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Effect of Immigrant Nurses on Labor Market Outcomes of US Nurses

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Abstract

We study the effect of immigration of foreign-trained, registered nurses (RNs) on the employment and wages of US-trained RNs. We use the "area" approach and study effects of immigration in labor markets defined by the state. We find substantial evidence that immigration by foreign-trained nurses increases the supply of nurses and that this increase in supply is associated with a decrease in annual earnings. Estimates suggest that a 10 percent increase in supply due to immigration is associated with a one to four percent decrease in annual earnings.

Introduction

It is widely believed that there is a severe nursing shortage in the United States (US) and that the shortage will remain for many years.[1] To address this and similar shortages in the past, the government has eased immigration restrictions on foreign-trained nurses. For example, in 1989, Congress passed the Immigration Nursing Relief Act (INRA) that established a five-year pilot program to allow foreign-educated nurses to enter the country on H-1A visas. Almost immediately, there was a substantial response to this legislation as over 24,000 immigrant nurses entered the US by May 1989, and many nurses who entered the country through this program adjusted to lawful permanent resident status (Meyer, 2006). This program was ended in 1995. However, in 1999, a new program, H-1C visas, was created for nurses that targeted medically underserved areas. Further, changes in immigration rules in 2003 allowed nurses to enter under H1-B visas. The North American Free Trade Agreement (NAFTA) in 1994 also allowed Canadian nurses to enter the U.S. to work. Partly in response to these policy changes, the proportion of foreign-born among newly licensed registered nurses fell from about 10 percent in 1995 to close to five percent in 1998, and then rose to close to 15 percent by 2003 and remained at that level until 2007 (Brush et al., 2004).[2]

[1]According to the Department of Health and Human Services (2002), there was a shortage of 110,000 nurses in the US in 2000, which was projected to increase to 149,000 in 2005 and to 275,000 by 2010. The Bureau of Health Professionals projects a shortage of RNs over the next 15 fifteen years, with a 12% shortage by 2010 and a 20% shortage by 2015(http://bhpr.hrsa.gov/healthworkforce/reports/methindentifysummary.pdf, website last accessed October 19, 2011).
[2]The 2007 figure is from authors' calculation using NCLEX data.

All discussions of solutions to the nursing shortage recognize that immigration will likely play an important role in alleviating current and future nurse shortages (Galessell-Brown, 1998; Berliner and Ginzberg, 2002; Kline, 2003; Aiken et al., 2003; Chaguturu and Valllabhaneni, 2005; Lafer, 2005; Tsitouras and Lopez, 2009). However, immigration of nurses has long generated concerns among health professionals, nursing advocates, and policy analysts about its consequences (Joel, 1996; Glaessel-Brown, 1998; Trucios-Haynes, 2002; Brush et al., 2004; Lovell, 2006; Blakeney, 2006). Specifically, there is concern about how foreign-trained nurses will affect the quality of patient care, the labor market opportunities of US-trained nurses and the supply of nurses in the sending countries (Immigrant Nurse Relief Act, 1989; Glaessel-Brown, 1998; Trucios-Haynes, 2002; Brush et al., 2004; Lovell, 2006; Aiken et al., 2001; Flynn and Aiken, 2002).

Despite its potentially important consequences, there has been little systematic study of the effect of immigration of nurses on the economic opportunities of domestic nurses (Immigration Nursing Relief Advisory Committee, 1995; Schumacher, 2008). Therefore, public concern and opinion on this issue is largely based on standard economic theory, which predicts that an increase in supply of workers in an occupation should lower wages. However, the available empirical evidence on this issue includes a surprisingly wide range of possible consequences: from immigrants having no adverse effects on the labor market opportunities of US workers to large negative effects (see Edmonston and Smith, 1997 for a summary of previous literature; and Card, 2005; Card 2009; Borjas, 2003; Borjas and Katz, 2005 for a review of more recent research). Moreover, the effects of immigration in nursing may differ from those found for workers in general, or for workers in other occupations. Thus, it remains an unanswered question as to how immigration of foreign-trained nurses affects the economic well-being of domestic nurses.

Answering this question is important because of the vital role that nurses play in providing medical care. If foreign-trained nurses are depressing the wages of domestic nurses, as some advocates claim, then the future domestic supply of nurses will shrink, exacerbate the apparent nurse shortage, and worsen the supposed consequences of the shortage such as poor quality patient care.[3] In fact, the widespread use of administered prices in health care (e.g., Medicare and Medicaid) may encourage hospitals and other providers to reduce quality perhaps by substituting low-paid immigrant nurses for high-paid domestic nurses. This may be harmful not only to domestic nurses' labor market opportunities, but also to consumers (patients) if foreign-trained nurses are of lower quality than domestic nurses. This problem may be particularly important in health care because of the difficulty of observing the quality of care. On the other hand, if foreign-trained nurses are of the same quality as U.S. trained nurses, but willing to work for less, then the same quality of health care can be delivered at lower cost, but this consumer benefit will come at the expense of domestic nurses who will have worse labor market opportunities than otherwise.

The objective of this paper is to study the effect of immigration of foreign-trained registered nurses (RNs) on the employment and wages of domestic RNs.[4] The nursing context, although narrow, provides a particularly advantageous setting to study the effect of immigration on native workers. Focusing on one, clearly defined occupation alleviates empirical problems that plague research in this area. First, it is straightforward to identify

[3]While it is widely believed that patient care has been adversely affected by the nurse shortage, the evidence on this point is not conclusive. Several observational studies have reported a positive association between the quantity of nurses (per patient) and patient outcomes (see Aiken et al. 2002 and Needleman et al. 2002 for prominent examples), but this does not imply that the current level of nurses is not optimal.

[4]We limit our study to registered nurses (RNs) and in the rest of the paper we use the generic term nurse instead of registered nurse. It is also important to distinguish foreign-trained nurses from foreign-born nurses who are trained in US. It is the former group that is of interest here.

the native workers most affected by foreign-trained nurses: US-trained RNs. The level of competition between immigrants and natives within such a narrowly defined occupation category is unquestionably high. In contrast, studies focused on the effect of immigration on a broader range of native workers, which often classify workers into groups using a few observable characteristics such as education and age, do not accurately identify similar workers competing for the same jobs. This problem may explain why previous studies often fail to find an effect of immigrants on natives, although this is just one possible explanation. Second, by focusing on one occupation it is easier to adjust for demand shifts that may confound the relationship between immigration and wages. Variables that affect the demand for nurses such as the number of hospital admissions and demographic factors related to population health are readily available. Studies of broader groups of immigrants face more difficulty adjusting for potential demand side factors that may affect wages and immigrant location decisions. Third, health care is a highly regulated service industry (e.g., minimum nurse staffing ratios) and there is arguably less scope for firms (e.g., hospitals) to adjust to changes in immigration (supply of labor) by altering the production process and exporting services. Finally, examining the effect of nurses on a skilled occupation such as nursing is of growing interest given the rising levels of education around the world and the increasing migration of skilled workers into the U.S. In sum, while the narrowness of our study limits its applicability, the empirical advantages associated with this narrow focus improve the internal validity and credibility of the analysis.

To accomplish our objectives, we used data from several years of the National Sample Survey of Registered Nurses (NSSRN), which is a dataset uniquely appropriate for this analysis. Unlike the Census, which is used by most previous research to study effects of immigration, the NSSRN provides information on whether a registered nurse works in nursing or in an occupation other than nursing. This distinction is important with respect to identifying the group of nurses affected by immigration because a sixth of all licensed registered nurses work in occupations other than nursing, and occupational choice can be an important adjustment in response to an increase in supply caused by immigration. In addition, the Census does not identify foreign-trained nurses, but only foreign-born nurses. It is the former group that is germane to the study of the effect of immigration on wages. Finally, the Census does not identify nurses with a valid nursing license, which is required to work as a nurse, and the Census is not intended to be representative for narrowly defined occupations within states.

We obtained estimates of associations between the supply of nurses and labor market outcomes using an instrumental variables approach. We used the lagged number of foreign-trained nurses to instrument for the current supply of nurses. Our results indicated that immigration of foreign-trained nurses significantly increased the supply of nurses in labor markets defined at the state level. However, changes in the supply of nurses, as a result of immigration, were not associated with wages or earnings in a consistent manner. While there was some evidence that an increase in the supply of nurses due to immigration was associated with a decrease in annual earnings, the same was not true for wages. In addition, most estimates were not statistically significant reflecting, at least partly, the fact that the instruments were somewhat “weak”. Nor was the change in supply associated with the probability of not working in nursing. Overall, our findings are consistent with many of the results in the broader literature that finds a weak association between immigration and labor market outcomes of US-born (trained) workers (Card 2005).

Research Design

Our interest is in determining the effect of immigration of foreign-trained nurses on the wages and employment of US-trained nurses. Our analysis is based on what has become

known as the "area approach." The assumption underlying this approach is that areas, in our case states, represent separate labor markets and that RN wages are determined by supply and demand factors in those markets. Immigration of nurses to a state represents a shift (increase) in the supply of nurses in that market and simple labor market theory suggests a decrease in wages as a result of immigration.[5] We use the state to define the local labor market because of the regulatory environment that governs nursing. During most of the period of our analysis, each state required a nurse to be licensed in that state to legally work there and obtaining a state license involved significant administrative hurdles. Importantly, prior to 2000, there were no compacts between states that allowed a nurse licensed in one state to legally work in another (Philipsen and Haynes, 2007). By 2006, there were only 20 states that belonged to a multi-state licensing group with only one large state Texas participating. Our data end in 2004 when most states did not allow a nurse to work unless licensed in (only) that state. A second advantage of using the state as the definition of the market is it minimizes potential measurement error. The NSSRN was intended to accurately represent the population of nurses at the state level. For smaller geographic area, for example counties, the NSSRN is unlikely to produce accurate estimates. The problem may be particularly severe because we use the NSSRN to estimate the number of foreign-trained nurses. At the county level, the number of foreign-trained nurses is often quite small to construct reliably an estimate of the number of foreign-trained nurses.[6] We acknowledge that the state may be too large of a geographic area, particularly in large states with multiple population centers that may be separate labor markets. Unfortunately, the data do not let us use a smaller unit of geography. To assess whether eliminating large states with multiple population centers affects estimates, in some analyses we dropped three such states: CA, Fl and TX. We present the results with and without these states.

Applying the area approach to the analysis of the effect of immigration on wages, we specify the following regression model for wages:

$$\ln W_{ijt}=\alpha_j+\beta_t+\delta_1 \ln N_{jt}+\delta_2 \ln P_{jt}+\gamma Z_{jt}+\pi X_i+v_{ijt}$$
$$i=1,\ldots,N \quad \text{(persons)}$$
$$j=1,\ldots,51 \quad \text{(states)}$$
$$t=1988, 1992, 1996, 2000, 2004 \qquad (1)$$

In equation (1), ln W_{ijt} is the log hourly wage of a US-trained registered nurse living in state j in year t. We assume that log wages are a function of the natural logarithm of the number

[5]The nursing market has sometimes been characterized as monopsonistic. However, the most recent study of the issue concluded that "… whatever one thinks about the importance of monopsony, classic or new, the market for RNs is a questionable example given the relatively high mobility of RNs across employers. (Hirsch and Schumaker, 2005, p.987)." This and other papers (e.g., Hirsch and Shumaker, 1995; Adamache and Sloan, 1982) suggest that it is not unreasonable to assume that the market for nurses is competitive. However, even if we assume that the market for nurses is characterized by monopsony, the main prediction that motivates the empirical analysis is very likely to remain valid (Manning, 2003). Immigration will shift the (upward sloping) supply of labor to the firm to the right. This will result in lower wages (that remain below the marginal product). This is necessarily true if immigrant nurses have a lower reservation wage than natives, which seems likely given the motivation for immigration and labor market opportunities in most sending countries. It is also true if immigrants have a higher reservation wage than natives and the marginal cost of immigrant nurses rises with employment at a rate that is not too much less than native nurses. The marginal cost of employment is affected by the costs of recruiting and training more nurses. It seems unlikely that these costs would rise significantly more slowly for immigrant nurses than native nurses. In sum, the primary prediction—that wages fall as a result of immigration—is likely valid whether the market for nurses is characterized by perfect competition or monopsony.

[6]The sampling frame and sample sizes in the NSSRN are not sufficient to conduct county-level analyses. The NSSRN was not intended to produce accurate county estimates. To provide an illustration of the problem, we often found that the number of foreign-trained nurses was very small (sometimes zero) in some relatively large counties. Also, some large counties were omitted from the sampling frame. A comparison to the Census 2000 often resulted in large discrepancies as to the number of nurses in a county. The match between the Census and NSSRN was substantially better at the state level. Nevertheless, we attempted to use county to define the local labor market. However, we were never able to obtain a sufficiently strong relationship between foreign-trained nurses and the total number of nurses in the county, which is the relationship that underlies our empirical strategy (i.e., instrumental variables).

of registered nurses (N_{jt}) in state j, the natural logarithm of the size (number) of the working age population (P_{jt}) in state j, individual characteristics (X_{jt}) and demand side factors (Z_{jt}) specific to state j. Individual characteristics include: age, sex, marital status, education (dummy variables indicating whether she has a diploma from secondary school, an Associate degree, a BA degree, MA or higher in nursing), experience in nursing (dummy variables indicating whether she received nursing license 0–4 years ago, 5–8 years ago, more than eight years ago), and race (white v. other). Demand side factors include per capita hospital inpatient admissions (and its square), per-capita hospital outpatient visits (and its square), the proportion of persons that are elderly, proportion of persons that are black, population growth, per capita income and the unemployment rate. The parameters α_j and β_t denote state and year fixed effects. A similar model is estimated for employment in nursing, which is an indicator equal to one if person is employed in nursing and zero otherwise (employed outside of nursing or not employed).

One potential problem with estimating equation (1) is that the size of nursing labor force (i.e. supply) in an area $\ln N_{jt}$ may be endogenous; indeed, this is a classic example of non-identification of equilibrium price and quantity. There may be unobserved demand factors correlated with both wages and the size of labor force that may bias estimates. To partly address this issue, we include controls for demand side factors such as number of inpatient hospital admissions. In addition, we use an instrumental variables (IV) procedure to address this problem. We instrument for the number of nurses using the 4-year lag number of foreign-trained nurses. The IV model is:

$$\ln N_{jt}=\rho_j+\sigma_t+\mu Z_{jt}+\lambda_1 \ln IM_{j(t-4)}+\lambda_2 \ln P_{jt}+\kappa X_i+u_{jt} \quad (2)$$

$$\ln W_{ijt}=\alpha_j+\beta_t+\delta_1 \ln \widehat{N}_{jt}+\delta_2 \ln P_{jt}+\gamma Z_{jt}+\pi X_i+v_{ijt} \quad (3)$$

In equation (2), the (log) number of nurses in the in state j in year t is a function of the lagged (log) number of foreign-trained nurses in state j in year t, which is the instrument. Importantly, as Peri and Sparber (2010) show convincingly, the specification of equation (2), which included the log number of nurses and the log of the working population, is superior to other common specifications such as using the log of the ratio of the number of nurses to the working age population because it minimizes measurement error.

Equation (2) is estimated using aggregate data at the state level. It is the first stage used to predict the (supply) number of nurses that is used in equation (3) and denoted by ($\ln \hat{N}_{jt}$). Because this approach is a non-standard IV, standard errors for equation (3) are constructed to account for the predicted nature of the key independent variable using methods of Murphy and Topel (1985) and Hardin et al. (2003).

Our IV strategy depends on the assumption that state of residence of foreign-trained nurses four years prior does not depend on current, unmeasured determinants of the demand for nurses in a state (i.e. is exogenous), and that the number of foreign-trained nurses four years prior is correlated with the total number of nurses in that state.[7] The rationale for this instrument is the substantial evidence that immigrants prefer locations with previously arrived immigrants. Thus, foreign-trained nurses will locate where previous foreign-trained

[7]Most foreign-trained nurses enter the country on work visas and the process of obtaining such visas is characterized by significant bureaucratic delays. Thus, arguably, entry of foreign-trained nurses lagged four years is exogenous to demand side factors (see Hanson (2007 for a similar argument with respect to all immigration).

nurses have located, and not necessarily because of demand conditions in that area. This approach has been widely used in the past (Card 2001, Card 2009). Empirically the current number of foreign-trained nurses in an area is strongly correlated with the lagged number of foreign-trained nurses in that area, which is consistent with the idea that current immigrant location choices depend on previous immigrant location choices. Besides cultural affinity, another explanation of this correlation is that information networks among foreign-trained nurses lowers the cost of job seeking and costs of moving to a new location. Given this network rationale for choosing a location to live and work, the exclusion restriction of the instrumental variables procedure is plausibly valid. The lagged number of foreign-trained nurses will be correlated with the total number of nurses because of immigrant network effects, but not unmeasured determinants of demand. As we show later, the first stage estimates (equation 2) of the association between the lagged number of foreign trained nurses and the total number of nurses indicate a sufficiently strong correlation to make the instrumental variables approach feasible.

The exclusion restriction would be violated if there was serial correlation in unmeasured factors that determine both wages and where foreign-trained nurses live. Evidence that this is not the case is found from estimates of a slightly reformulated specification of equation (2) that includes lags of the demand side variables (Z). We re-estimated equation (2) including 4-year lags of per capita hospital inpatient admissions (and its square) and per-capita hospital outpatient visits (and its square). A test of the joint significance of these lagged demand side variables could not reject the null hypothesis of no effect. Thus, there does not appear to be a correlation between lagged measures of determinants of demand and unmeasured, current determinants of the total number of nurses. Based on this result, we believe it is reasonable to assume that the same result would hold for the 4-year lag of the number of foreign-trained nurses, particularly because the location decisions of foreign-trained nurses will be motivated by factors unrelated to demand.

We also assessed the validity of the exclusion restriction by using the contemporaneous number of foreign-trained nurses and the 8-year lag of foreign-trained nurses as additional instruments and then testing the over identifying restrictions of the model. The over identification tests were carried out using the just identified model that included only the 4-year lag of the log number of foreign-trained nurses. The results of these tests indicated that we cannot reject the over identification restrictions when we use the 4-year and 8-year lags as instruments for the total number of nurses. However, tests associated with using the contemporaneous measure of the number of foreign-trained nurses were less positive. Tests statistics indicated that we could in fact reject the null of no effect at the approximately the 0.15 level of significance. These results are not surprising because the contemporaneous number of foreign-trained nurses is the least likely instrument to be valid, as unmeasured, contemporaneous demand factors may influence current location of foreign-nurses and the total number of nurses. As a result of these tests, we did not use the contemporaneous measure of foreign-trained nurses as an instrument.

Changes in immigration policy targeted at nurses (e.g., H1-C visas) during our period of analysis motivate alternative specifications of equation (2). For example, in 1989 immigration policy was changed to encourage immigration by nurses, and in 1995 it was changed again making it more difficult for a nurse to immigrate. Therefore, the association between lagged foreign-trained nurses and the total number of nurses may change over time. Accordingly, we allow for such possibilities by including interactions between lagged foreign-trained nurses and year. Similarly, different regions of the country may exert stronger or weaker pull on foreign-trained nurses because of the reasons given above as to what determines immigrant location choices. Thus, the association between lagged foreign-trained nurses and the total number of nurses may differ by region and year. We allow for

region by year differences in the first stage correlation by including interactions between lagged foreign-trained nurses and region and year.

In sum, the IV strategy is well suited to the purposes of our research, as it provides an estimate of the effect of a shift in supply of nurses due to immigration on wages (local average treatment effect-LATE), which is exactly our objective. Moreover, the exclusion restriction underlying the instrumental variables approach is plausible. We acknowledge, however, that instrumental variables estimates from equations (2) and (3) are not "structural" estimates because equation (2) omits some important determinants of demand for nurses that may be correlated with the supply of nurses such as the wages in other medical professions (physicians, nurses' aides, etc.). Therefore, IV estimates will capture the direct (structural) and indirect (e.g., factor substitution) effect of a change in nursing supply on nurses' wages and employment.[8]

Data

The National Sample Survey of Registered Nurses (NSSRN) is the most extensive and comprehensive survey of registered nurses in the US. It has been conducted approximately every four years since 1977.[9] Each survey has information on approximately 35,000 nurses from a universe of all licensed RNs. Information is collected by mail with telephone follow-ups over an eight month period from March to November (except in 1984). The response rates were high: 70 to 80 percent. For most analyses, we used data for 1988, 1992, 1996, 2000 and 2004. An important aspect of NSSRN is that it is representative of all persons who have an active license to practice as a registered nurse in the US including individuals who are retired, employed, but not in nursing, and not currently working. This sampling frame is important given our interest in the effect of nurse immigration on the labor market outcomes of all registered nurses. For other nationally representative datasets such as CPS or Census this is not the case, as these data provide information on a person's current occupation, but do not identify all registered nurses. Since about 17 percent of registered nurses do not work as nurses, the Census or the CPS underestimate the actual size of the nursing work force (Health Resources Service Administration, http://bhpr.hrsa.gov/healthworkforce/reports/rnpopulation/preliminaryfindings.htm).

The NSSRN is designed to provide accurate estimates of the number of nurses by state. The NSSRN is arguably the most appropriate source of data to compute the number of nurses, and the number of foreign-trained nurses, by state and year. For each state, we calculated the number of licensed RNs, which is our measure of the supply of nurses, and the number of licensed foreign-trained RNs. We used individual level weights provided in the NSSRN to calculate these quantities. We used all states, as the NSSRN is intended to provide accurate state-level estimates. In addition, because immigrants are geographically concentrated, for some analyses, we limited the sample to states where in 2000 at least five percent of the population was foreign born. This criterion resulted in a sample of 27 states.

The NSSRN provides information on whether a registered nurse received training in the US or in a foreign-country and the date she passed the US license exam to practice as registered nurse in the US. These data are employed to compute the number of foreign-trained nurses, number of US trained nurses, and the number of years since the RN received a license.

[8]Demand side variables, for example hospital admissions, may also be endogenous if wages determine costs, prices and thus demand for healthcare services. However, insurance coverage reduces the likelihood that this will be a problem, as most people pay a small fraction of the price of healthcare services. We view these demand side factors as stemming from underlying levels of illness or preferences for health and health care.

[9]The NSSRN is mandated by several federal laws: Title IX, Public Law 94-63, Nurse Training Act of 1975, Section 951; Section 806 (f) of Public Law 105–392, the Health Professions Education Partnerships Act of 1998; and Section 792 of the PHS Act.

The NSSRN contains information on several individual characteristics including age, gender, race/ethnic background, education, marital status and family size that are used as control variables. It also has information on whether an individual with an active RN license is working as a nurse, in another occupation, or whether she works at all. Among those who work in nursing it provides data on their annual salary, number of weeks worked last year and number of usual hours worked per week in the principal nursing job. We used data on annual earnings and hours worked to compute the hourly wage of RNs in the principal nursing position. In years other than 2004, the NSSRN also provides data on earnings, the number of hours and weeks a RN worked in all other nursing jobs (other than the principal nursing job). Thus, using data from 1988 to 2000, we constructed an alternative measure of annual earnings that pertains to all nursing positions. Approximately 10 percent of the sample holds more than one nursing job. We present results for this alternative measure of earnings in an appendix.

Data on the state unemployment rates are taken from the Bureau of Labor Statistics and data on the state per-capita income come from the Bureau of Economic Analysis, and are merged with the micro-level NSSRN data.[10] Data on proportion of the state population over age 65, and the proportion of the state population that is black are taken from the Bureau of Economic Analysis. The Area Resource File (ARF) is used to obtain information about the number of hospital inpatient days and number of hospital outpatient visits, which are important demand side determinants of the number and wages of nurses. Appendix Table 1 reports the description of the outcomes of interest for state samples.

Results

The first results we present are estimates of equation (2), which represents the first stage of the instrumental variables procedure. Estimates from this model are partial correlations between the instruments and the (log) total number of nurses in a state. We used several instruments individually and in combination. Table 1 presents these estimates, and column headings indicate which instrument, or instruments, are used, and whether demand side variables are included as controls. All models include the log of working age population in the state, and state and year effects. Additional controls for demand side determinants of the number of nurses are: the proportion of population that is elderly, the proportion of population that is black, population growth, per-capita income, the unemployment rate, the per capita number of hospital inpatient days (and its square), and the per capita number of hospital outpatient visits (and its square). All models are estimated using weighted least squares regressions where the weights are the state population.

The first column of Table 1 reports estimates of the partial correlation between the 4-year lag of the log number of foreign-trained nurses and the log of the total number of nurses. Estimates indicate that a 100 percent increase in the number of foreign-trained nurses is associated with between a 1.9 and 2.3 percent increase in the total number of nurses. These estimates are reasonable given that foreign-trained nurses represent approximately 3.6 percent of the total number of nurses in our sample. As expected, adding controls for demand side factors reduces the estimate, but only modestly. These estimates imply that an inflow of foreign-trained nurses significantly increased the total number of nurses, although there was some displacement of US-trained nurses in response to immigration. Point estimates suggest that for every two immigrant nurses that arrive in a state, approximately one US nurse leaves the state or the nursing occupation. Notably, controlling for demand side factors that are significantly related to the total number of nurses does not eliminate the positive association between the number of foreign-trained nurses and the total number of

[10]Preliminary analyses also included lags and leads of these variables, but the addition of these variables made no difference.

nurses. While estimates suggest that increases in demand are associated with both an increase in the total number of nurses and the number of foreign-trained nurses, there remains a large, significant and positive association between the total number of nurses and the number of foreign-trained nurses net of demand shifts. The partial F-statistic (or equivalently the T-statistic squared) listed at the bottom of Table 1 is 14.4 and indicates that the first stage correlation for this instrument is modest and on the margin in terms of concern that the instrument is "weak." We discuss this again when we review the second stage estimates.

The second column of Table 1 presents results from a model that uses the 4- and 8-year lag of the log number of foreign-trained nurses. The estimate for the 4-year lag is 0.019 and is similar to the previous column, but the estimate for the 8-year lag is virtually zero. Consistent with the insignificance of the 8-year lag, the joint F-test for the two instruments is smaller and somewhat less significant than when only the 4-year lag is used as an instrument.

The last two columns present estimates from models that allow the association between the 4-year lag of the log number of foreign-trained nurses and the log of the total number of nurses to differ by year, and by year and region. Estimates in column (3) indicate that the association between the lagged number of foreign-trained nurses and all nurses becomes less positive in later years, particularly in 2000 and 2004. The F-statistic associated with the excluded instruments is 6.6, which is modest in magnitude. The last column of Table 1 presents only the main effect of the 4-year lag of the log of foreign-trained nurses, and estimates of the 19 interactions between region (5) and year (4) are not shown. The key statistic for this model is the partial F for the excluded instruments; it is 4.7, which is a borderline value in terms of a weak instrument test.

We re-estimated models in Table 1 using two alternative samples of states: in one case, we dropped CA, FL and TX, and in the other we used 27 states that had a foreign-born population greater than 5 percent. Dropping CA, Fl, and TX was motivated by concerns that large states with multiple population centers may not be appropriate definitions of the labor market for nurses despite the state licensing requirement. The second sample was motivated by the fact that immigrants are not evenly distributed across the country, but instead concentrate in several states. Results for these two samples are presented in Appendix Tables 2 and 3. For both samples, results are very similar to those presented in Table 1. The 4-year lag of the log number of foreign-trained nurses is significantly correlated with the log of the total number of nurses. The 8-year lag of the log number of nurses is not significantly correlated with the log of the total number of nurses. In addition, the association between the 4-year lag of the log number of foreign-trained nurses and the log of the total number of nurses differs by year, and by year and region.

Overall, estimates in Table 1 (and Appendix Tables 2 and 3) suggest that immigration of nurses increased the supply of nurses in a state, although there was some displacement of domestic nurses, which is a result that is consistent with other research based on the area approach (Peri and Sparber 2010).[11] However, the strength of the association between the lagged number of foreign-trained nurses and the total number of nurses is modest. Based on conventional assessment standards (e.g., partial F-statistic > 10), these modest associations are an indication of a weak instrument problem, which may result in significant bias of instrumental variables estimates.

[11]Displacement could occur through migration, or through failing to renew (or obtain) a nursing license.

We now turn to assessing the association between the (log) number of nurses and the (log) wages for the principal nursing job of US-trained nurses. Estimates are presented in Table 2. OLS estimates indicate that a 100 percent increase in the log number of nurses is associated with a statistically significant 9.1 percent decrease in wages when controls for demand side factors are included in the model. Notably, controlling for determinants of demand, which should make estimates more negative under the assumption that unmeasured factors increase demand for nurses (and therefore the quantity of nurses), makes estimates less negative. IV estimates of the association between the log number of nurses and log wages are more varied ranging from −0.182 to 0.07 in models that control for determinants of demand. In addition few IV estimates are statistically significant. Finally, estimates do not differ substantially by sample, as estimates obtained using all states do not differ much from estimates obtained from the other two samples.

Table 3 presents estimates of the association between the log number of nurses and the log of annual earnings. It has the same format as Table 2. Here too, OLS estimates indicate that an increase in the log number of nurses is associated with a decrease in earnings; a 100 percent increase in the number of nurses is associated with a statistically significant 12 percent decrease in annual earnings in models that control for determinants of demand. IV estimates are almost always negative, often statistically significant, and quite uniform in magnitude. While estimates are not independent because of the overlap across samples, estimates using different instruments are largely the same. In general, IV estimates indicate that a 100 percent increase in the number of nurses is associated with approximately a 20 percent decrease in annual earnings. In Appendix Table 4, we report estimates of the association between the log number of nurses and annual earnings in all nursing positions, as opposed to earnings in only the principal nursing position as in Table 3. Approximately 10 percent of nurses hold more than one position. Estimates in Appendix Table 4 are very similar to those in Table 3. All IV estimates from models that include controls for determinants of demand are negative and magnitudes of estimates are similar to those in Table 3 ranging from −0.56 to −0.09.

To summarize, IV estimates in Table 2 do not provide clear evidence of the effect of immigration on US-trained nurses' wages and annual earnings. With respect to wages, IV estimates from models that control for determinants of demand are between −0.184 and 0.085, which is suggestive of no association. In the case of annual earnings, IV estimates are almost always negative and range from −0.393 to −0.124, and but only 1 in 4 are statistically significant. In the case of annual earnings, it is also noteworthy that the IV estimates are always more negative when determinants of demand are included in the model than when they are excluded, and larger than OLS estimates, which is again expected if the supply of nurses is endogenous because of unmeasured determinants of demand. However, the relative imprecision of the IV estimates limits our ability to draw firm conclusions, and the inconsistency of the wage and annual earnings results, while potentially due to measurement error in constructing wages using annual earnings divided by hours, makes it prudent to draw only tentative conclusions even in the case of annual earnings. Our reading of the evidence is that it indicates that immigration of foreign-trained nurses may have reduced the annual earnings of U.S. nurses and that the elasticity of annual earnings with respect to immigration is approximately −0.1 if we assume a two-to-one relationship between the arrival of a foreign-trained nurse and the total number of nurses, which is consistent with estimates in Table 1.

The next analysis we conducted was to investigate whether an increase in foreign-trained nurses was associated with a change in employment status. If immigration increased the supply of nurses and adversely affected wages in nursing, then nurses may move to other professions, or out of the labor force (Peri and Barber 2009). Indeed, such changes may limit

the (observed) adverse wage effects of immigration; domestic nurses with the best outside (nursing) labor market opportunities could switch occupation, which would reduce any effect of immigration on wages of nurses. The empirical approach for this analysis is the same as that for wages: we obtain OLS and IV estimates of the association between the total number of (licensed) nurses and the probability of being employed as a nurse. The dependent variable in this analysis equals one if a nurse is employed in nursing and zero otherwise (employed, but not in nursing, or not employed).

OLS estimates in Table 4 are negative, relatively small (less than seven percent of mean) and not statistically significant. IV estimates are more mixed and do not point to a systematic association. Most IV estimates are relatively small and none are statistically significant. Overall, we conclude that immigration has not induced a significant (i.e., relatively large) shift out of nursing by US nurses. We also examined the effect of immigration of foreign-trained nurses on hours of work per year (results not reported). IV estimates from these analyses indicated that the increased supply of nurses due to immigration was unrelated to hours of work per year of US nurses.

Conclusion

In this paper, we find substantial evidence that immigration by foreign-trained nurses increased the supply of nurses in labor markets defined by state boundaries. This increase in supply is associated with a decrease in annual earnings. Estimates suggested that a 10 percent increase in the total number of nurses due to immigration was associated with a one to four percent decrease in annual earnings, although estimates were not always significant. In contrast, estimates provided little evidence that the increase in supply was associated with wages or the probability of not working as a nurse. While there was much consistency in IV estimates of the association between immigration induced increases in the total number of nurses and annual earnings, the absence of similar evidence for wages and the weakness of our instruments limits our ability to draw definitive conclusions. It is possible that measurement error in wages, which depends on self-reported measures of annual earnings, weeks worked per year and hours worked per week, may explain the absence of greater evidence of an effect of immigration on wages. However, an alternative explanation of the pattern of results is weak instrument bias (Bound et al. 1995; Stock and Yogo 2005). The partial F-statistics for the instruments in first stage regressions were modest and in the range (e.g., F-statistics ranging from 6 to 10) where the bias due to weak instruments may be problematic.

Our results suggest that using immigration policy to solve the current and expected “shortage” of nurses may adversely affect the earnings of US-trained nurses, although the evidence was at best suggestive. While lowering the cost of healthcare may be viewed as a positive outcome given the current concern over the rising costs of healthcare, achieving such a reduction in costs through importing lower-priced, skilled labor will be at the expense of skilled US workers—in this case nurses. Moreover, because the quality of patient care is difficult to observe and measure, there is the additional question of whether immigrant nurses are of the same quality as domestic nurses and whether patient care is being affected by the immigration. This is an area for future research.

Our results are consistent with other studies of the effect of immigration on wages and earnings that used the area approach (see among others Card 2009 for a review). Borjas (2003) provides a summary of previous findings:

> “The measured impact of immigration on the wage of native workers fluctuates widely from study to study (and sometimes even within the same study), but seems to cluster around zero.” (Borjas 2003, p. 1335)

While Borjas' quote seems apt for our results with respect to wages, we conclude somewhat more in favor of a modest, negative effect of immigration on nurses' earnings. However, the inconsistency of findings with respect to the effect of immigration of foreign-trained nurses on US nurses' wages and annual earnings is not easily explained and justifies our cautious conclusion.

Our narrow focus had some advantages over previous work. First, we were able to identify workers directly affected by immigration. Second, we had relatively good measures of the determinants of demand for workers that could help identify supply shifts. Third, firms in the health care industry have less ability to significantly alter the production of services given regulatory and institutional constraints. While our approach yielded similarly mixed findings as much of the previous research, this narrower approach may be a productive way to proceed given the empirical problems that characterize studies of broader groups of immigrants.

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Table 1

Estimates of the Association between the (log) Number of Nurses and the (log) Number of Foreign-trained Nurses

	4-Year Lag Model		4- and 8-Year Lag	4-Year Lag by Year	4-Year Lag by Yr. by Region
	No Demand Variables	**Demand Variables**	**Demand Variables**	**Demand Variables**	**Demand Variables**
Log Foreign-trained Nurses					
4-year Lag Log Foreign-trained Nurses	0.023*** (0.007)	0.019*** (0.005)	0.019*** (0.006)	0.023*** (0.007)	−0.012 (0.024)
8-year Lag log Foreign-trained Nurses			0.000 (0.006)		
4-year Lag Log Foreign-trained *1992				−0.001 (0.005)	Estimates For 19
4-year Lag Log Foreign-trained *1996				−0.004 (0.006)	Interactions Not Shown
4-year Lag Log Foreign-trained * 2000				−0.016*** (0.006)	
4-year Lag Log Foreign-trained * 2004				−0.025*** (0.006)	
Log Working Age Population	0.900*** (0.092)	0.646*** (0.019)	0.646*** (0.019)	0.670*** (0.019)	0.682*** (0.021)
Inpatient Admissions (per capita)		0.233** (0.110)	0.232** (0.111)	0.199* (0.108)	0.172 (0.106)
Inpatient Admissions, Squared		−0.053 (0.033)	−0.053 (0.033)	−0.048 (0.032)	−0.025 (0.030)
Outpatient Visits (per capita)		0.243*** (0.078)	0.243*** (0.078)	0.232*** (0.073)	0.140** (0.065)
Outpatient Visits, Squared		−0.044*** (0.014)	−0.044*** (0.014)	−0.047*** (0.014)	−0.029** (0.012)
F-statistic of Test of Joint Significance of Excluded Instruments (p-value)	10.8*** (0.001)	14.4*** (0.000)	6.6*** (0.002)	6.6*** (0.000)	4.7*** (0.000)
F-statistic of Test of Joint Significance of Inpatient and Outpatient Variables (p-value)		4.5*** (0.002)	4.5*** (0.002)	3.6***. (0.007)	2.7** (0.030)
F-statistic of Test of Joint Significance of All Demand Variables (p-value)		12.2*** (0.000)	12.0*** (0.000)	11.4*** (0.000)	10.0*** (0.000)

Notes: Figures in each column are based on a single regression with the (log) number of nurses as the dependent variable. Each regression includes controls for year and state effects (estimates not shown). To conserve space, estimates for the following demand side variables are also not shown: proportion elderly, proportion black, unemployment rate, per-capita income, and population growth (4-year change). Regressions are weighted by state population. Sample size is 255.

** 0.01<p=<0.05,

*** p=<0.01.

Table 2

Estimates of the Association between (log) Wage in Principal Nursing Position of US-trained Nurses and (log) Number of Nurses

	All States				Excluding CA, FL, TX		States >5% Foreign Population	
Log Wages	**OLS No Demand Variables**	**OLS Demand Variables**	**IV No Demand Variables**	**IV Demand Variables**	**IV No Demand Variables**	**IV Demand Variables**	**IV No Demand Variables**	**IV Demand Variables**
Log Number of Nurses	−0.161*** (0.035)	−0.091*** (0.037)						
Instrument: 4-Year Lag Log Number Foreign-trained Nurses			−0.016 (0.106)	0.071 (0.122)	0.019 (0.114)	0.088 (0.139)	0.214 (0.232)	0.085 (0.186)
Instrument: 4- and 8-Year Lags Log Number Foreign-trained Nurses			−0.039 (0.109)	0.065 (0.121)	−0.003 (0.112)	0.083 (0.138)	0.201 (0.211)	0.083 (0.186)
Over ID Test: Coefficient, (T-statistic), and [p-value] on 8 Yr Lag Log Num. Foreign-trained Nurses			−0.002 [0.415]	−0.002 [0.472]	−0.001 [0.686]	−0.001 [0.782]	−0.001 [0.874]	0.005 [0.274]
Instrument: 4-Year Lag Log Number Foreign-trained Nurses by Year			−0.161** (0.065)	−0.091 (0.092)	−0.227*** (0.061)	−0.205*** (0.093)	0.115 (0.160)	0.029 (0.128)
Instrument: 4-year lag Log Number Foreign Nurses by Year by Region			−0.243 (0.168)	−0.182*** (0.063)	−0.255*** (0.096)	−0.184*** (0.062)	−0.224 (0.146)	−0.184 (0.268)
Number of Observations	122796		122796		109220		69709	
Mean Wage	20.54		20.54		20.22		21.82	

Notes: Figures in each cell are based on a single regression. Each regression includes controls for: respondent's age, education, gender, whether white, marital status, years since received nursing license, year and state effects, state unemployment rate, per-capita income, proportion elderly, proportion black, population growth (4-year change), hospital admissions per-capita (and its square) and outpatient visits per capita (and its square). Regressions are weighted by individual weight. Murphy-Topel standard errors that account for clustering at state-year level are in parentheses.

** 0.01<p=<0.05,

*** p=<0.01.

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Table 3

Estimates of the Association between (log) Annual Earnings in Principal Nursing Position of US-trained Nurses and (log) Number of Nurses

	All States				Excluding CA, FL, TX		States >5% Foreign Population	
Log Annual Earnings	**OLS No Demand Variables**	**OLS Demand Variables**	**IV No Demand Variables**	**IV Demand Variables**	**IV No Demand Variables**	**IV Demand Variables**	**IV No Demand Variables**	**IV Demand Variables**
Log Number of Nurses	−0.194*** (0.035)	−0.118*** (0.043)						
Instrument: 4-Year Lag Log Number Foreign-trained Nurses			−0.179 (0.149)	−0.198 (0.196)	−0.183 (0.164)	−0.219 (0.194)	−0.244 (0.359)	−0.393 (0.264)
Instrument: 4- and 8-Year Lags Log Number Foreign-trained Nurses			−0.183 (0.149)	−0.200 (0.177)	−0.162 (0.154)	−0.212 (0.196)	−0.330 (0.318)	−0.389 (0.264)
Over-ID Test: Coefficient and [p-value] on 8-Yr Lag Log Num. Foreign-trained Nurses			0.000 [0.885]	0.001 [0.746]	0.001 [0.644]	0.001 [0.715]	−0.008 [0.252]	−0.013* [0.056]
Instrument: 4-Year Lag Log Number Foreign-trained Nurses by Year			−0.185*** (0.081)	−0.124 (0.117)	−0.308*** (0.088)	−0.281*** (0.133)	−0.015 (0.189)	−0.194 (0.141)
Instrument: 4-year lag Log Number Foreign Nurses by Year by Region			−0.294 (0.281)	−0.263*** (0.072)	−0.330** (0.153)	−0.300*** (0.076)	−0.250 (0.153)	−0.272 (0.279)
Number of Observations	121376		121376		108013		68819	
Mean Annual Earnings	40060		40060		39399		42114	

Notes: Figures in each cell are based on a single regression. Each regression includes controls for: respondent's age, education, gender, whether white, marital status, years since received nursing license, year and state effects, state unemployment rate, per-capita income, proportion elderly, proportion black, population growth (4-year change), hospital admissions per-capita (and its square) and outpatient visits per capita (and its square). Regressions are weighted by individual weight. Murphy-Topel standard errors that account for clustering at state-year level are in parentheses.

** 0.01<p=<0.05,

*** p=<0.01.

Table 4

Estimates of the Association between the Probability of being Employed in Nursing (versus employed in other occupation or not employed) and (log) Number of Nurses

	All States				Excluding CA, FL, TX		States >5% Foreign Population	
	OLS No Demand Variables	**OLS Demand Variables**	**IV No Demand Variables**	**IV Demand Variables**	**IV No Demand Variables**	**IV Demand Variables**	**IV No Demand Variables**	**IV Demand Variables**
Log Number of Nurses	−0.022 (0.025)	−0.044 (0.028)						
Instrument: 4-Year Lag Log Number Foreign-trained Nurses			−0.121 (0.083)	−0.062 (0.079)	−0.079 (0.072)	−0.059 (0.088)	−0.236 (0.166)	−0.034 (0.107)
Instrument: 4- and 8-Year Lag Log Number Foreign-trained Nurses			−0.116* (0.066)	−0.062 (0.077)	−0.073 (0.060)	−0.060 (0.085)	−0.213 (0.147)	0.033 (0.107)
Over ID Test: Coefficient, (T-statistic), and [p-value] on 8-Yr Lag Log Num. Foreign-trained Nurses			0.000 [0.848]	−0.000 [0.938]	0.000 [0.879]	−0.000 [0.942]	0.002 [0.697]	0.004 [0.242]
Instrument: 4-year lag Log Number Foreign Nurses by Year			−0.110* (0.064)	−0.003 (0.046)	0.011 (0.034)	−0.011 (0.059)	−0.131 (0.135)	−0.100 (0.081)
Instrument: 4-year lag Log Number Foreign Nurses by Year by Region			0.004 (0.214)	−0.039 (0.046)	0.019 (0.095)	0.070 (0.064)	−0.033 (0.084)	−0.067 (0.084)
Number of Observations	151831		151831		134609		86933	
Mean Annual Earnings	0.87		0.87		0.87		0.86	

Notes: Figures in each cell are based on a single regression. Each regression includes controls for: respondent's age, education, gender, whether white, marital status, years since received nursing license, year and state effects, state unemployment rate, per-capita income, proportion elderly, proportion black, population growth (4-year change), hospital admissions per-capita (and its square) and outpatient visits per capita (and its square). Regressions are weighted by individual weight. Murphy-Topel standard errors that account for clustering at state-year level are in parentheses.

** 0.01<p=<0.05,

*** p=<0.01.

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Appendix Table 1

Summary Statistics: NSSRN 1988, 1992, 1996, 2000, 2004

	All State	States with >5% Foreign-born Population
Average Number of US born Nurses/state	48760 (50190)	62002 (57698)
Average Number of Foreign-trained Nurses/state	1977 (4032)	3105 (5202)
Average Number of Foreign-trained Nurses, lagged by four years/state	1685 (3775)	2909 (4867)
Average Log Number of US born Nurses/state	10.28 (1.07)	10.51 (1.16)
Average Lagged Log Foreign-trained Nurses/state	6.00 (1.76)	6.84 (1.77)
Log Working Age Population/state	14.44 (1.03)	14.72 (1.07)
Proportion of Population Elderly	0.13 (0.02)	0.12 (0.23)
Proportion of Population Black	0.11 (0.12)	0.06 (0.05)
Unemployment Rate	5.30 (1.65)	5.42 (1.64)
Per-capita Income ($10,000s)	2.42 (0.69)	2.61 (0.72)
Population Growth (4-Year Change)	0.04 (0.04)	0.06 (0.05)
Inpatient Admissions (per capita)	1.07 (0.43)	1.02 (0.51)
Outpatient Visits (per capita)	2.02 (0.68)	1.95 (0.68)

Note: Figures in parenthesis correspond to standard errors.

Appendix Table 2

Estimates of the Association between the (log) Number of Nurses and the (log) Number of Foreign-trained Nurses All States Except California, Florida and Texas

	4-Year Lag Model Demand Variables	4- and 8-Year Lag Demand Variables	4-Year Lag by Year Demand Variables	4-Year Lag by Year by Region Demand Variables
Log Foreign-trained Nurses				
4-year Lag Log Foreign-trained Nurses	0.016*** (0.005)	0.016*** (0.005)	0.020*** (0.007)	−0.009 (0.024)
8-year Lag log Foreign-trained Nurses		0.001 (0.005)		
4-year Lag Log Foreign-trained *1992			0.004 (0.006)	Estimates For 19
4-year Lag Log Foreign-trained *1996			−0.006 (0.006)	Interactions Not Shown
4-year Lag Log Foreign-trained * 2000			−0.011 (0.007)	
4-year Lag Log Foreign-trained * 2004			−0.020*** (0.007)	
Log Working Age Population	0.667*** (0.020)	0.667*** (0.020)	0.674*** (0.020)	0.712*** (0.023)
Inpatient Admissions (per capita)	0.353*** (0.103)	0.352*** (0.104)	0.243** (0.101)	0.128 (0.106)
Inpatient Admissions, Squared	−0.060** (0.030)	−0.060** (0.030)	−0.050* (0.029)	−0.005 (0.030)
Outpatient Visits (per capita)	0.164** (0.080)	0.163** (0.080)	0.182** (0.079)	0.117* (0.067)
Outpatient Visits, Squared	−0.034** (0.015)	−0.034** (0.015)	−0.039*** (0.015)	−0.025* (0.013)
F-statistic of Test of Joint Significance of Exc. Instruments (p-value)	10.2*** (0.002)	5.3*** (0.006)	4.1*** (0.001)	5.4*** (0.000)
F-statistic of Test of Joint Significance of Inpatient and Outpatient Vars. (p-value)	6.4*** (0.0001)	6.3*** (0.000)	4.0***. (0.005)	2.7*** (0.000)
F-statistic of Test of Joint Significance of All Demand Variables (p-value)	13.3*** (0.000)	13.1*** (0.000)	9.1*** (0.000)	5.3*** (0.000)

Notes: Figures in each column are based on a single regression with the (log) number of nurses as the dependent variable. Each regression includes controls for: state unemployment rate, per-capita income, proportion elderly, proportion black, and population growth (4-year change), and state and year effects. Regressions are weighted by state population. Sample size is 240.

** 0.01<p=<0.05,

*** p=<0.01.

Appendix Table 3

Estimates of the Association between the (log) Number of Nurses and the (log) Number of Foreign-trained Nurses States with Foreign Population Greater than 5%

	4-Year Lag Model Demand Variables	4- and 8-Year Lag Demand Variables	4-Year Lag by Year Demand Variables	4-Year Lag by Year by Region Demand Variables
Log Foreign-trained Nurses			0.047*** (0.013)	−0.042 (0.032)
4-year Lag Log Foreign-trained Nurses	0.031*** (0.012)	0.031** (0.013)		
8-year Lag log Foreign-trained Nurses		−0.000 (0.014)		
4-year Lag Log Foreign-trained *1992			−0.002 (0.009)	Estimates For 19
4-year Lag Log Foreign-trained *1996			−0.002 (0.010)	Interactions Not Shown
4-year Lag Log Foreign-trained * 2000			−0.019** (0.008)	
4-year Lag Log Foreign-trained * 2004			−0.018** (0.009)	
Log Working Age Population	0.958*** (0.123)	0.959*** (0.124)	0.805*** (0.123)	0.885*** (0.112)
Inpatient Admissions (per capita)	0.187 (0.172)	0.186 (0.176)	0.261 (0.179)	0.261 (0.179)
Inpatient Admissions, Squared	−0.053 (0.034)	−0.053 (0.035)	−0.058* (0.034)	−0.058* (0.034)
Outpatient Visits (per capita)	0.221** (0.086)	0.221** (0.088)	0.193** (0.082)	0.193** (0.082)
Outpatient Visits, Squared	−0.034** (0.016)	−0.034** (0.017)	−0.031** (0.016)	−0.031** (0.016)
F-statistic of Test of Joint Significance of Exc. Instruments (p-value)	6.7*** (0.010)	3.4** (0.04)	3.1*** (0.01)	10.0*** (0.00)
F-statistic of Test of Joint Significance of Inpatient and Outpatient Vars. (p-value)	2.7** (0.03)	2.6** (0.04)	2.3** (0.06)	1.0 (0.41)
F-statistic of Test of Joint Significance of All Demand Variables (p-value)	4.7*** (0.00)	4.7*** (0.000)	6.6*** (0.000)	2.9*** (0.000)

Notes: Figures in each column are based on a single regression with the (log) number of nurses as the dependent variable. Each regression includes controls for: state unemployment rate, per-capita income, proportion elderly, proportion black, and population growth (4-year change), and state and year effects. Regressions are weighted by state population. Sample size is 135.

** 0.01<p=<0.05,

*** p=<0.01

Appendix Table 4

Estimates of the Association between (log) Annual Earnings in All Nursing Positions and (log) Number of Nurses

	All States				Excluding CA, FL, TX		States >5% Foreign Population	
Log Annual Earnings	**OLS No Demand Variables**	**OLS Demand Variables**	**IV No Demand Variables**	**IV Demand Variables**	**IV No Demand Variables**	**IV Demand Variables**	**IV No Demand Variables**	**IV Demand Variables**
Log Number of Nurses	−0.153*** (0.036)	−0.100*** (0.041)						
Instrument: 4-Year Lag Log Number Foreign-trained Nurses			−0.134 (0.152)	−0.360 (0.225)	−0.173 (0.172)	−0.468* (0.260)	−0.133 (0.507)	−0.555 (0.415)
Instrument: 4- and 8-Year Lags Log Number Foreign-trained Nurses			−0.138 (0.154)	−0.367 (0.266)	0.169 (0.171)	−0.489* (0.261)	−0.260 (0.399)	−0.559 (0.390)
Over ID Test: Coefficient, (T-statistic), and [p-value] on 8-Yr Lag Log Num. Foreign-trained Nurses			−0.000 [0.836]	0.002 [0.910]	0.000 [0.906]	−0.001 ([.812]	−0.006 [0.633]	0.001 [0.993]
Instrument: 4-Year Lag Log Number Foreign-trained Nurses by Year			−0.172* (0.073)	−0.087 (0.138)	−0.305*** (0.088)	−0.560*** (0.204)	0.049 (0.187)	−0.155 (0.146)
Instrument: 4-year lag Log Number Foreign Nurses by Year by Region			−0.210 (0.242)	−0.152 (0.113)	−0.267** (0.133)	−0.255*** (0.084)	−0.100 (0.228)	−0.155 (0.164)
Number of Observations	95424	95424	95424	95424	85042	85042	54111	54111
Mean Annual Earnings	39751	39751	39751	39751	39062	39062	41798	41798

Notes: : Figures in each cell are based on a single regression. Each regression includes controls for: respondent's age, education, gender, whether white, marital status, years since received nursing license, year and state effects, state unemployment rate, per-capita income, proportion elderly, proportion black, population growth (4-year change), hospital admissions per-capita (and its square) and outpatient visits per capita (and its square). Regressions are weighted by individual weight. Murphy-Topel standard errors that account for clustering at state-year level are in parentheses.

** 0.01<p=<0.05,

*** p=<0.01.