X	X	X
LFP of Married Skilled Women		X	X	X
Women)		X	X	X
Share of Whites in the Population		X	X	X
Year and City FE	Yes	Yes	Yes	Yes
Region X Year FE	No	No	Yes	Yes
State X Year FE	No	No	No	Yes

Note: The data is from the 1980, 1990, and 2000 U.S. Census and the 2010 American Community Survey. The dependent variable is the number of native primary school teachers aged 25-64 years in a city as a fraction of the city's population. The key independent variable is the number of full-time employed foreign-born nurses age 25-64 in a city as a fraction of the population in a city. For the 2SLS regressions, the foreign-born nurses/population is instrumented using the predicted foreign-born nurses/pop constructed by using the historical distribution of high-skilled immigrants across cities in 1980 to allocate the national flow of nurses to each city (net of the contribution of each city to the national flow). All specifications are weighted by the city population. Standard errors in parentheses are clustered at the city level. The symbol * denotes signficant at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level. Only * is used in this table.

Appendix Table 5. Wage Distribution of RNs by Native and Foreign Status and Experience Level

Group	Experience	Share in Percentile Range of Aggregate Wage Distribution			
	Age Group	0-25 Percentile	26-50 Percentile	51-75 Percentile	76-100 Percentile
Native-Born	< 11 years	0.32	0.32	0.21	0.15
Foreign-Born	< 11 years	0.34	0.27	0.22	0.18
Native-Born	11-20 years	0.25	0.25	0.26	0.24
Foreign-Born	11-20 years	0.25	0.23	0.24	0.28
Native-Born	21-30 years	0.22	0.24	0.27	0.27
Foreign-Born	21-30 years	0.22	0.18	0.24	0.37
Native-Born	31+ years	0.23	0.23	0.25	0.29
Foreign-Born	31+ years	0.21	0.17	0.24	0.38

Note: Constructed using the 2000 Census. The hourly wage is net of city fixed effects.

Appendix Table 6. Estimating the Displacement Effects of Foreign Nurses using Variation at the City X Year X Experience level: Alternative Specification

	Dependent Variable: Log(FTE Native Nurses) / Population						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Share Foreign	-1.554	-1.629	-1.644	-1.501	-1.735	-1.558	-1.645
	(0.327)***	(0.308)***	(0.411)***	(0.503)***	(0.402)***	(0.391)***	(0.460)***
Experience/Age	Exp	Exp	Exp	Exp	Exp	Age	Age
Includes Nurses Grad Degree	Yes	Yes	No	No	No	Yes	No
Excludes California	No	No	No	Yes	No	No	No
Excludes Top Immigrant Cities	No	No	No	No	Yes	No	No
Controls							
Experience/Age FE	X	X	X	X	X	X	X
City FE	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X
City X Exp FE	X	X	X	X	X	X	X
City X Year FE	X	X	X	X	X	X	X
Exp X Year FE	X	X	X	X	X	X	X
Sample	All	Limited	All	All	All	All	All
No. Cities	175	78	166	155	159	195	187
No. Observations	1,087	624	1,016	938	964	1,238	1,155

Note: The data is from the 1980, 1990, and 2000 U.S. Census and the 2010 American Community Survey. The limited sample includes cities that have information for all years, all experience groups. All regressions include as control the share of the relevant experience (age) group in the city's population and are weighted by population size. Standard errors in parentheses are clustered at the city level. The symbol * denotes signficant at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level. Only *** is used in this table.

Appendix Table 7. Displacement Effects on Unemployment and NILF

	Unemployed Native Nurses/Pop		NILF Native Nurses/Pop	
	(1)	(2)	(3)	(4)
	A. OLS			
Foreign-Born Nurses (FTE)/Pop	-0.008	0.007	-0.037	-0.017
	[0.013]	[0.015]	[0.031]	[0.039]
R-Squared	1,140	1,140	1,140	1,140
Observations	0.429	0.563	0.769	0.829
	B. 2SLS (Instrument - Predicted Foreign-Born Nurses/Pop)			
Foreign-Born Nurses (FTE)/Pop	0.002	0.019	-0.053	-0.049
	[0.032]	[0.059]	[0.061]	[0.092]
R-Squared	1,140	1,140	1,140	1,140
Observations	0.428	0.562	0.769	0.829
Controls	See Table 3, Column (3)			
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Region X Year FE	Yes	Yes	Yes	Yes
State X Year FE	No	Yes	No	Yes

Note: The data is from the 1980, 1990, and 2000 U.S. Census and the 2010 American Community Survey. The dependent variable for Column (1) and (2) is the number of unemployed native nurses per capita and the dependent variable for columns (3) and (4) is the number of native nurses reporting that they are not in the labor force per capita. The controls included are the same as that in Table 3. All specifications are weighted by the city population. The standard errors clustered by city are reported in parentheses.

Appendix Table 8. Effect of Foreign RNs on Native RN Inflows and Outflows

	Native Nurse Inflow/Pop		Native Nurse Outflow/Pop		Inflow-Outflow/Pop	
	(1)	(2)	(3)	(4)	(1)-(3)	(2)-(4)
	A. OLS					
Foreign-Born RNs (FTE)/Pop	-0.133	0.014	0.075	-0.053	-0.209	0.068
	[0.144]	[0.171]	[0.090]	[0.112]	[0.186]	[0.229]
Observations	675	675	675	675	675	675
R-squared	0.839	0.904	0.770	0.830	0.692	0.825
	B. 2SLS (Instrument - Predicted Foreign-Born Nurses/Pop)					
Foreign-Born Nurses (FTE)/Pop	-0.562*	-0.576	-0.127	-0.690	-0.435	0.114
	[0.335]	[0.493]	[0.260]	[0.471]	[0.394]	[0.577]
Observations	675	675	675	675	675	675
R-squared	0.832	0.896	0.765	0.798	0.690	0.825
Controls	See Table 3, Column (3)					
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Region X Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State X Year FE	No	Yes	No	Yes	No	Yes

Note: The data is from the 1980, 1990, and 2000 U.S. Census. . For the 2SLS regressions, the foreign-born nurses/population is instrumented using the predicted foreign-born nurses/pop constructed by using the historical distribution of high-skilled immigrants across cities in 1980 to allocate the national flow of nurses to each city (net of the contribution of each city to the national flow). All specifications are weighted by the city population. Standard errors in parentheses are clustered at the city level.

Appendix Table 9. Robustness Checks - Reduced Form Effect of Foreign Educated Flows on the Number of New Native Nurses

	Dep. Var: Native Exam Takers / Population $_{s,t}$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependency Variable$_{s, 1980}$*(Foreign Passers/Population)$_{t-j}$	-0.652	-1.009	-0.153	-0.706	-0.534	-0.543	-0.242	-0.182
	(0.226)***	(0.496)**	(0.288)	(0.339)**	(0.156)***	(0.117)***	(0.149)	(0.211)
Lag (j)	4 years	4 years	6 years	5 years	3 years	2 years	1 year	0 years
Weighted by Population	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
State FE	X	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X	X
Region X Year FE	X	X	X	X	X	X	X	X
State Level Time-Varying Controls	X	X	X	X	X	X	X	X
HMO Early Adopter X Year FE	X	X	X	X	X	X	X	X
No. Observations	1,071	1,071	969	1,020	1,122	1,173	1,224	1,274

Note: The data is from NCLEX statistics from 1986-2010. All specifications are weighted by the state's population. The dependency variable (share foreign born in 1980) is normalized to have unit standard deviation before interacting. The regions refer to the 9 regions defined by the Census. The state level time-varying controls are: Lag of a cubic polynomial in state population, lag of the relative wage of nurses vs. workers with at least some college, lag of share of the population aged 0-19, 20-39, and 40-59 years, lag of share of whites in the population, lag of share of females in professional occupations. HMO Early Adopter is defined as being a top 10 state in the percentage of population enrolled in a HMO in 1994: District of Columbia, California, Massachusetts, Oregon, Colorado, Arkansas, Hawaii, New York, Maryland, and Winconsin. The top five states are: California, New York, Illinois, New Jersey, and Florida. Standard errors clustered at the state level are reported in parentheses. The symbol * denotes significant at the 10 percent level, ** at the 5 percet level, and *** at the 1 percent level. Only ** and *** are used in this table.

Appendix Table 10. Displacement Effects of Foreign-Born Nurses on Native-Born Nurses - Cross-State Approach

	Outcome: Native Nurses (FTE)/Population		
	(1)	(2)	(3)
	A. OLS		
Foreign-Born Nurses (FTE)/Pop	-1.564***	-1.272***	-1.010***
	[0.282]	[0.246]	[0.262]
Observations	204	204	204
R-Squared	0.941	0.966	0.981
	B. 2SLS (Instrument - Predicted Foreign-Born Nurses/Pop)		
Foreign-Born Nurses (FTE)/Pop	-2.673***	-2.422***	-2.293***
	[0.506]	[0.594]	[0.605]
	204	204	204
R-Squared	0.924	0.955	0.974
Population (Cubic Polynomial)	X	X	X
Demand-Side Controls:			
Share of State Pop > 65 years		X	X
Log (Average Hourly Wages)		X	X
Physicians per 1,000 Population		X	X
Supply-Side Controls:			
Share of State Pop Aged 25-34, 35-44, 45-54, and 55-64 years		X	X
Share of Females in Professional Jobs		X	X
LFP of Married Skilled Women		X	X
Log (Average Hourly Wage of Skilled Women)		X	X
Share of Whites in the Population		X	X
Year FE	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Region X Year FE	No	No	Yes
Excludes California	No	No	No
Excludes Top Immigrant States	No	No	No

Note: The data is from the 1980, 1990, and 2000 U.S. Census and the 2007 and 2010 American Community Survey. The dependent variable is the number of full-time employed native nurses aged 25-64 years in a state as a fraction of the population in a state. The key independent variable is the number of foreign-born nurses aged 25-64 years in a state as a fraction of the population in a state. For the 2SLS regressions, the foreign-born nurses/population is instrumented using the predicted foreign-born nurses/pop constructed by using the historical distribution of high-skilled immigrants across cities in 1980 to allocate the national flow of nurses to each state (net of the contribution of each state to the national flow). All specifications are weighted by the state population. Standard errors in parentheses are clustered at the state level. The symbol * denotes significant at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level. Only *** is used in this table.

Appendix Table 11. Estimating the Displacement Effects of Foreign RNs Using Variation at the State X Year X Experience Level

(1980, 1990, and 2000 U.S. Census and the 2010 Three-Year Aggregate ACS)

	Dependent Variable: FTE Native Nurses / Population			
	(1)	(2)	(4)	(5)
FTE Foreign Nurses / Population	-1.074	-1.214	-1.020	-1.150
	(0.596)*	(0.575)**	(0.696)	(0.743)
Experience/Age	Exp	Exp	Age	Age
Includes Nurses Grad Degree	Yes	No	Yes	No
Controls				
Experience/Age FE	X	X	X	X
State FE	X	X	X	X
Year FE	X	X	X	X
State X Exp FE	X	X	X	X
State X Year FE	X	X	X	X
Exp X Year FE	X	X	X	X
No. States	51	51	51	51
No. Observations	397	394	399	398

Note: Standard Errors clustered at the state level. All regressions include as control the share of the relevant experience (age) group in the state's population and are weighted by population size. The symbol * denotes significant at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level. Only * and ** are used in this table.

Appendix Table 12. Summary Statistics for California Survey of Registered Nurses (2006 and 2010)

County level (57 counties)				
Share of Foreign-Educated in RN Workforce			2006	2010
			0.097	0.122
Individual Level Variables	Native Nurses		Foreign-Educated	
	2006	2010	2006	2010
Support from Other Nurses Working with You				
Deviation from Mean	0.39	0.37	0.19	0.24
Dummy =1 if Very Satisfied	0.38	0.42	0.18	0.24
Teamwork between Coworkers and Yourself				
Deviation from Mean	0.41	0.41	0.25	0.33
Dummy =1 if Very Satisfied	0.40	0.44	0.21	0.30
Demographics				
Age	48.82	48.51	47.47	46.85
Female Dummy	0.90	0.90	0.91	0.87
Single Dummy	0.10	0.13	0.12	0.12
White Dummy	0.75	0.72	0.18	0.12
Black Dummy	0.06	0.04	0.01	0.02
Dummy Child 0-5	0.10	0.12	0.15	0.17
Dummy Children 0-18	0.49	0.47	0.60	0.63
Education Level				
Diploma	0.09	0.06	0.23	0.18
Associate Degree	0.42	0.45	0.10	0.09
Bachelor's Degree	0.35	0.24	0.57	0.54
Master's or PhD	0.13	0.24	0.07	0.16
Job Setting				
Hospital	0.49	0.51	0.59	0.57
Nursing Home	0.02	0.03	0.08	0.12
Physicians Office	0.08	0.10	0.02	0.03
Year of Tenure in Job	10.20	9.77	10.04	8.62
Experience	19.07	18.23	20.90	17.49
Works Part-time (<35 hours)	0.36	0.36	0.20	0.21
Works over-time (>40 hours)	0.17	0.14	0.23	0.14
No. Observations	2,738	3,431	455	780