Effect of Immigrant Nurses on Labor Market Outcomes of US Nurses

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August 2009

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Funding for this research was provided by grants from NICHD (1R01HD056512-01A2) and the Russell Sage Foundation.

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Abstract

We study the effect of immigration of foreign-trained registered nurses (RNs) on the employment and wages of domestic RNs. We use the "area" approach and study effects of immigration in local labor markets defined by county or PMSA. Our analysis suggests that immigration of foreign-trained nurses significantly increases the overall supply of nurses in an area, but these increases in supply have little effect on the wages and employment of domestic nurses.

Introduction

It is widely believed that there is a severe nursing shortage in the US and that it is likely to worsen in the next decade.[1] To address this and similar shortages in the past, the government has eased immigration restrictions on foreign-trained nurses. As a result, the proportion of foreign-trained nurses in the US has fluctuated in ways consistent with the easing (or tightening) of immigration policy. The latest data available indicate an upward trend; the proportion of foreign-trained among newly licensed registered nurses has almost tripled from approximately five percent in 1998 to 15 percent in 2003 (Brush et al., 2004).

All discussions of the current 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

[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 823,400 nurses by 2020 (available at http://bhpr.hrsa.gov/nursing/, last visited 8/25/09).

(Immigration Nursing Relief Advisory Committee, 1995; Schumaker, 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; Borjas, 2003; Borjas and Katz, 2005 for most 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 wage of domestic nurses, as some advocates claim, the domestic supply of nurses will shrink and, at least in the short run, exacerbate the apparent nurse shortage and worsen the supposed consequences of the shortage such as poor quality patient care.[2] In fact, the widespread use of administered prices in health care (e.g., Medicare and Medicaid) may encourage hospitals and other providers to (seek) substitute low-paid immigrant nurses for high-paid domestic nurses. This may be harmful not only to domestic nurses, 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

[2] 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.

of the same quality as U.S. trained nurses then only domestic nurses will be harmed by immigration.

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.[3] The nursing context provides a particularly advantageous setting to study the effect of immigrants on native workers. First, it is easy to identify the native workers most affected by foreign-trained nurses: US-trained RNs. Therefore, the level of competition between immigrants and natives within such a narrowly defined occupation category is unquestionably high. Second, it is easier to adjust for demand side shocks when focusing on one industry. Variables that affect demand for nurses (e.g. hospital level demand variables, demographic factors that affect the healthcare sector and economic trends) are available and relatively easy to measure. Studies of broader groups of immigrants face much more difficulty adjusting for potential demand side confounders. Third, health care is a highly regulated service industry (e.g., minimum staffing ratios) and there is arguably more limited scope for firms (e.g., hospitals) to adjust to changes in immigration (supply of labor) by altering the production process and exporting output or services.

To accomplish our empirical objectives, we used data from several years of the National Sample Survey of Registered Nurses (NSSRN), 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 to define the precise group of nurses affected by immigration because a sixth of all licensed registered nurses work in occupations other than nursing. Our results indicate that immigration of foreign-trained nurses increases the supply of

[3] 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.

nurses in local labor markets, but these increases in supply have little (no) effect on the wages and employment of domestic nurses. This finding is consistent with those in the broader literature (see Card, 2005) and with the only two other studies to consider this question specifically in the context of nursing (Immigration Nursing Relief Advisory Committee, 1995; Schumaker, 2008).

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 the assumption that counties, or Primary Metropolitan Statistical Areas (PMSAs), are separate labor markets and that RN wages are determined by supply and demand factors in those markets, or what has become known as the "area approach." Immigration of nurses to a county (PMSA) represents a shift (increase) in the supply of nurses in that market. We use two different definitions of the labor market because no single definition is perfect; for example, county may be too small and PMSA may be too large. In short, the correct definition of the nursing labor market is not clear and thus, we use two definitions to assess how sensitive estimates are to this choice.

We specify the following regression model for wages:

$$W_{ijt} = \alpha_j + \beta_t + \delta(N_{jt}/P_{jt}) + \gamma Z_{jt} + \pi X_i + v_{ijt}$$

(1) $i = 1,...,N$ (persons)
$j = 1,...,N$ (county/PMSA)
$t = 1988, 1992, 1996, 2000$

In equation (1), W_{ijt} is the log hourly wage of a US-trained registered nurse living in county (or PMSA) j in year t. We assume that log wages are a function of the proportion of registered nurses in the working age population (N_{jt}/P_{jt}) in county (PMSA) j, individual characteristics (X_{jt})

and demand side factors (Z_{jt}) specific to county (PMSA) j. Individual characteristics include: age, sex, marital status, education (dummy variables indicating whether she has a diploma, an Associate degree, a BA degree, MA or higher education 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 admissions (and its square), the proportion of persons that are elderly, proportion of persons that are black, per capita income and the unemployment rate.[4] The parameters α_j and β_t denote county (or PMSA) and year fixed effects. A similar model is estimated for the probability of employment: employed in nursing, employed outside of nursing, and not employed.

One potential problem with estimating equation (1) is that the size of nursing labor force in an area (N_{jt} / P_{jt}) may be endogenous. There may be unobserved demand variables correlated with the size of labor force that may bias estimates. To partly address this issue, we include controls for demand side factors.[5] In addition, we use an instrumental variables (IV) procedure to address this problem. We instrument for the proportion of nurses in the working age population using the proportion of foreign-trained nurses in the working population. The assumption is that foreign-trained nurses represent an exogenous shift in supply (conditional on other covariates). The IV model is:

[4] Preliminary analyses included a larger set of demand side variables including per capita in-patient days in short term general hospitals, per capita in-patient days in long term general hospitals, per capita Medicare in-patient days in short term general hospitals, per capita Medicare in-patient days in non-general long term hospitals, average hospital size (total beds/number of hospital), and number of hospitals. Results using this larger set of variables are very similar to those reported in the text.

[5] These factors 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.

(2) $N_{jt} / P_{jt} = \rho_j + \sigma_t + \mu Z_{jt} + \lambda(IM_{jt} / P_{jt}) + \kappa X_i + u_{jt}$

(3) $W_{ijt} = \alpha_j + \beta_t + \delta(\frac{\hat{N}_{jt}}{P_{jt}}) + \gamma Z_{jt} + \pi X_i + v_{ijt}$

In equation (2), the proportion of nurses in the working age population in county j in year t is a function of the proportion of foreign-trained nurses (IM_{jt} / P_{jt}) in county j in year t, which is the instrument. Equation (2) is estimated using individual level data.[6] It is the first stage used to predict the (supply) proportion of nurses in the working age population that is used in equation (3) and denoted by $(\frac{\hat{N}_{jt}}{P_{jt}})$.

We also estimate the direct effect of immigration on the wage of US-trained nurses using a reduced form model, as specified in equation (4).

(4) $W_{ijt} = \tilde{\alpha}_j + \tilde{\beta}_t + \tilde{\delta}(\frac{IM_{jt}}{P_{jt}}) + \tilde{\gamma} Z_{jt} + \tilde{\pi} X_i + \tilde{v}_{ijt}$

We use the symbol ~ to denote a reduced form parameter. We use the terminology of reduced form loosely because we do not estimate a structural model. For example, equation (1) omits some important determinants of demand for nurses that are likely to be correlated with the supply of nurses such as the wages in other medical professions (physicians, nurses' aides, etc.). In this sense, equation (1) is a reduced form model too. Thus, our use of the term reduced form in referring to equation (4) is simply intended to denote that we are measuring the effect of

[6] Individual level data was used to estimate equation (2) even though the proportion of nurses in the working age population and proportion of foreign-trained nurses in the working age population vary only by county (PMSA) and year. Thus all observations in an area have the same value of these two variables. This was done to facilitate the IV estimation and construction of standard errors. Standard errors are obtained assuming that observations with an area-year unit are not independent. However, we also estimated the model in an alternative two-step fashion. We estimated equation (2) using aggregate data (excluding individual level covariates) to derive the predicted proportion of nurses in the working age population, and estimated equation (3) using individual level data. In this case, we constructed standard errors for equation (3) that accounted for the predicted nature of the key independent variable (Murphy and Topel 1985; Hardin 2002; Hardin et al 2003). Results from this alternative method were very similar to those presented in the text (see Appendix Table 2 for alternative fist stage estimates).

immigrant nurses that works through changes in the supply of nurses and the effect of that change on wages.

One limitation of the "area approach" is that migration of domestic nurses in response to immigration may mediate the effect of immigration. If so, there will be no, or a small, shift in supply and the coefficient on the proportion of immigrant nurses would be close to zero. This is not the case in our analysis. The first stage relationship between the proportion of foreign-trained nurses and the proportion of all nurses is quite strong (conditional on other covariates). We report these estimates below.

While our IV strategy is based on a sufficiently strong correlation between the proportion of immigrant nurses and the proportion of all nurses, it still depends on the assumption that immigration of foreign-trained nurses is exogenous. However, unmeasured demand side factors may attract immigrant nurses to a specific area. This would result in upward biased (too positive) estimates of the effect of immigrants on wages. We attempted to address this issue in several ways. First, we used the four-year lag of the proportion of foreign-trained nurses in the working age population as an instrument, which is motivated by evidence that immigrants tend to prefer locations with other immigrants. The argument underlying this strategy is that contemporaneous demand is unlikely to be correlated with past location decisions. Unfortunately, the four-year lag of the proportion of foreign-trained nurses in the working age population was not a strong predictor of the current proportion of foreign-trained nurses in the working age population. Second, we used the contemporaneous share of immigrants (all, low- or high-skilled) among workers in a county to instrument for the proportion of foreign-trained nurses in the working age population. This approach assumes that contemporaneous demand shocks for nursing are uncorrelated with the demand shocks for immigrants in other occupations.

Here too, we found a very weak relationship between the proportion of foreign-trained nurses and the share of immigrants.[7]

In sum, we found that the current share of foreign-trained nurses in the working age population of a county (or PMSA) is largely unrelated to the four-year lagged share of foreign-trained nurses, or the contemporaneous share of other immigrants. This finding suggests that demand side factors may be particularly important determinants of foreign-trained nurse location, as it does not appear that foreign-trained nurses locate where there are a relatively large number of foreign-trained nurses or other foreign-born persons. However, we do not find that the inclusion of demand side variables has much effect on our estimates (reported below). It may be the case that foreign-trained nurses are locating for idiosyncratic (not systematically related to demand) reasons such as the institutional networks that international recruiting firms develop or specific management preferences. Nevertheless, we recognize the potential problem and its implications for the interpretation of our estimates.

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

[7] We refined these two strategies by matching immigrants (lagged and contemporaneous) by country of origin. This was not helpful. We also used variation in immigration policy that occurred over the past 20 years to improve the first stage relationship between the lagged and current share of immigrant nurses. Between 1989 and 1994, immigration policy toward nurses was liberal because of the creation of the special H1 A visa category solely for nurses. Then between 1995 and 1999, with the end of the H1 A visa, immigration policy toward nurses became less hospitable. The creation of the H1 C visa in 1999 for nurses serving underserved communities, many of which are in urban areas, once again created a more welcoming policy for nurses. Finally, NAFTA created a special opportunity for Canadian nurses post 1994. We allowed the effect of lagged immigrant share to differ by time period, but this did not improve the first stage relationship.

every four years since 1977.[8] 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 are high: 70 to 80 percent. We use data for 1988, 1992, 1996, and 2000, as these are the years when the proportion of foreign-training nurses fluctuated significantly across large cities. We do not use the data for 2004, the most recent year for which the NSSRN data are available, because changes in language of questions in 2004 relating to nurse earnings and hours worked make them incompatible with the data for earlier years.[9]

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 working as registered nurses, 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.[10] 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 county (PMSA) and year.

NSSRN provides all data in general public use files and county public use files. We use the county public use files that identify the county in which an RN lives and works. As stated,

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[8] 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.

[9] In the years prior to 2004 (1988, 1992, 1996 and 2000), the NSSRN provided data on the number of hours and weeks a RN worked in all other nursing jobs (other than the principal nursing job) and the annual amount she earned in these jobs. But the 2004 data do not include information on hours and weeks worked in the nursing occupations other than the principal nursing occupation. We use data on annual earnings and hours worked in all nursing occupations to compute the hourly wage of RNs. Since these data are not available in 2004, we use only the 1988, 1992, 1996, and 2000 NSSRN surveys.

[10] This is not the case with other nationally representative datasets such as CPS or Census that 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 under-estimate the actual size of the nursing work force (Health Resources Service Administration, http://bhpr.hrsa.gov/healthworkforce/reports/rnpopulation/preliminaryfindings.htm).

we conduct the analysis using two different definitions of the labor market for nurses: county and Primary Metropolitan Statistical Area (PMSA). For each definition of the labor market, we calculate the proportion of the working age population that is RN, which is our measure of the supply of nurses, and the proportion of the working age population that is foreign-trained nurses. We use individual level weights provided in the NSSRN to calculate these quantities. To improve the accuracy of estimates of the size of the nursing labor pool and the number of immigrant nurses, we limit our study to counties with at least 75 observations in each year of the NSSRN and PMSAs with at least 100 observations in each year. These selection criteria resulted in 60 counties and 65 PMSAs. We compared our estimates of the number of nurses obtained from the 2000 NSSRN to similar estimates from the 2000 Census. The correlation coefficient between the NSSRN and Census estimates was 0.98 for the 65 PMSAs and 0.97 for the 60 counties. For the PMSA sample, the mean absolute difference between the NSSRN and Census estimates of the number of nurses was 1801 (9% of the mean number of nurses per PMSA) with a standard deviation of 2816 (14%); for the county sample, the mean absolute difference in the two estimates was 1605 nurses (15% of the mean number per county) with a standard deviation of 2061 (19%). We note that the Census is not designed to give accurate estimates of the number of nurses in the population of a county or PMSA. On the other hand, the NSSRN is designed to provide accurate estimates of the number of nurses by state. In sum, the two sources of data are broadly consistent, but given the absence of a gold standard it is difficult to assess with certainty the accuracy of the NSSRN estimates.

NSSRN provides information on whether a registered nurse received training in the US or in a foreign-country and when 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.

The NSSRN provides information on many individual characteristics including age, gender, race/ethnic background, education, marital status and family size that are used as control variables. It also provides 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 in the principal nursing job, number of weeks worked last year and number of usual hours worked per week in the principal nursing job. The NSSRN also provides data on the number of hours and weeks a RN worked in all other nursing jobs (other than the principal nursing job) and the annual amount she earned in these jobs. We use data on annual earnings and hours worked in all nursing occupations to compute the hourly wage of RNs. Appendix Table 1 reports the description of the outcomes of interest for the county and PMSA samples.

Data on the county unemployment rate are taken from the Bureau of Labor Statistics and data on the county per-capita income from the Bureau of Economic Analysis, and are merged with the micro-level NSSRN data.[11] Data on proportion of the county population over age 65, and the proportion of the county population that is black are taken from the Bureau of Economic Analysis. We construct these measures to correspond to the geographic unit that is relevant—either the county or PMSA.

The Area Resource File (ARF) is used to compute a set of variables that are likely to affect demand for RNs. These variables, all measured at the appropriate geographic level (county or PMSA) are: per capita in-patient days in short term general hospitals, per capita in-

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

patient days in long term general hospitals, per capita Medicare in-patient days in short term general hospitals and per capita Medicare in-patient days in non-general long term hospitals, average hospital size (total beds/number of hospital), number of hospitals, per capita hospital admissions, per capita hospital beds, per capita long term hospital beds by MSA and year. The ARF provide county level data for 1985, 1990, 1995, and 2000, and for all variables, except Medicare in-patient days in non-general short term and long term hospitals, for 1996. We use a weighted average of 1985 and 1990 to predict the ARF demand side variables for 1988 and a weighted average of 1990 and 1995 predict ARF demand side variables for 1992. Similarly, we use 1995 and 2000 data to compute Medicare in-patient days in non-general short term and long term hospitals for 1996. Finally, we use the 2000 census to estimate the population of foreign-born persons in the US by county (and PMSA) from six countries/regions: the Philippines, Canada, the UK, India, west-indies and Nigeria. In 2000, more than 80 percent of the foreign-trained nurses in the US were from these six/countries/regions

Results

The first results we show are estimates of the association between the proportion of nurses in the working age population and the proportion of foreign-trained nurses in the working age population obtained from equation (2). Table 1 presents these estimates. Appendix Table 2 presents corresponding estimates using data aggregated to the county-year (PMSA-year). The left panel of Table 1 presents estimates obtained using the county as the definition of the labor market and the right panel presents estimates obtained using the PMSA as the definition of the labor market. Several models are estimated that differed by the set of control variables. Model 1 includes controls for RN's education, age, marital status, gender, whether white, years since

received nursing license in the US, and county/PMSA and year effects. Model 2 includes additional controls for proportion of population that is elderly, proportion of population that is black, per-capita income, the unemployment rate, and population growth over the past four years, which are all measured at the county or PMSA level. Model 3 includes per-capita hospital admissions and its square in addition to the controls in Model 3. Finally, Model 4 includes the proportion of a county population (or PMSA) that was born in the six countries/regions that account for a large majority of foreign-trained nurses in the US, and interactions between this foreign-born share and hospital admissions (and its square). The specification of Model 4 is motivated by the fact that demand side variables should play a more important role in attracting foreign-trained nurses in places with relatively few persons of similar background (i.e., amenities). All models are estimated using weighted least squares regressions where the weights are the sampling weights provided in the NSSRN.

As can be observed in Table 1, all coefficients on the proportion of foreign-trained nurses in the working age population are positive, greater than one, and statistically significant. This implies that an increase in foreign-trained nurses in an area significantly increases the supply of all nurses, which is the hypothesis that underlies concerns that immigrant nurses may adversely affect the wages of domestic nurses. The addition of demand side factors (Models 2, 3 and 4) has minimal influence on estimates of the association between the proportion of foreign-trained nurses in the working age population and the proportion of all nurses in the working age population. Notably, the absence of a mediating effect is not due to the fact that the demand side factors are not significant predictors, as estimates associated with almost all demand side factors are statistically significant.

One concern regarding the estimates in Table 1 is their magnitudes. Estimates imply that every additional foreign-trained nurse increases the supply of nurses by one or more—sometimes by 1.8 nurses. This finding does not make sense unless demand side factors are severely confounding estimates, which does not appear to be the case. However, standard errors are relatively large and much smaller effect sizes could not be rejected. In addition, the underlying data are somewhat crude and this may affect the scale of the effect size.[12] Overall, our reading of the evidence in Table 1 is that an increase in the number of foreign-trained nurses in an area is associated with a significant increase in the supply of nurses in that area, although we cannot be definitive about the exact magnitude of that shift in supply.

We now turn to assessing the effect of this increase in supply on the wages of domestic (US-trained) nurses. Table 2 presents estimates of the association between the percent of nurses, or the percent of foreign-trained nurses, in the working age population and the (log) wages of domestic nurses. Again, we conduct separate analyses depending on which definition of the labor market is being used: county or PMSA. The left panel of Table 2 presents estimates pertaining to the county definition and the right panel presents estimates pertaining to PMSA definition. We estimate two models (Model 3 and Model 4) that differ depending on the control variables included in the model. Model 4 includes additional controls for the percent of county (PMSA) population that is from leading nurse sending countries in a county and interactions between this variable and hospital admissions and its square (see Table 1 specifications). We also obtain instrumental variables estimates of the association between the percent of nurses in the working age population and log wages using the percent of foreign-trained nurses in the population as an instrument for the percent of all nurses in the working age population. Finally,

[12] We investigated whether the linear specification of the percent foreign-trained nurses may be the cause of the relatively large estimates. Specifically, we used a quadratic specification and estimated effects with this specification were very similar to those in Table 1.

we conduct separate analyses using samples stratified by whether or not a nurse has a BA degree in nursing, and whether or not a nurse works in a hospital setting. The stratification by education is intended to assess whether foreign-trained nurses have different effects on different skill categories of domestic nurses. The stratification by workplace setting (hospital or not) reflects the fact that a large majority of foreign trained nurses are recruited by hospitals to work in hospitals (68%). All estimates are obtained using weighted least squares regression where the weights are the sampling weights provided by the NSSRN.

The top panel of Table 2 presents the estimates of the association between the percent of nurses in the working age population, or percent of foreign-trained nurses in the working age population, and log wages for US-trained nurses. All estimates in the top panel are not statistically significant and, perhaps more importantly, estimates are small in magnitude. For example, non-IV estimates from Model 4 indicate that a one percentage point increase in the percent of nurses in the working population, which represents a two standard deviation change or an approximately 50 percent increase in the number of nurses, is associated with 0.8 percent decrease in wages in the county analysis and a 2.0 percent increase in wages in the PMSA analysis. Similarly, estimates from Model 4 indicate that a one percentage point increase in the percent of foreign-trained nurses in the working population, which represents a twenty standard deviation change, is associated with 2.8 percent increase in wages in the county analysis and an 8.9 percent increase in wages in the PMSA analysis. These last estimates are reduced form estimates (equation 4 above). Finally, IV estimates indicate that a one percentage point increase in the percent of nurses in the working population is associated with 2.7 percent increase in wages in the county analysis and a 4.8 percent increase in wages in the PMSA analysis. It is also

worth pointing out that the IV model is just identified, so the IV are the ratio of the two reduced form estimates that have been presented

All of these estimated wage responses discussed so far are quite small when compared to the change in supply with which they are associated. One question that arises is whether there is sufficient statistical power to detect effect sizes we might expect. Assume that the elasticity of demand for nurses in a county (or PMSA) is -4.0, which is highly elastic and likely to be too large in reality. In this case, a 50 percent increase in the supply of nurses would be associated with a 12.5 percent decrease in wages. The standard errors of the IV estimate from the county analysis imply that we could not detect reliably such an effect size, but the standard errors of the IV estimate from the PMSA analysis imply that we would be able to detect reliably such an effect. In fact, the elasticity of demand is likely to be much smaller than -4.0 and if so, the analysis has sufficient statistical power to detect reliably relatively small effects. For example, if the elasticity is -1.0, then a one percentage point change in the percent of nurses in the working age population, which is an approximately 50 percent increase in the supply of nurses, would be associated with a 50 percent decrease in the wage. Clearly, we have sufficient statistical power to detect an effect of this size.

In the remaining panels of Table 2, we present reduced form estimates of the association between the percent of foreign-trained nurses in the working age population in a county (PMSA) and log wages for different samples of domestic nurses stratified by education and place of employment.[13] Almost all of these remaining estimates are not statistically significant and small in magnitude. Consider the estimates from Model 4 pertaining to the sample of nurses who work

[13] We do not present IV estimates for these samples because we do not have a sufficient number of reliable instruments. As noted above, we do not estimate a true structural model because we omit wages of other inputs that are related to nurses (e.g., physicians). This issue is even more relevant in the analyses that stratify nurses because the other nursing categories are clearly substitutes. Given our interest is really on the reduced form, we just present these estimates.

in a hospital. A one percentage point increase in the percent of foreign-trained nurses in working age population is associated with a 2.4 percent decrease in wages in the county analysis and a 5.0 percent increase in wages in the PMSA analysis. Both estimates are quite small given that a one percentage point increase in the percent of foreign-trained nurses in the working population represents a very large increase in (immigrant) nurses. Any reasonable estimate of the elasticity of demand for nurses would imply a decrease in the wage of at least 25 percent for such an increase in supply. In only one case do we observe an estimate that is not trivial in magnitude, and this is in the sample of nurses with a BA. In the PMSA analysis, a one percentage point increase in the percent of foreign-trained nurses in the population is associated with approximately a 25 percent increase in the wages of nurses with a BA. While this association is consistent with the notion that domestic nurses with BAs are complements with foreign-trained nurses, the absence of any other statistically significant, or practically important, effects makes us suspicious of this one significant estimate. For example, wages of nurses without a BA did not fall in response to the increase in foreign-trained nurses.

An increase in immigrant nurses could also affect the hours and weeks of work through job changes and changes in production (patient care). An analysis of wages will not detect such changes, but any changes of this type would be reflected in annual earnings. Therefore, we repeat the analyses underlying Table 2, but use annual earnings in nursing instead of wages. Estimates from these analyses are reported in Table 3.

There are few statistically significant estimates in Table 3, and as in Table 2, most estimates are small in magnitude. The exceptions are estimates obtained using the sample of nurses currently not working in hospitals. For this group, an increase in foreign-trained nurses in an area is positively associated with annual earnings. However, we did not observe a

corresponding increase in wages for this group. Therefore, the large increase in earnings would come from more hours (weeks) of work. There is no strong reason to expect such an increase. Moreover, given the absence of other evidence consistent with these estimates, we tend to downplay there significance.

The final analyses we conducted was to investigate whether an increase in foreign-trained nurses was associated with a change in employment status. If immigration adversely affected wages in nursing, then nurses may move to other professions, or out of the labor force. Indeed, such changes may limit the 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. Table 4 presents estimates from two multinomial logit regression analyses. One analysis used three employment status categories: employed in nursing (reference), employed, but not in nursing, and not employed. The other analysis used four categories: employed in nursing, but not in a hospital (reference), employed in nursing in a hospital, employed, but not in nursing, and not employed. We reiterate that the distinction between hospital and non-hospital employment is motivated by the fact that most immigrant nurses are recruited to work in hospitals.

Similar to the other analyses, estimates in Table 4 are not statistically significant and small in magnitude. Estimates from Model 4 indicate that a one percentage point increase in the percent of foreign-trained nurses in the working age population, which is a very large change in the number of immigrant nurses, is associated with: a 7.4 percentage point increase in the probability of being employed, but not in nursing in the county analysis, and a 1.5 percentage point increase the probability of being employed, but not in nursing in the PMSA analysis.

These are small effects. Other estimates are similarly small, and there is little evidence of significant changes in employment status associated with an increase in immigration of nurses.

Conclusion

> "It remains a fascinating question how firms in a given industry can adapt their production technology so closely to local supplies of different types of labor without substantial changes in relative wages. (Card 2005, p. F321)

This quote by Card (2005) is an apt conclusion for our paper. While we find substantial evidence that immigration by foreign-trained nurses increases the supply of nurses in local labor markets (e.g., counties), we find little (no) evidence that such increases in the supply of nurses has any appreciable effect on wages, annual earnings or employment status of domestic nurses. Why this is so remains a mystery to us and most other economists.

Card (2005) concludes that the explanation of this apparent paradox is that firms within local labor markets adapt their production technologies to absorb the increase in factor supply to leave wages unchanged. In the health care industry, there is ample possibility for such changes. Health care providers (e.g., hospitals) can expand services that are nurse intensive (e.g., ICU, NICU), or they can forgo adopting new technologies, or changes to the physical infrastructure, that serve as substitutes for nurses. Whether this is health care firms are responding to is an interesting hypothesis to explore in future research. Focusing on one industry or one occupation, as we do here for nursing, is likely to be a productive approach for studying this problem because of the relative ease of obtaining the institutional knowledge that would be critical to identifying the possible changes to look for in response to an increase in immigration.

References

Aiken, LH, SP Clarke, DM Sloane, JA Sochalski, R Busse, & H Clarke, et al. 2001. "Nurses' reports on hospital care in five countries" *Health Affairs*, Vol 20, Issue 3, 43-53.

Aiken, LH., SP Clarke, DM Sloane, JA Sochalski, & JH Silber. 2002. "Hospital Nurse Staffing and Patient Mortality, Nurse Burnout, and Job Dissatisfaction" *JAMA,* 288:1987-1993.

Aiken, LH., SP Clarke, RB Cheung, DM Sloane, & JH Silber. 2003. "Educational Levels of Hospital Nurses and Surgical Patient Mortality." *JAMA*, 290, 1617-1623.

Berliner, HS, & E. Ginzberg. 2002. "Why This Hospital Nursing Shortage Is Different". *JAMA*. 288:2742-2744.

Blakeney, BA. 2006. "International Nurse Migration: Crisis or Opportunity" Statement by President, American Nurses Association on May 17, 2006. Fetched online on August 26, 2009 at: http://www.icn.ch/triad/nna2006/Barbara_Blakeney.pdf

Borjas, G. 2003. "The Labor Demand Curve Is Downward Sloping: Reexamining The Impact Of Immigration On The Labor Market," *Quarterly Journal of Economics*, 118(4), pages 1335-1374.

Borjas, G. & LF Katz. 2005. "The Evolution of the Mexican-Born Workforce in the United States," *NBER Working Papers* 11281, National Bureau of Economic Research, Inc.

Brush, B., J. Sochalski, and AM Berger. 2004. "Imported Care: Recruiting Foreign Nurses To U.S. Health Care Facilities." *Health Affairs*, 23 (3): 78-87.

Card, D. 2005. "Is the New Immigration Really so Bad?" *Economic Journal*, Royal Economic Society, vol. 115(507), pages F300-F323, November.

Chaguturu S. &Vallabhaneni S. 2005. "Aiding and Abetting — Nursing Crises at Home and Abroad" *The New England Journal of Medicine*. Volume 353:1761-1763, October 27, Number 17.

Edmonston, B. & J. Smith Ed. 1997. The New Americans: Economic, Demographic, and Fiscal Effects of Immigration, Washington D.C.: National Academy Press.

Flynn, L. & LH Aiken. 2002. "Does International Nurse Recruitment Influence Practice Values in U.S. Hospitals?" *Journal of Nursing Scholarship*, 34 (1): 67 -73.

Department of Health and Human Services. 2002. "Projected Supply, Demand and Shortages of Registered Nurses: 2000-2020." U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professionals. National Center for Health Workforce Analysis. July.

Galessell-Brown, E. 1998. Use of Immigration Policy to Manage Nursing Shortages. Journal of Nursing Scholarship, Vol. 30 Iss. 4, 306 – 401.

Immigration Nursing Relief Act, 1989. United States. Congress. House. Committee on the Judiciary. Published in 1989, U.S. G.P.O. ([Washington, D.C.)

Immigrant Nursing Relief Advisory Committee. 1995. Report to the secretary of labor on the Immigration Nursing relief Act of 1989. Washington DC: United States Government Printing Office.

Joel, L. 1996. Immigration: Why Is It Still Up for Discussion? *American Journal of Nursing*, Vol. 96 – Iss. 1 - p 7. Editorial

Kline, DS.2003 "Push and Pull Factors in International Nurse Migration" *Journal of Nursing Scholarship,* Volume 35 p 107, June.

Lafer, G. 2005. "Hospital Speedups and the Fiction of a Nursing Shortage" *Labor Studies Journal* - Volume 30, Number 1, Spring, 27-46.

Lopez, MP, & DJ Tsitouras. 2009. How the Reluctance to Embrace Immigrant Nurses is Mortally Wounding the U.S. Healthcare System. Available at SSRN: http://ssrn.com/abstract=1434169

Lovell, V. 2006. 'Solving the Nursing Shortage through Higher Wages." Institute for Women's Policy Research Publication C363A., Institute for Women's Policy Research, Washington, DC.

Needleman J, Buerhaus P, Mattke S, Stewart M, & Zelevinsky K. 2002. Nurse-staffing levels and quality of care in hospitals. *The New England Journal of Medicine*; 346: 1415–1422.

Trucios-Haynes. E. 2002. "Temporary Workers and Future Immigration Policy Conflicts: Protecting U.S. Workers and Satisfying the Demand for Global Human Capital", *40 Brandeis Law Journal 967*.

Schumacher, EJ. 2008. "Foreign Born Nurses in US Labor Markets," Working Paper, Trinity University, Texas.

Table 1
Estimates of the Association between the Percent of Nurses and the Percent of Foreign-trained Nurses in Working Age Population

	County Analysis				PMSA Analysis			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Percent of Foreign-trained Nurses In Working Age Population	1.240*** (0.386)	1.400*** (0.410)	1.178*** (0.434)	1.019** (0.450)	1.671*** (0.362)	1.848*** (0.355)	1.735*** (0.371)	1.844*** (0.345)
Proportion of Population Elderly		5.810** (2.513)	3.866 (2.470)	2.581 (2.480)		8.594*** (2.164)	7.673*** (1.986)	6.075*** (1.950)
Proportion of Population Black		2.306* (1.363)	2.020* (1.220)	1.779 (1.303)		2.748** (1.315)	2.650** (1.226)	2.440** (1.129)
Unemployment Rate		-0.016 (0.011)	-0.016 (0.011)	-0.019 (0.012)		-0.009 (0.008)	-0.009 (0.008)	-0.004 (0.008)
Per-capita Income ($10,000s)		-0.172*** (0.064)	-0.163*** (0.059)	-0.178*** (0.059)		-0.137** (0.054)	-0.124** (0.053)	-0.131** (0.052)
Population Growth (4-Year Change)		0.209 (0.582)	0.028 (0.603)	0.057 (0.593)		0.215 (0.286)	0.071 (0.276)	0.236 (0.280)
Hospital Admissions			7.403** (3.225)	13.450*** (4.560)			11.096*** (3.378)	11.856*** (4.512)
Hospital Admissions Squared			-13.839 (8.455)	-33.529*** (12.137)			-36.570*** (9.893)	-44.988*** (12.782)
Percent Foreign-born from Nurse Sending Countries (FB)				0.209 (0.138)				-0.072 (0.132)
Hospital Admissions* FB				-3.373* (1.785)				-1.460 (1.785)
Hospital Admissions Squared*FB				12.392* (6.347)				8.801 (6.096)

Notes: Each column is a separate regression. In addition to the covariates listed in the row headings, each regression also controls for RN's education, age, marital status, gender, whether white, years since received nursing license in the US, county/PMSA and year effects. Regressions are weighted by individual sampling weight and robust standard errors clustered on county/PMSA-year are in parenthesis.* 0.05<p=<0.1, ** 0.01<p=<0.05, ***p=<0.01.

Table 2
Estimates of the Association between Log Wage of US Nurses, and the Percent of Nurses and Percent of Foreign-trained Nurses in Working Age Population

	County Analysis			PMSA Analysis		
All Nurses	Model 3	Model 4	Model 4-IV	Model 3	Model 4	Model 4-IV
Percent Nurses in Working Age Population	-0.009	-0.008	0.027	0.001	0.020	0.048
	(0.018)	(0.018)	(0.103)	(0.020)	(0.021)	(0.060)
Percent Foreign-trained Nurses in Working Age Population	0.020	0.028		0.132	0.089	
	(0.102)	(0.102)		(0.103)	(0.108)	
Nurses with BA						
Percent Foreign-trained Nurses in Working Age Population	-0.056	-0.018		0.263*	0.235*	
	(0.165)	(0.160)		(0.142)	(0.136)	
Nurses Without BA						
Percent Foreign-trained Nurses in Working Age Population	0.082	0.061		0.037	-0.015	
	(0.092)	(0.093)		(0.109)	(0.119)	
Nurses Working in Hospitals						
Percent Foreign-trained Nurses in Working Age Population	-0.035	-0.024		0.083	0.050	
	(0.124)	(0.121)		(0.115)	(0.126)	
Nurses Not Working in Hospitals						
Percent Foreign-trained Nurses in Working Age Population	0.046	0.049		0.104	0.063	
	(0.125)	(0.132)		(0.163)	(0.154)	

Notes: Figures in each cell are estimates from a separate regression. All regression models include education, age, marital status, gender, whether white, years since received nursing license in the US, county/PMSA unemployment rate and per capita income, population growth, per capita hospital admissions and admissions squared, and year and county/PMSA effects. Regression Model 4 also includes percent foreign-born in the county/PMSA from major nurse sending countries and interactions of this variable with per capita hospital admission and admissions-squared. Regressions are weighted by individual sampling weight and robust standard errors clustered on county/PMSA-year are in parenthesis.* 0.05<p=<0.1, ** 0.01<p=<0.05, ***p=<0.01.

Table 3
Estimates of the Association between Log Annual Earnings of US Nurses, and the Percent of Nurses and Percent of Foreign-trained Nurses in Working Age Population

	County Analysis			PMSA Analysis		
All Nurses	Model 3	Model 4	Model 4-IV	Model 3	Model 4	Model 4-IV
Percent Nurses in Working Age Population	-0.037	-0.037	0.141	-0.028	0.004	0.094
	(0.026)	(0.026)	(0.163)	(0.026)	(0.025)	(0.081)
Percent Foreign-trained Nurses in Working Age Population	0.118	0.145		0.251	0.174	
	(0.138)	(0.141)		(0.198)	(0.138)	
Nurses with BA						
Percent Foreign-trained Nurses in Working Age Population	0.044	0.136		0.310	0.260	
	(0.244)	(0.243)		(0.245)	(0.184)	
Nurses Without BA						
Percent Foreign-trained Nurses in Working Age Population	0.139	0.096		0.193	0.094	
	(0.184)	(0.190)		(0.200)	(0.154)	
Nurses Working in Hospitals						
Percent Foreign-trained Nurses in Working Age Population	-0.082	-0.039		-0.101	-0.171	
	(0.135)	(0.143)		(0.164)	(0.174)	
Nurses Not Working in Hospitals						
Percent Foreign-trained Nurses in Working Age Population	0.383	0.385		0.788**	0.722**	
	(0.282)	(0.284)		(0.377)	(0.287)	

Notes: Figures in each cell are estimates from a separate regression. All regression models include education, age, marital status, gender, whether white, years since received nursing license in the US, county/PMSA unemployment rate and per capita income, population growth, per capita hospital admissions and admissions squared, and year and county/PMSA effects. Regression Model 4 also includes percent foreign-born in the county/PMSA from major nurse sending countries and interactions of this variable with per capita hospital admission and admissions-squared. Regressions are weighted by individual sampling weight and robust standard errors clustered on county/PMSA-year are in parenthesis.* 0.05<p=<0.1, ** 0.01<p=<0.05, ***p=<0.01.

Table 4
Estimates of the Association between the Employment Status of US Nurses and Percent of Foreign-trained Nurses in Working Age Population

	County Sample		PMSA Sample	
	Model 3	Model 4	Model 3	Model 4
Employed, Not in Nursing	0.076	0.074	-0.011	0.015
(Employed in Nursing is Reference Category)	(0.054)	(0.057)	(0.048)	(0.048)
Not Employed	-0.018	-0.038	0.051	0.049
	(0.049)	(0.051)	(0.038)	(0.040)
Employed in Nursing, Hospital	0.059	0.089	0.111	0.061
(Employed in Nursing, Non-hospital is Reference Category)	(0.126)	(0.127)	(0.114)	(0.102)
Employed, Not in Nursing	0.077	0.075	-0.013	0.013
	(0.056)	(0.059)	(0.049)	(0.049)
Not Employed	-0.022	-0.044	0.051	0.047
	(0.052)	(0.053)	(0.040)	(0.042)

Notes: Each cell is the marginal effect of the percent of foreign-trained nurses in the working age population on the probability of being in the specified employment state. Estimates were obtained from a multinomial logit regression. All regression models include education, age, marital status, gender, whether white, years since received nursing license in the US, county/PMSA unemployment rate and per capita income, population growth, per capita hospital admissions and admissions squared, and year and county/PMSA effects. Regression Model 4 also includes percent foreign-born in the county/PMSA from major nurse sending countries and interaction of this variable with per capita hospital admission and admissions-squared. Regressions are weighted by individual sampling weight and robust standard errors clustered on county/PMSA-year are in parenthesis.* $0.05<p=<0.1$, ** $0.01<p=<0.05$, *** $p=<0.01$.

Appendix Table 1
Summary Statistics: NSSRN 1988, 1992, 1996, and 2000

	County Analysis	PMSA Analysis
Percent Nurses in Working Age Population	1.8	1.7
	(0.5)	(0.4)
Percent Foreign-trained Nurses in Working Age Population	0.06	0.05
	(0.06)	(0.05)
Hourly Wage of US-trained Nurses (in 2000 dollars)	23.76	23.85
	(9.31)	(9.82)
Annual Earnings of US-trained Nurses (in 2000 dollars)	41,712	41668
	(17,465)	(17858)
Percent Employed		
In Nursing	86.26	86.26
In Hospital settings	56.08	55.81
Other than Nursing	4.86	4.86
Number of Observations in the Wage Analysis	26015	46640
Number of Counties/PMSAs	60	65

Note: Figures in parenthesis correspond to standard errors.

Appendix Table 2
Estimates of the Association between the Percent of Nurses and the Percent of Foreign-trained Nurses in Working Age Population

	County Analysis				PMSA Analysis			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Percent of Foreign-trained Nurses In Working Age Population	1.304*** (0.451)	1.418*** (0.491)	1.227** (0.516)	1.045* (0.542)	1.319*** (0.428)	1.451*** (0.418)	1.386*** (0.418)	1.565*** (0.394)
Proportion of Population Elderly		4.071 (2.532)	2.133 (2.610)	-0.165 (2.693)		7.320*** (2.285)	6.605*** (2.370)	6.296*** (2.281)
Proportion of Population Black		0.899 (1.535)	0.853 (1.439)	0.460 (1.540)		3.855** (1.863)	3.722** (1.799)	4.026** (1.650)
Unemployment Rate		-0.010 (0.013)	-0.007 (0.013)	-0.009 (0.013)		-0.006 (0.009)	-0.003 (0.008)	-0.000 (0.008)
Per-capita Income ($10,000s)		-0.139* (0.075)	-0.128* (0.074)	-0.150** (0.075)		-0.126** (0.057)	-0.153*** (0.055)	-0.140** (0.057)
Population Growth (4-Year Change)		0.763 (0.792)	0.691 (0.781)	0.605 (0.777)		0.413 (0.395)	0.302 (0.380)	0.386 (0.372)
Hospital Admissions			3.166 (2.903)	9.590* (5.565)			5.917* (3.019)	10.817** (5.188)
Hospital Admissions Squared			-3.440 (8.932)	-24.938 (15.968)			-22.431** (9.509)	-41.192*** (14.547)
Percent Foreign-born Nurse Sending Countries (FB)				0.176 (0.159)				0.004 (0.155)
Hospital Admissions* FB				-3.386* (2.017)				-2.802 (1.966)
Hospital Admissions Squared*FB				13.847** (6.867)				13.237** (6.495)

Notes: Each column is a separate regression applied on county/PMSA-year data of percent nurses and percent foreign-trained nurses in working-age population
All regression models include year and county/PMSA effects. Robust standard errors clustered at county/PMSA-year level in parenthesis.
* 0.05<p=<0.1, ** 0.01<p=<0.05, ***p=<0.01.