Foreign Nurse Importation and the Supply of Native Nurses*

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Abstract

The importation of foreign nurses has been used as a strategy to ease nursing shortages in the United States. The effectiveness of this policy depends critically on the long-run response of native nurses. We examine the effects of immigration of foreign-born registered nurses on the long-run employment and occupational choice of native nurses. Using a variety of empirical strategies that exploit the geographical distribution of immigrant nurses across US cities, we find evidence of large displacement effects - over a ten-year period, for every foreign nurse that migrates to a city, between 1 to 2 fewer native nurses are employed in the city. We find similar results using data on nursing board exam-takers at the state level - an increase in the flow of foreign nurses significantly reduces the number of natives sitting for licensure exams in more dependent states relative to less dependent states. We find little evidence that native flight is driven by a decline in wages. Using data on self-reported workplace satisfaction among a sample of California nurses, we find suggestive evidence that part of the displacement effects could be driven by a decline in the perceived quality of the workplace environment. We also find some evidence that states that depend more heavily on foreign nurses may have fewer incentives to increase the capacity of their nursing schools - a factor which has been cited in recent years as a primary constraint in expanding the size of the native nursing workforce.

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1 Introduction

Registered nurses (RNs) are the single largest group of healthcare professionals in the United States and their demand is expected to grow at unprecedented levels over the next ten to fifteen years. The latest U.S. Bureau of Labor Statistics occupational outlook (2012) estimates that the employment of registered nurses will grow 26 percent from 2010 to 2020, much faster than the average for all occupations (14 percent). Several factors contribute to this prediction - aging and growth of the population, expected shortage of primary care physicians and technological advances. These projections are likely to underestimate the growth rate as they do not incorporate the passing of the Affordable Care Act which is expected to expand health insurance coverage to 32 million Americans. Moreover, thousands of nurses are likely to retire in the next decade (close to 30 percent of native nurses were 55 or older in 2010).

The supply of nurses appears to have responded - 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 re-entered the labor force due to the recession. As the economy recovers, these nurses are expected to return to non-nursing jobs or reduce their hours of work (Staiger et al., 2012). Nurse shortages are likely to have serious implications for the quality of 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 is large enough to meet the healthcare demands in the near future. One strategy that has been actively pursued in the US nursing market is the hiring of foreign-born nurses.[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 under the argument that they provide critical temporary relief in times of acute shortages, the American Nurse Association (ANA) strongly opposes them 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 ANA's argument holds true, 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

[1] See Buerhaus et. al (2009) and Tulenko (2012) for thorough reviews of the literature.

[2] Several 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.

nurse importation on the long run supply of nurses.[3] In particular, we explore if the importation of foreign nurses has affected the employment of native nurses and the number of natives deciding to pursue a nursing career.

The question of how immigration affects native workers has long been of interest to labor economists. Several dozen papers have been written on this topic.[4] Nevertheless, besides the fact that there remains no strong consensus on whether immigration has any negative labor market effects on competing native workers, most studies have focused on broad groups of the population and it is not clear whether the results of these studies can be extrapolated to particular occupations, such as nursing.[5] The impact of immigration is likely to be occupation-specific and depend, among other things, on the degree of substitution (or complementarity) between natives and immigrants 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 a positive effect of the inflow of scientists and engineers on the number of natives working in the field (Kerr and Lincoln, 2011; Hunt and Gauthier-Loiselle, 2010).[6]

We use several empirical strategies and datasets. All our strategies exploit the large geographic variation in immigrant concentration in the nursing sector in the United States to identify how foreign nurse importation has affected native nurses in various dimensions. We start by exploring the effects of foreign nurse migration on the aggregate number of employed native nurses. Using data from the 1980, 1990, 2000 Census and the 2010 American Community Survey, we follow Card's

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

[5] A small number of papers have looked at the effect of foreign nurse immigration on native nurses (Schumacher, 2011; 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.

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

(2001) cross-area approach and relate ten-year changes in the number of native nurses per capita in a city to ten-year changes the number of foreign-born nurses per capita. To instrument for foreign nurse flows into a city, we use the historical distribution of other high-skilled immigrants across cities in the US to allocate the national flow of foreign-born nurses to each city. We find large displacement effects - for every foreign nurse that migrates to a city there are between 1 and 2 fewer native nurses observed working in the city. The estimated negative effects are robust to estimation technique (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 nursing workforce. Furthermore, we also find large displacement effects when we use a second approach. 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 to examine how changes over time in immigrant concentration within a city across experience groups differentially affects native nurses with different experience levels within a city. This approach is complementary to the spatial correlations approach as it allows us to control for unobserved shocks that vary by city across time. As would be expected if there is at least some degree of substitution between nurses of different experience levels, the estimated effects are smaller than those using the cross-area approach, but 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 nurses in the same city.

Having established large displacement effects on the aggregate native nurse 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 high-immigrant cities. We also find little evidence that displacement is due to more native nurses becoming unemployed or exiting the labor force. Overall, this suggests that the displacement effects observed are likely to be due to native nurses switching occupations or fewer potential nurses in a city choosing to enter nursing.

To directly test for the possibility that foreign nurse migration might effect the number of natives choosing to enter nursing, we utilize annual data on the number of individuals taking the nursing board examinations for registered nurses (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 nurses are associated with fewer natives joining the occupations 4 years later (the time it gets to obtain a nursing degree) in states that are historically dependent on foreign nurses relative to less dependent states (Kerr and Lincoln, 2011). Once again we find strong negative effects, with magnitudes comparable to that of the first two approaches.

In the remainder of the paper, we examine what might be driving these large displacement effects. Are foreign nurses driving wages down such that native 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? Have they reduced the need to make necessary reforms to expand the capacity of nursing schools?[7] Although we cannot directly test the relevance of each of these channels, we provide some suggestive evidence for each of these potential factors.

Wages are unlikely to explain our results, both because the labor supply of nurses have been found to be very inelastic[8] and because our displacement estimates suggest that foreign nurses did not expand the overall size of the nursing workforce. In other words, our displacement results imply an inward shift in the supply curve of native nurses rather than just a move along the native labor supply curve. Nevertheless, we still estimate wage regressions based on specifications similar to the displacement regressions and find no significant impact of foreign nurses on the wages of native nurses.

Absent data on number of slots available at nursing schools, the results we estimate using the NCLEX data can be interpreted as providing suggestive evidence that states that are more dependent on foreign nurses might have not invested as much in expanding the capacity of nursing schools relative to less dependent states when foreign nurses were available for hire. This is particularly true for the later part of the period, when it has been documented that thousands of qualified applicants were turned away by nursing schools, and therefore the supply of slots, and not the demand, was the main determinant of the observed number of graduates (Buerhaus et. al, 2009; AACN, 2012).

Several studies and surveys have found that satisfaction derived from working and quality of the work environment are important factors affecting the labor supply decision of existing RNs, perhaps even more so than wage levels.[9] To the extent that foreign nurses reduce the incentives of employers to improve working conditions or directly impact the quality of co-worker interactions within a workplace, they might affect the number of 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, which includes questions on nurses' satisfaction with several aspects of their most recent nursing position. Exploiting

[7] 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 nursing schools (Joynt and Kimball, 2008).

[8] See Shields (2004) for a review of the literature.

[9] Shields and Ward (2001) find that that job satisfaction is the single most important determinant of intentions to quit among nurses in the National Health Service in the UK. 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 non-monetary aspects of the job might be important in promoting labor supply.

cross-sectional variation at the county level in the inflow of foreign nurses in that four-year period, we find that a higher concentration of foreign nurses in a county increases the probability that a native nurse reports being relatively dissatisfied with the level of support from other nurses and the quality of teamwork with co-workers in her workplace. The fact that the results are robust to controlling for other ratings such as the adequacy of the number and skill level of RNs 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 county.

Taken together, our findings suggest that while importing foreign nurses might be an effective strategy to address nursing shortages in the short run, it might have the unintended consequence of reducing significantly the long-run supply of native nurses. If most of the displacement effects occur as a result of the reduction in the incentives to invest in improving working conditions or expanding the capacity of nursing schools, then a possible solution could be to combine an immigration policy that facilitates the hiring of foreign nurses to provide temporary relief with explicit conditions requiring employers to invest on initiatives to retain native nurses.

2 Data and Descriptive Statistics

We use the 1980 to 2000 US Censuses and the American Community Survey three-year aggregate for 2010 (2008-2010) as our main data sources. The average sample size per year is about a hundred thousand nurses. We focus on workers age 25 to 64 who reported their occupation to be that of a Registered Nurse. Table 1 presents descriptive statistics of RN's demographic and labor supply characteristics by foreign born status and their evolution over time.[10] As observed, foreign born nurses have steadily increased their share in the nurse workforce, going from representing 8 percent in 1980 to 14 percent in 2010.[11] 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, more than 55 percent of foreign nurses have at least a bachelor's degree, most native nurses have only an associate degree or diploma. Foreign nurses are significantly more likely to work in hospitals and much less likely to work in physicians' offices. Natives nurses are

[10] 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.

[11] These numbers are very similar to the share of foreign born in the overall population in the US, which was 8 percent in 1980 and 16 percent in 2010.

about 50 percent less likely to do shift work[12] and 50 percent more likely to work part-time, and as shown in Cortes and Pan (2012), these differences are not fully explained by their higher likelihood of working in hospitals and nursing homes. Finally, foreign nurses earn on average about 15 percent more than natives. Wage regressions presented in Cortes and Pan (2012) show that only about two thirds of the premium can be explained by detailed geographic location, education and observable job characteristics suggesting that foreign nurses might be more skilled than native nurses.

Our empirical strategies exploit the large concentration of foreign nurses in particular areas of the country. Table 2 presents the share of foreign-born nurses for the largest cities in the US for each census decade from 1980 to 2010.[13] In 2010, the top three cities include Miami, Los Angeles and New York where more than half of all registered nurses were foreign-born. In contrast, in cities like Pittsburgh and St. Louis, less than 5 percent of all registered nurses were born abroad. 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, concentration of nurses in the top cities is even larger; the average foreign born share in the nurse labor force in the top 5 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 nurses and the number of foreign-born nurses per capita across cities from 1980 to 2010.

3 Empirical Strategy and Results

We start our analysis by studying 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 the omitted variable problem is addressed.

3.1 Spatial Correlations Approach

In our first approach, we exploit variation across cities and over time in foreign nurse concentration to identify the causal effects of the inflow of foreign-born nurses on the number of native nurses in a city (Card, 2001, 2005).[14] A city in our analysis corresponds to a Metropolitan Statistical

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

[13] 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.

[14] We use cities as the main unit of analysis rather than states for several reasons. First, there is significant variation in foreign nurse concentration across cities within a state. Second, using cities as the economic unit allows to control for state level shocks, which is particularly important in this setting given that the nursing occupation is regulated by state level agencies. Third, we expect relatively low geographic mobility in the nursing population, as most workers are married women. In Appendix Table 8 and 9, we estimate the city-level models using state-level data and the

Area (MSA) as defined by the US Census Bureau. As the geographic boundaries of MSAs change somewhat over time, we utilize the crosswalk by Card and Lewis (2007) that use 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, 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 nurses per capita in a city in 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.[15] X_{it} is a vector of time-varying city level controls, θ_{jt} is a vector of region*time fixed effects, λ_i is a vector of city fixed effects and τ_t is a vector of time period 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, the log of average hourly wages as a proxy for the city's income level and the number of physicians per 1000 population. Variables to capture the supply side of the native nursing labor market include the share of the city population age 25 to 34, 35 to 44, 45 to 54 and 55 to 64, the share of females in professional occupations,[16] the labor force participation of skilled married women, the log average hourly wage of skilled women outside of nursing and the share of whites in the population.[17] Finally, in some specifications, we also include flexible state*time fixed effects to better account for unobserved demand and supply factors that vary across locality and time. In particular, given that state boards of nursing are responsible for the regulation of the nursing practice in the US, the inclusion of state*time fixed effects enables us to control for changes in licensing requirements, minimum nurse staffing ratios, etc over time. The summary statistics for this sample are presented in Appendix Table 1.

The OLS estimation of β is likely to be biased as 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 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 nurses, 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

effects are qualitatively similar.

[15] This adjustment takes into account the fact that native nurses are more likely to be part-time employed 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).

[16] Buerhaus et. al (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.

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

of foreign nurses in a city, we adopt an instrument common in the immigration literature that uses the historical distribution of migrants across US cities (Card, 2001). In our analysis, we instrument for the number of foreign nurses in a city using the following variable:

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

where i denotes city, c country of origin and t time period.[18] The underlying identification assumption is that both components in the sum are orthogonal to unobserved shocks to the number of native nurses in the city. Our specification of the immigration instrument incorporates two variations to the standard instrument. First, we use the historical 1980 geographic distribution of skilled immigrants age 25 to 64 (defined as those with some college or more) *excluding* immigrants who are nurses. This historical distribution is likely to be more exogenous to persistent shocks to the local nursing labor market than if we were to use the historical geographic distribution of immigrant nurses.[19] Second, to address the concern that the aggregate national foreign nurse flow at time t may be correlated with local conditions at the city level (especially for large cities), 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 foreign-born nurses per 1000 population in a city on the instrument (predicted number of foreign-born nurses in a city per 1000) are reported in Appendix Table 2. The coefficient on the instrument indicates that as the predicted number of foreign-born nurses in a city increases by 10 this is associated with an inflow of 2 to 3 foreign-born nurses to the city. The first-stage 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 (column 5) and excluding the top three immigrant cities in each year (column 6).[20]

Panel A in Table 3 reports the OLS estimates for the displacement regressions. All regressions are weighted by the city's population and standard errors are clustered at the city level. 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 3 to 7 native nurses are

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

[19] 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.

[20] 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.

displaced. 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 of foreign-born nurses 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. Panel B in Table 3 reports the 2SLS estimates where we instrument for the number of foreign-born nurses as a fraction of the population in a city with 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 - the magnitudes imply that for every one foreign-born nurse that enters a city, approximately two native nurses 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.

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 experience as a determinant of skill and exploiting variation through time in immigrant concentration within a city across experience groups. The main assumption of this approach 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 natives with the same 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 they hire as most foreign nurses migrate between the ages of 25 to 35.[21] Our empirical specification

[21] Using confidential data from the Philippines Overseas Employment Administration (POEA), which includes all temporary contracts of nurses migrating to the US, we calculate that 75% of nurses migrate when they are 35 years

is the following:

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

where i stands for city, j for experience group and t for decade/time period. $\frac{Native\_Nurses_{ijt}}{Population_{it}}$ is the number of full-time equivalent native nurses of experience level j, in city i in period t, and $\frac{Foreign\ Nurses_{ijt}}{Population_{it}}$ 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 issues with this approach. The first is that work experience is not directly observed in the Census. 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 likely age of joining the labor force by education level and citizenship. Our measure incorporates the fact that native nurses that 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 vs. 22). Foreign nurses' average age at graduation, in contrast, does not depend on the type of degree.[22][23]

A second issue with this approach is that sample sizes do not allows us to further divide the experience groups by education levels as in Borjas (2003), so we are implicitly assuming that nurses with different levels of education are substitutable. This might be a reasonable assumption for nurses with a bachelor's degree or an associate degree, but 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 drop 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 population into segments of similar length, for example: 0 to 10 years of experience, 11 to 20, 21 to 30, and 31 plus. However, for this strategy to work, there should be clear differences in labor market performance by experience group, and furthermore, immigrants should perform most similarly to natives with their experience level. To explore if this is indeed the case for the nurse workforce, in Appendix Table 3, we compare the wage distribution of immigrants

old or younger, and 90% when they are younger than 40.

[22] 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.

[23] 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.

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. One observation stands out: there are marked differences between the wage distribution of nurses with little experience level and the rest, but much smaller differences when more experienced groups are compared.[24] Additionally, at least for one immigrant group (experience of 21-30 years) the most similar native distribution is that of a different experience range (31+). Given this characterization, we divide nurses into only two groups: the very young (or the least experienced) and the rest.[25]

Table 4 presents the OLS estimation of equation (3) under different specifications and samples.[26] All regressions are weighted by the city's population and 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 top nurse migrant cities (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 of a given experience level that migrate to a city, we observe close to 9 fewer natives of the same experience level working as nurses in the same city. The size of the displacement effects estimated for nurses is similar to the estimated by Borjas (2006) for the general population. His results imply that 6.1 fewer native workers choose to reside in a particular metropolitan area for every ten additional immigrants who enter that locality and have the same education and experience level.

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

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

[25] Estimates are similar and statistically significant, though smaller by about 20 percent, when the sample is divided in 3 experience groups: 1-10, 11-20, 21+.

[26] 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. This specification has been shown by Peri and Sparber (2012) to be biased toward identifying displacement. In Appendix Table 4, we present results using this specification. The coefficients are all negative and 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 Nurses are Being Displaced?

Having established large displacement effects on the aggregate native nurse workforce, we examine which groups of the nursing population are most affected by foreign nurse inflows. Panel A and Panel B of Table 5 presents the displacement effects for native nurses of different age ranges and education levels, respectively. For these specifications, we focus on the 2SLS estimates, using the same instrument as that in the baseline displacement regressions reported in Table 3. We find that foreign nurses affected native nurses in every age group, with the largest negative effects observed among older nurses aged 45 to 54. Although this results might seem counter-intuitive given that foreign nurses are likely to be composed of 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.[27] We discuss the possibility that foreign nurses affect the quality of the work environment in greater detail in Section 5.2.

With respect to education levels, we find large displacement effects for native nurses with an associate degree or a bachelor's degree, and much smaller and non-significant effects for nurses 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 degree. Although foreign nurses are more likely to have a Bachelor's degree as compared to native nurses, most nursing positions can be filled by nurses with either education level.[28]

3.4 Where do Displaced Nurses 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 5, we present the OLS and 2SLS estimates of the regression of the number of native nurses who report being unemployed (or not in the labor force) per capita on the number of foreign-born nurses per capita. We find no evidence that cities with higher foreign nurse immigration is 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 individual (based on his/her last job) who is not currently employed in the previous five years. Individuals whose last held job

[27] A study of nurses aged 50 and older in the UK found that "that stress and the associated burnout were major influences on decision making with regard to employment over the age of 50." and it also identified more flexible hours as a as a key factor in encouraging older nurses to remain in or return to work (Watson, et al 2003).

[28] 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.

was more than five years ago are not assigned an occupation code.

Next, we explore the possibility that native nurses internally migrate in response to foreign nurse migration to a particular city. There are two possibilities - in response to an influx of foreign nurses, native nurses 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 natives over a ten-year period as the census only asks for a respondent's city of residence in the previous five years. Furthermore, this question was only asked in 1980, 1990 and 2000.[29] Starting from 2001, the ACS only asks about internal migration in the past year. With these caveats in mind, Appendix Table 6 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 - estimates from our preferred specification reported in the last column of Appendix Table 6 indicate that foreign nurse migration has a close to zero and non-significant 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, and is likely explained by the fact that a majority of native nurses are married women and 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 nurses choosing not to enter the nursing profession.

4 Effects on Natives Entering the Nursing Profession

Our finding in the previous section that foreign nurses reduce the number of young native nurses suggests that the inflow of foreign born nurses might affect not only employment and labor supply decisions of existing nurses, but also the number of natives joining the occupation. In this section we test for this possibility more directly by utilizing annual data on the number of US-educated individuals who sat for the nursing board examinations for registered nurses (NCLEX) by state from 1983 to 2010.[30] 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

[29] 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*.

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

will focus on very reduced form specifications.[31]

Our empirical strategy, inspired by Kerr and Lincoln (2011), tests whether increases in the aggregate (national) flow of foreign nurses (normalized by the country's population) are associated with fewer natives joining the occupations 4 years later in states that historically have been very dependent on foreign nurses relative to less dependent states. To measure historical dependency on foreign nurses, we use data from the 1980 Census to construct the share of registered nurses who are foreign-born at the state level.[32] For ease of interpretation, we normalize the dependency measure to have unit standard deviation. Our empirical specification takes the following form:

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

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}).[33]

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 migration laws, such as the 1989 Nurse Relief Act, which created a non-immigrant visa category (the H1A) exclusively for nurses with no limits placed on the number of nurses who could enter the US. As observed in the figure, while the law was on effect, the share of foreign educated taking the exam 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 in 2005 that released 50,000 green cards to be allocated exclusively to foreign nurses and their families. To the extent that the passing of these

[31] The number of foreign nurses passing the NCLEX is considered a good proxy for the actual inflow of foreign nurses to the US. 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, who 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 employer or by a recruiting agency (CGFNS, 2009).

[32] Results are almost identical when we use as dependency measure the number of foreign born nurses per 1000 people in the state, constructed using the 1980 Census.

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

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 in which we omit the five states that depended more heavily on foreign nurses in 1980 (California, New York, Illinois, Florida, New Jersey). To further check that our results are not driven by the most dependent states and that effects are also observed for states in other parts on the dependency distribution, we estimate a model similar to (4), but replacing the interaction term by quintile dummies interacted with the aggregate flow measure:

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

where states in the bottom quintile of the dependency distribution serve as the reference group.

Even if the flow was orthogonal to state specific shocks, one might be concerned that states that depend heavily 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 confound is the expansion of managed care organizations during the 1990s and the large state variation in the speed of adoption of this new form of health care delivery, with some of the states characterized by high dependency on foreign nurses also being early adopters of managed care, California in particular. As Buerhaus et al (2009) show, in the first half of the 1990s, growth in the employment of RNs was significantly lower in states with high health maintenance organization (HMO) rates. To deal with this issue, we present specifications in which we include interactions of a dummy for early adapter with year fixed effects. An early adapter is defined as being a top 10 state in the percentage of population enrolled in a HMO in 1994.[34]

In addition, we also control for other variables that might be correlated with historical dependence and that are likely to affect our outcome. Using CPS data we construct the following variables and include a 4 year lag of each in our model: the share of whites in the population, age composition of the population (share aged 0-19, 20-39, 40-59), a cubic in the state's population size, the share

[34]The percent enrolled in HMO by state was taken from Buerhaus et. al (2009) Table 5-1. Results are robust to changing the definition of an early adopter to being a top 5 or a top 17 state (the definition used by Buerhaus et. al (2009)) in the percentage enrolled in a HMO

of females in professional occupations and the relative wage of nurses vs. other workers with at least some college. 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 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 7 we present results using other 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 exam per capita people by 10 at the national level is associated with approximately 7 fewer natives taking the exam 4 years later for each standard deviation growth in state dependency. As suggested by column (5), which excludes the top 5 states and by the quintile specifications, the effect is not driven by the most dependent states. Reassuringly, all the coefficients in the quintile specification are negative (the reference group is the bottom quintile), with effects generally decreasing in magnitude as we move down in the distribution of dependency. An increase in one foreign educated nurse per capita at the aggregate level reduces the number of native nurses taking the exam in states with the highest dependency by about 2.7 and in states with medium level dependency (quintiles 2 and 3) by about 1.4, relative to the effect on the bottom quartile. 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.

A series of robustness tests are presented in Appendix Table 7. Column (1) reproduces our preferred specification. Column (2) shows the unweighted estimation of (4). Columns (3) to (8) consider different lags. Results using a 2 or a 3 year lag are similar (albeit slightly smaller) to using a 4 year lag, which is expected given that it takes between 2 and 4 years to become a nurse. Effects are larger when focusing on a 5 year lag, but much smaller and not statistically significant when we use a 6 year lag. The fact that there is little correlation between the number of native nurses taking the exam 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 the 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 working environment and investments in expanding the capacity of nursing schools.

5.1 Wages

There are two reasons why it is unlikely that the main mechanism driving our large displacement effects is an adverse effect of foreign nurses on wages. The first is a consensus in the literature of a very inelastic labor supply of registered nurses (for a survey see Shields (2004)). The second is that such large effects, which imply that the total number of nurses stays constant or declines, can only be explained by a shift of the aggregate native labor supply curve to the left and not merely by a move along the curve. Nevertheless, we still explore if we can find evidence that the inflow of foreign nurses had a negative effect on the wages of native nurses using the empirical approaches of sections 3.1 and 3.2. Tables 7 and 8 present the results. We fail to find any significant negative (or positive) effect of foreign educated nurses on native wages. All of our coefficients are positive, small and not statistically significant.

An alternative explanation that has been proposed 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 (2012), we use Census data from 1970-2010 and wages as a measure of skill to examine this issue and find a positive wage premium for nurses educated in the Philippines (the top sending country), but not for foreign nurses educated elsewhere. We also show evidence that suggests that the wage premium reflects actual quality differences between foreign and native nurses. This provides further evidence suggesting that wage considerations are unlikely to be the key driver of native nurse displacement.

5.2 Working Conditions

Several studies and surveys have found that 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, relations with colleagues, and promotion and training opportunities are all important determinants of the decision to quit nursing. 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.[35] The hiring of foreign nurses can impact the quality of working conditions directly by making it more difficult or less enjoyable to interact with foreign co-workers due to language or cultural differences. Foreign nurse importation might also indirectly impact the work environment

[35] www.nursingworld.org/HomepageCategory/NursingInsider/Archive_1/2008NI/Jun08NI/ANATestifiesRNImmigaation.html

by reducing the incentives of employers to improve the work environment in order to retain native nurses. Although we lack data to test for the indirect effects, we will provide some evidence on the direct effects in the next section.

5.2.1 Foreign Nurses and Co-Worker Interactions

In this section, we explore if an increase in the number of foreign workers 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[36] (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 California Board of Registered Nursing.[37] The sample size is relatively large at approximately 5000 nurses per year. The survey is designed to provide a description of licensed registered nurses in California and to examine changes over time and includes rich information about the respondents' job and demographic characteristics. Most importantly, for the purpose of our analysis, the survey includes a section on nurses' opinion about their most recent nursing position. The section asks the respondents to rate their satisfaction on 29 different characteristics of the job. The rating scale takes values from 1 to 5 (with 5 being the highest satisfaction level).[38] Here, we focus on the two factors that relate to the respondents' reported relationship with other nurses: (1) support from other nurses you work 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 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 foreign nurse concentration and reported satisfaction with co-workers, as in previous analysis, we exploit cross-region 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 the following:[39]

[36] Many hospitals in California have established an English only policy in the workplace. In September of 2012 a Central California hospital with an English only 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`.

[37] The survey has been 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 is a significant inflow of foreign educated workers between the two years - the foreign share increased from 13 percent to 17 percent.

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

[39] We prefer to use shares 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.

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

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

We exploit two sources of variation - (1) variation across counties (specifications not including county fixed effects) and (2) variation within county across time (specifications including county fixed effects, π_c). In specifications that include county fixed effects, we also include region*year fixed effects (δ_{rt}), where region is a broader geographical division than county (the counties are grouped into 8 regions in California).[40] 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 regressions include year fixed effects (θ_t).[41]

Unfortunately, data limitations do not allow us to construct an instrument for $Share\ Foreign\ Educated_{ct}$.[42] 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 by health care professionals or a health care system in crisis. Moreover, we control for the ratings given to two other dimensions related to nursing staff that might be correlated to shocks that led to an increase in the share of foreign nurses in a county: (1) adequacy of RN skill level where you work and (2) adequacy of the number of RN staff where you work. Finally, we estimate equation (6) separately for natives 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 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 natives and foreign educated nurses, respectively. For native respondents, all but one of the estimated coefficients on the share foreign 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 satisfaction by 10 to 15 percent of the population mean. When county fixed effects are added, the estimates using deviation from mean are close to zero

[40] The regions include Northern counties, Sacremento, San Francisco, Central Valley, Central Coast, Los Angeles, Inland Empire and Border Counties.

[41] The summary statistics for this sample are presented in Appendix Table 10.

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

and no longer significant, whereas the estimates using a measure that captures a "high-degree" of satisfaction continues to be negative, albeit not significant. The results for satisfaction level with "Teamwork between coworkers and yourself" are more robust and indicate a strong negative relationship between the share of foreign nurses and native nurse satisfaction. The relationship is even stronger when county fixed effects are included in the model. The magnitude of the effects are slightly larger compared to the previous question on support. While the estimates for the ratings given by foreign nurses are generally positive and large, they are imprecisely estimated. The large standard errors are likely due to the significantly fewer observations in the foreign educated nurse sample.

Overall, these results provide suggestive evidence that in counties with more foreign educated nurses, native nurses 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 a decline in levels of satisfaction relative to counties that experienced a smaller increase in the foreign share. This suggests that one potential reason why native nurses may exit nursing in response to foreign nurse importation could be due to the deterioration in the workplace environment resulting from the change in coworker composition.

5.3 Capacity of Nursing Schools

Most experts agree that in recent years the main bottleneck to expanding the size of the native nurse workforce has been the capacity of nursing schools. At least since the early 2000s a significant number of qualified applicants have been turned away from nursing programs. In California, for example, in 2002 45.8% of qualified applicants were not accepted to associate degree in nursing (ADN) programs.[43] Data at the national level for 2011 shows that 51% of qualified applicants to ADN programs and 36% 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%) and lack of clinical sites (60.8%) are the most common major barriers to expanding enrollment. Large investments at the state-level are needed to address this problem and several states have already implemented policies in this direction.[44] To the extent that the availability of foreign nurses reduces the incentives of

[43] See link: http://bhpr.hrsa.gov/healthworkforce/reports/nursingedu5states.pdf

[44] For example, in 2006, Maryland awarded $6 million in grants through the Nurse Support Program (NSP). The legislatively-created NSP aims to expand the pool of nurses by increasing the capacity of nursing programs. In the same year, the Illinois General Assembly enacted the Nurse Educator Assistance Act. This Act provides up to $5,000 in loan repayment and $10,000 in scholarship funds to nursing students enrolled in graduate nursing programs. The state legislature in Colorado passed two bills in 2006 focused on their nurse faculty shortage. The legislation targeted both the financial barriers to graduate education and the salary differential for nursing working in academia versus

states to invest in expanding the capacity of nursing schools and of hospitals to step in by sponsoring nursing schools and increasing their availability for clinical rotations, it might negatively affect the number of natives nurses entering the occupation. To test for this possibility, and absent data on number of slots available at nursing schools, we again turn to data on native nurses taking the board examination at the state level, but concentrate on the most recent period, where the number of graduates was likely determined by the supply of slots in nursing schools and not by the demand. Restricting the time period to the last decade does not change significantly the results obtained in section 4 (see column (5) of Table 6): an increase in the number of foreign born nurses coming to the US, decreases the number of natives taking the exam in more dependent states relative to less dependent states, a few years later.

6 Conclusion

As healthcare becomes an even larger part of the US economy, there is a pressing need to find long term solutions to the recurrent shortage of healthcare workers. This paper explores the long run consequences of hiring foreign nurses, a practice used extensively to combat nursing shortages, even though it is typically argued for on the grounds that it is a temporary 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. For every foreign nurse that migrates to a city, there are approximately one to two fewer native nurses observed working in the city. These findings are corroborated by data on nursing board exam-takers - 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 licensure examinations. Turning to the possible factors that might drive the displacement of native nurses, we find little evidence that the displacement effects are driven by a decline in wages. We find some suggestive evidence that foreign nurse migration may impact the perceived quality of the workplace environment - native nurses 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 co-workers.

Our finding of large displacement effects of foreign nurse migration 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 and, if anything, 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

practice.

and find similar crowding-in effects.[45] Nevertheless, there are key differences 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.[46] 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 of large displacement effects on the native nurse population suggest that relying heavily on foreign nurses to fill the gap in the 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 areas and 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.

Data Appendix

Construction of the Entry Age to Labor Market

We use the National Sample Survey of Registered Nurses to compute the median age of entry to the labor market by degree type. 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) is significantly higher than the same number for a bachelor's degree (22) or for a diploma (21). This is true only for natives, there is no variation in graduation age by degree type for foreign educated nurses (21 years old), with the exception of those who have a graduate degree (26 for both natives and foreign educated). 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.[47] 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.

[45] 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).

[46] 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.

[47] We identify nurses with a Diploma in the 1980 Census as those workers who report having 3 years of college. In 1990 having a Diploma is equivalent to having an Associate's Degree, occupational program.

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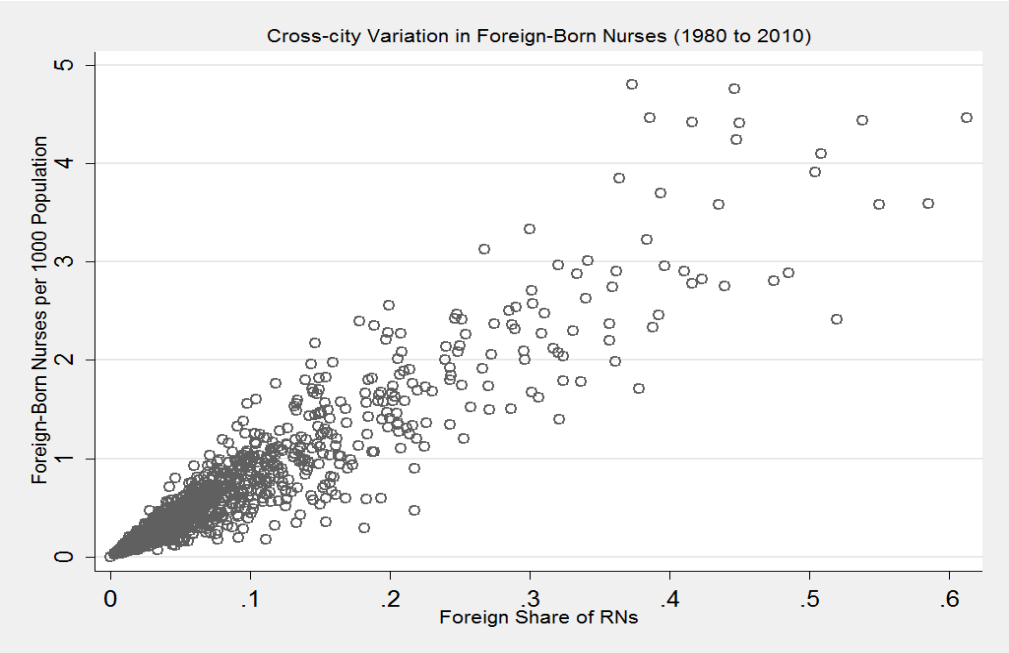
Figure 1. Cross-city Variation in Foreign-Born Nurses (1980 to 2010)



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 - NCLEX Passers

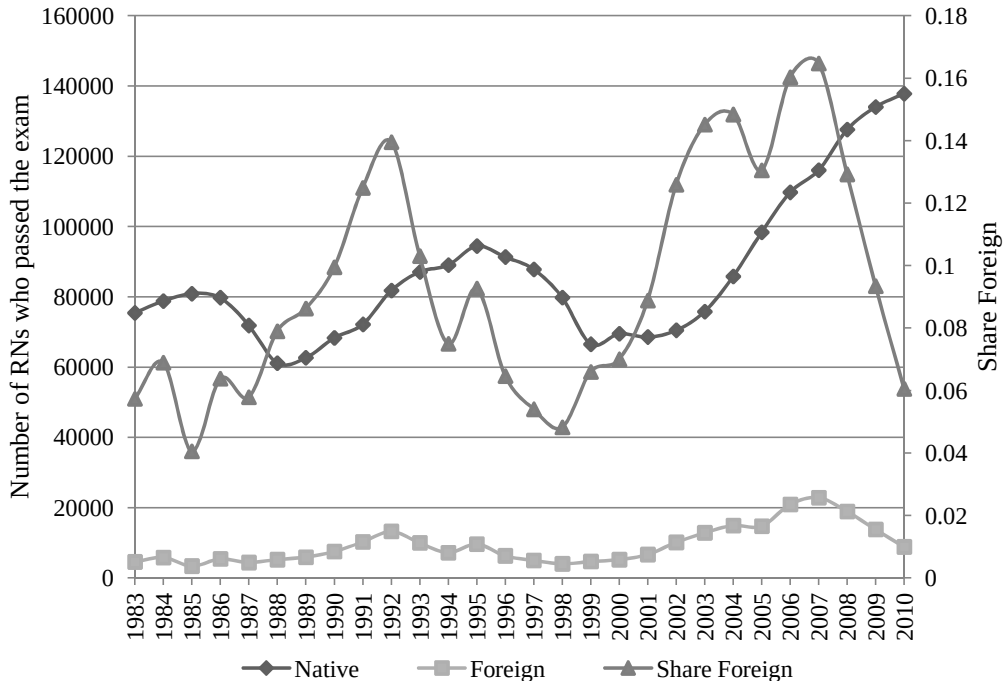


Table 1. Demographic and Labor Supply Characteristics of Stock of Nurses by Foreign Born Status

	Native Nurses						Foreign Born Nurses					
Year	1970	1980	1990	2000	2007	2010	1970	1980	1990	2000	2007	2010
Share							0.07	0.09	0.09	0.12	0.13	0.14
Age	42.13	40.25	40.71	43.53	45.07	45.40	41.84	39.44	41.08	42.74	44.07	44.41
Female	0.98	0.96	0.95	0.93	0.92	0.92	0.97	0.95	0.94	0.90	0.88	0.87
Single	0.09	0.12	0.12	0.11	0.12	0.12	0.17	0.18	0.15	0.14	0.14	0.14
Child age 0-5	0.24	0.19	0.21	0.15	0.14	0.14	0.26	0.25	0.20	0.18	0.17	0.17
Child age 0-18	0.66	0.62	0.61	0.58	0.55	0.54	0.55	0.59	0.61	0.62	0.61	0.62
Bachelors	0.11	0.21	0.31	0.37	0.40	0.41	0.14	0.27	0.42	0.50	0.55	0.56
Graduate Deg.	0.05	0.10	0.13	0.14	0.14	0.12	0.08	0.22	0.14	0.13	0.14	0.13
Hospital	0.64	0.67	0.67	0.61	0.62	0.61	0.72	0.79	0.77	0.68	0.69	0.68
Nursing Home	0.08	0.08	0.08	0.08	0.07	0.07	0.06	0.07	0.06	0.11	0.09	0.09
Physicians Off.	0.08	0.06	0.07	0.07	0.07	0.05	0.06	0.03	0.04	0.03	0.03	0.02
Other Health	0.08	0.04	0.07	0.12	0.13	0.15	0.08	0.02	0.05	0.09	0.10	0.13
LFP	0.72	0.84	0.90	0.89	0.91	0.93	0.74	0.88	0.92	0.85	0.90	0.95
Shift Work			0.14	0.13	0.15	0.15			0.20	0.20	0.23	0.23
< 35 hrs/week	0.18	0.22	0.23	0.22	0.22	0.21	0.12	0.14	0.15	0.14	0.13	0.14
35-40 hrs/week	0.37	0.43	0.41	0.52	0.53	0.55	0.44	0.56	0.52	0.62	0.64	0.65
41-59	0.08	0.10	0.16	0.14	0.15	0.14	0.08	0.08	0.14	0.11	0.11	0.11
60+ hours	0.02	0.02	0.04	0.03	0.03	0.03	0.03	0.04	0.05	0.06	0.06	0.05
Hourly wage*	13.72	12.30	15.45	16.92	18.73	18.75	15.14	13.59	17.67	19.60	21.69	21.48
(1990 dollars)	(10.20)	(8.42)	(8.10)	(9.52)	(10.18)	(9.65)	(11.70)	(8.61)	(9.65)	(11.42)	(12.41)	(11.15)
Number of Obs.	17378	56480	85245	103926	72599	75599	1314	5410	8320	14040	11025	12450

Note: The data is from the Census and American Community Survey. The sample includes all people ages 25-64 who reported Registered Nurse as their occupation. The variable we use to construct the shift dummy was not included in the 1970 and 1980 Censuses. *Standard deviation is reported in parenthesis.

Table 2. Share of Foreign Born Nurses in Nursing Workforce, US largest cities

	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-LI	0.03	0.03	0.04	0.03
Pittsburgh, PA	0.02	0.01	0.02	0.02

Note: Cities were selected if they had a population of at least 2 million in 2000. Constructed using Census and ACS data. The sample is restricted to individuals aged 25-64 who reported registered nurse as their occupation.

Table 3. Displacement Effects of Foreign-Born Nurses on Native Nurses: Cross-city Approach

	Outcome: Native Nurses (FTE)/Population					
	(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***
	[0.141]	[0.145]	[0.141]	[0.175]	[0.155]	[0.129]
Obs	1,140	1,140	1,140	1,140	1,052	1,112
R-squared	0.892	0.916	0.936	0.952	0.928	0.935
	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***
	[0.278]	[0.345]	[0.373]	[0.767]	[0.682]	[0.566]
	1,140	1,140	1,140	1,140	1,052	1,112
R-squared	0.844	0.889	0.915	0.920	0.884	0.909
Population (cubic polynomial)	X	X	X	X	X	X
Demand-side controls:						
Share of city pop > 65		X	X	X	X	X
to 39, 40 to 49, 50 to 59		X	X	X	X	X
Log(average hourly wages)		X	X	X	X	X
Physicians per 1000 population		X	X	X	X	X
Supply-side controls:						
44, 45-54, 55-64		X	X	X	X	X
occ		X	X	X	X	X
LFP of married skilled women		X	X	X	X	X
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, 2000 US Census and 2010 American Community Survey. The dependent variable is the number of native nurses age 25-64 in a city as a fraction of the population in a city. 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. * signficant at 10% level, ** at 5% level and *** at 1% level.

Table 4. Displacement Effects of Foreign-Born Nurses on Native Nurses: 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	-0.959	-0.972	-0.983	-0.800	-1.045	-1.073	-1.125
	(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, 2000 US Census and 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 clustered at the city level are reported in parenthesis * signficant at 10% level, ** at 5% level and *** at 1% level.

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

	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	1,140	1,140	1,140	1,140	1,140	1,140	1,140	1,140
Obs	0.839	0.861	0.880	0.906	0.890	0.892	0.865	0.900
	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	1,140	1,140	1,140	1,140	1,140	1,140		
Obs	0.848	0.867	0.900	0.921	0.812	0.862		
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, 2000 US Census and 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 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. * signficant at 10% level, ** at 5% level and *** at 1% level.

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

	Dep. Var: Native Exam Takers / Population $_{s,t}$				
	(1)	(2)	(3)	(4)	(5)
	I. Linear Effects				
Dependency Variable$_{s, 1980}$*(Foreign Passers/Population)$_{t-j}$	-0.524	-0.627	-0.652	-1.052	-0.462
	(0.143)***	(0.191)***	(0.226)***	(0.535)*	(0.174)**
	II. Quintiles Specification				
Dummy Top quintile $_{s, 1980}$*(Foreign Passers/Population)$_{t-j}$	-2.404	-2.738	-2.697	-3.232	-1.932
	(0.660)***	(0.821)***	(0.868)***	(1.120)***	(0.633)***
Dummy Second quintile $_{s, 1980}$*(Foreign Passers/Population)$_{t-j}$	-1.349	-1.627	-1.634	-1.267	-0.722
	(0.635)**	(0.739)**	(0.806)**	(0.816)	(0.620)
Dummy Third quintile $_{s, 1980}$*(Foreign Passers/Population)$_{t-j}$	-1.481	-1.291	-1.336	-1.140	-1.527
	(0.802)*	(0.808)	(0.856)	(0.947)	(0.634)**
Dummy Fourth quintile $_{s, 1980}$*(Foreign Passers/Population)$_{t-j}$	-0.998	-1.041	-0.933	-1.166	-0.740
	(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	1071	1071	1071	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 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, 40-59, 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: DC, CA, MA, OR, CO, AR, HI, NY, MD, WI. The Top 5 states are California, New York, Illinois, New Jersey, Florida.

Table 7. Wage Effects of Foreign-Born Nurses on Native Nurses Using Cross-city Approach

	Outcome: 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]
Obs	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]
Obs	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		X	X	X	X	X
40 to 49, 50 to 59		X	X	X	X	X
Log(average hourly wages)		X	X	X	X	X
Physicians per 1000 population		X	X	X	X	X
Supply-side controls:						
55-64		X	X	X	X	X
Share of females in professional occ		X	X	X	X	X
LFP of married skilled women		X	X	X	X	X
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, 2000 US Census and 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 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. * signficant at 10% level, ** at 5% level and *** at 1% level.

Table 8. Wage Effects of Foreign-born Nurses using Variation at the City X Year X Experience level

	Dependent Variable: Avg.L(Hourly wage of native nurses) / Population						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
FTE Foreign Nurses *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	1087	624	1016	938	964	1238	1155

Note: The data is from the 1980, 1990, 2000 Census and 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. * signficant at 10% level, ** at 5% level and *** at 1% level.

Table 9. Share Foreign Educated and Nurse 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	5773	5555	5773	5555	5773	5555	5773	5555	5914	5598	5914	5598	5914	5598	5914	5598
	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	1124	1107	1124	1107	1124	1107	1124	1107	1130	1108	1130	1108	1130	1108	1130	1108
	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, Inland Empire and Border Counties. Individual controls include dummies for job setting (21), position (18), education (4), female, single, child 0-5, 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.

Appendix Table 1. Summary Statistics for Spatial Correlations Approach

	1980	1990	2000	2010
Native Nurse (FTE) per 1000 pop	3.91	5.60	5.77	6.20
% in age range:				
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 1000 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 age > 65	0.101	0.112	0.113	0.115
Share of pop age 25 to 34	0.167	0.180	0.145	0.136
Share of pop age 35 to 44	0.115	0.153	0.165	0.138
Share of pop age 45 to 54	0.101	0.103	0.133	0.146
Share of pop age 55 to 64	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 occ	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 among 25 to 64	0.862	0.802	0.745	0.732
Physicians per 1000 pop	2.279	2.815	3.091	3.251
No. of Cities	285	285	285	285

Note: The data is from the Census and ACS. 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 2. 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]
Obs	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		X	X	X	X	X
Log(average hourly wages)		X	X	X	X	X
Physicians per 1000 population		X	X	X	X	X
Supply-side controls:						
45-54, 55-64		X	X	X	X	X
Share of females in professional occ		X	X	X	X	X
LFP of married skilled women		X	X	X	X	X
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, 2000 US Census and 2007 and 2010 American Community Survey. The dependent variable in the first-stage regressions is the number of foreign-born nurses age 25-64 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. * signficant at 10% level, ** at 5% level and *** at 1% level.

Appendix Table 3. Wage Distribution of Nurses by Foreign Status and Experience Level

Group	Experience Group	Share in percentile range of aggregate wage distribution			
		0-25	26-50	51-75	76-100
Native	< 11	0.32	0.32	0.21	0.15
Foreign	< 11	0.34	0.27	0.22	0.18
Native	11-20	0.25	0.25	0.26	0.24
Foreign	11-20	0.25	0.23	0.24	0.28
Native	21-30	0.22	0.24	0.27	0.27
Foreign	21-30	0.22	0.18	0.24	0.37
Native	31+	0.23	0.23	0.25	0.29
Foreign	31+	0.21	0.17	0.24	0.38

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

Appendix Table 4. 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	1087	624	1016	938	964	1238	1155

Note: The data is from the 1980, 1990, 2000 Census and 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. * signficant at 10% level, ** at 5% level and *** at 1% level.

Appendix Table 5. 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
Obs	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
Obs	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, 2000 Census and 2010 ACS. 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. Standard errors clustered by city are reported in parentheses. ***significant at 1%, **5%, *1%.

Appendix Table 6. Effect of Foreign Nurses on Native Nurse 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 Nurses (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 Census.

Appendix Table 7. 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	1071	1071	969	1020	1122	1173	1224	1274

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, 40-59, 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: DC, CA, MA, OR, CO, AR, HI, NY, MD, WI. The Top 5 states are: California, New York, Illinois, New Jersey, Florida. Standard Errors clustered at the state level are reported in parentheses. ***significant at 1%, **5%, *1%.

Appendix Table 8. Displacement Effects of Foreign-Born Nurses on Native-Nurses at the State-Level: Cross-city 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]
Obs	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		X	X
Log(average hourly wages)		X	X
Physicians per 1000 population		X	X
Supply-side controls:			
45-54, 55-64		X	X
Share of females in professional occ		X	X
LFP of married skilled women		X	X
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

The dependent variable is the number of full-time employed native nurses age 25-64 in a state as a fraction of the population in a state. The key independent variable is the number of foreign-born nurses age 25-64 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. * signficant at 10% level, ** at 5% level and *** at 1% level.

Appendix Table 9. Estimating the Displacement Effects of Foreign Nurses using variation at the State X Year X Experience level
(1980, 1990, 2000 Census and 2010 3-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

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.

* signficant at 10% level, ** at 5% level and *** at 1% level

Appendix Table 10. Summary Statistics for California Survey of Registered Nurses (2006 and 2010)

County level (57 counties)

Share foreign educated in nurse 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)	0.36	0.36	0.20	0.21
Works over-time (>40)	0.17	0.14	0.23	0.14
No. Obs.	2738	3431	455	780