# ARE FOREIGN-TRAINED NURSES PERFECT SUBSTITUTES FOR U.S.-TRAINED NURSES?

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The authors investigate whether foreign- and U.S.-trained nurses are substitutes by studying the differences in their wages and whether wage differentials respond to relative supplies of foreign- and U.S.-trained nurses. Regression estimates suggest that foreign-trained nurses without a bachelor's degree enjoy a wage premium of 1 to 3% over similar U.S.-trained nurses after adjusting for demographic, workplace, work type, and geographic differences, but no wage difference exists among those with a bachelor's degree. For all nurses combined, the wage difference is modest and statistically insignificant. This result suggests that foreign- and U.S.-trained nurses are equally productive and close substitutes. The authors also test explicitly for whether foreign- and U.S.-trained nurses are substitutes and cannot reject the hypothesis that they are.

Recruitment of foreign-trained nurses in the United States is controversial. Critics have two primary concerns. The first stems from the fear that foreign-trained nurses take away the jobs of U.S.-trained nurses and lower their wages (Blakeney 2006). Critics argue that in the long run, the recruitment of foreign-trained nurses would discourage U.S. nationals to enter nursing and deepen the projected shortage of nurses (Aiken et al. 2003; Chen et al. 2013).[1] The second concern relates to the quality of foreign-trained nurses and how it affects patient care. Here critics argue that cultural differences and differences in training and language compromise the quality of care that foreign-trained nurses provide (Glaessel-Brown 1998;

[1]The Bureau of Health Professionals projects a shortage of 823,400 nurses by 2020 (accessed at http://bhpr.hrsa.gov/nursing/ [August 25, 2009]). Nursing shortage has been less severe during the Great Recession because of an increase in nurse supply. However, researchers project that approximately 118,000 RNs will leave the profession by 2015 (Staiger, Auerbach, and Buerhaus 2012).

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Aiken et al. 2001; Flynn and Aiken 2002; Trucios-Haynes, 2002; Aiken et al. 2003; Brush, Sochalski, and Berger 2004; Blakeney 2006; Lovell 2006).[2]

Partially because of these concerns, entry of foreign-trained nurses into the United States is highly regulated, and their share among RNs, around 3 to 5% in recent decades, is far less than the share of foreign-trained professionals in other health fields or in other high-skilled occupations (Kaushal and Fix 2006; Chen et al. 2013). While the government has sometimes eased immigration policy for nurses during periods of shortages, professional nursing organizations argue against greater immigration and dismiss the proposition that foreign-trained nurses provide a viable solution to what they view as a long-term nursing shortage (Joel 1996; Glaessel-Brown 1998; Berliner and Ginzberg 2002; Trucios-Haynes 2002; Brush et al. 2004; Lafer 2005; Blakeney 2006; Lovell, 2006; Chen et al. 2013).

Surprisingly, as we discuss in detail below, only a limited number of empirical studies have tested whether these popular beliefs about the effects of foreign-trained nurses on the U.S. labor market are valid. In this article, we add to this limited literature by examining wage differentials between foreign- and U.S.-trained nurses and assessing whether foreign-trained nurses are close substitutes for U.S.-trained nurses. Our analysis differs somewhat from typical studies of immigrant labor market consequences such as those that assess how low-skilled immigrants affect low-skilled natives in that we are assessing whether differences in the place of training and labor market experience and certain unobserved immigrant characteristics such as cultural competence and language proficiency affect productivity, and whether two types of labor with the same education credentials and amount of experience are strong substitutes.

Our analysis makes several contributions. First, we conduct separate analyses by nurse's education (degree) and assess whether wage differentials occur between U.S.-trained and foreign-trained nurses within educational groups. This issue is important because degree is a primary determinant of skill and nursing occupation (e.g., supervisor, clinical, educational), and there are differences between U.S.-trained and foreign-trained nurses in the types of educational training received. We do not expect nurses with different educational degrees to be close substitutes.

Second, we assess if wage returns to experience differ by whether a nurse is foreign-trained. In addition, for foreign-trained nurses, we allow the returns to experience to differ by whether that experience was accumulated in the United States or abroad. Past research has assumed that the returns to experience were the same for U.S.- and foreign-trained nurses and that among the foreign-trained, the returns were the same whether the experience was acquired in the United States or abroad.

Third, we assess whether wage differentials between U.S. and foreign nurses differ by the share of foreign-trained nurses in a labor market (state).

[2]The possibility that recruitment of foreign-trained nurses in the United States will affect the supply of nurses in sending countries is also a concern (Glaessel-Brown 1998; Aiken et al. 2001; Flynn and Aiken 2002; Trucios-Haynes 2002; Kline 2003; Brush et al. 2004; Lovell 2006; Chen et al. 2013).

How wage differentials change with respect to the relative size of the foreign-trained in the workforce is a theoretically consistent way to assess whether foreign nurses are close (perfect) substitutes for U.S. nurses (Card 2009; Ottaviano and Peri 2012). We improve on past attempts along these lines (e.g., Schumacher 2011; Kaestner and Kaushal 2012) by studying wage differentials instead of just U.S. nurse wages; by including explicit controls for demand-side factors that may influence wages as well as the location choices of foreign-trained nurses that are the main source of possible confounding; by narrowing the sample to states with meaningful numbers of foreign nurses; and by using an instrumental variables procedure that exploits the persistence of foreign nurses in a specific location.

## Previous Literature

Two studies have investigated the relative difference in wages of U.S. and foreign nurses (Schumacher 2011; Cortes and Pan 2012). Schumacher (2011) found mixed evidence. Estimates obtained using data from the Current Population Survey (CPS) from 1995 to 2008 indicated that foreign-born (not necessarily foreign-trained) nurses had wages that were, on average, 8% lower than those of U.S.-born nurses, although there was some heterogeneity by country of birth and length of time in the United States.[3] Estimates obtained using the National Sample Survey of Registered Nurses (NSSRN), however, indicated that foreign-trained and U.S.-trained nurses had similar wages with no meaningful or statistically significant differences. Cortes and Pan (2012) used data from the 1970 to 2000 Censuses and reported estimates similar to Schumacher's (2011). Specifically, foreign-born nurses, other than those from the Philippines, had wages that were 2 to 7% lower than those of native-born nurses. For nurses born in the Philippines, prior to 2000 the wage gap was similar to that experienced by other foreign-born nurses, but in 2000, they enjoyed a 4 to 7% wage premium over U.S.-born nurses.[4]

The lack of consensus as to whether wage differences exist between foreign and U.S. nurses leaves unanswered the central question of theoretical and policy concern—namely, whether foreign nurses are close substitutes for U.S. nurses. On the one hand, the presence of substantial wage differentials between foreign and U.S. nurses would suggest that the two groups have different productivities and that replacing U.S.-trained nurses with foreign-trained nurses on a one-for-one basis may adversely affect patient care. On the other hand, no wage difference between U.S. and foreign nurses would suggest that the two have similar productivities and, more important, that they are perfect substitutes.[5] In this case, replacement of

[3]The CPS (outgoing rotation file) has very small samples of foreign-born nurses. For example, over the 14-year period, there were 64 nurses born in India, 142 born in Canada, and a total of 921 total foreign nurses ( Schumacher 2011: Table 5).

[4]Pan and Cortes (2012) also used data from the 2000 NSSRN and 2008 California Survey of Registered Nurses. For these samples, estimates indicated that Filipino nurses had wages 6 to 13% higher than those of U.S. nurses; wages of other foreign-trained nurses were no different from those of U.S.-trained nurses.

[5]See Appendix A for the theoretical argument to support this statement.

U.S.-trained nurses with foreign-trained nurses would have little effect on quality of patient care. If the two are perfect substitutes, however, then increases in the supply of foreign-trained nurses would have substantial negative impacts on nurses' wages.[6]

To clearly identify whether foreign nurses are perfect substitutes requires assessing how wage differentials respond to relative supply shifts (Card 2009; Ottaviano and Peri 2012). No prior study has conducted such a test for nursing, but two studies have examined whether immigration has affected wages of U.S. nurses. Here, too, the literature has been mixed. Schumacher (2011) found that the wages of U.S.-born nurses were higher in cities with larger shares of foreign-born nurses, which is contrary to basic theory. In other specifications that rely on using college-educated women as controls for unmeasured demand factors, Schumacher (2011) reported that wages of U.S.-born nurses were lower in cities with larger shares of foreign-born nurses. Kaestner and Kaushal (2012) used an instrumental variables approach to study the same issue and reported that the wages of U.S.-trained nurses were lower in areas with a greater proportion of foreign-trained nurses, although estimates were somewhat imprecise. Note that these analyses do not answer the question of whether foreign- and U.S.-trained nurses are perfect substitutes but address only whether immigration affects the wages of U.S. nurses. To answer the former question, it is necessary to assess whether relative wages between foreign- and U.S.-trained nurses (i.e., wage differences) are affected by the relative supply of foreign nurses.

## Data

The NSSRN is the primary source of data we use to conduct our analysis. It is the most extensive and comprehensive survey of registered nurses in the United States and has been conducted approximately every four years since 1977.[7] Each survey has information on approximately 35,000 nurses from a universe of all licensed RNs. For most years, information is collected by mail with telephone follow-ups over an eight-month period from March to November. The survey response rates are high: 70 to 80%. Our analysis is based on data for 1984, 1988, 1992, 1996, 2000, 2004, and 2008.

An important aspect of NSSRN is that it is representative of every person who has an active license to practice as a registered nurse in the United States. For other nationally representative data sets such as the CPS and Census, this is not the case, as these data provide information on a person's current occupation, which misses nurses who are licensed and are therefore

[6]Nursing is often cited as an example of an occupation in which there is monopsony. Empirical evidence, however, does not consistently show this to be the case (Hirsch and Schumaker 1995, 2005). We do not address the empirical implications of monopsony with respect to the association between relative wages and relative labor supplies. It is an avenue for future research.

[7]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 Public Health Service (PHS) Act.

potential entrants to the nursing market, but who work in other occupations. More important for our analysis, NSSRN provides data on the country where the nurse received a nursing degree, whereas the CPS and Censuses provide data only on country of birth. Thus in these other data sets it is not possible to identify precisely the nurses who were trained in the United States and those who received training abroad (Kaestner and Kaushal 2012).

The NSSRN has information on many individual characteristics including age, race/ethnicity, 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 or in another occupation or whether he or she works at all. For those who work in nursing it provides information on their annual salary in the principal nursing job, number of weeks worked the previous year and number of usual hours worked per week in the principal nursing job, and annual earnings and hours worked in other nursing positions. We use data on annual earnings and hours worked in all nursing occupations to compute the hourly wage of RNs. To minimize reporting errors, we drop from the wage analysis nurses who reported earning less than the federal minimum wage. Further, to ensure that extreme values do not influence the outcome of our analysis, we restrict samples to nurses who worked more than 250 hours and less than 4,201 hours in the previous year.[8]

NSSRN provides general public-use files and county public-use files. We use the general public-use files that identify the state in which an RN lives and works. Since a vast majority of foreign-trained nurses, like most foreign-born population in the United States, live in a few states, in some analyses we restrict samples to the top 10 states where two-thirds of the foreign-trained nurses lived during our study period.[9]

The NSSRN is rich in details about an RN's work attributes. For instance, it provides detailed data on an RN's principal position in nursing (such as staff nurse, nurse practitioner, midwife, clinical nurse specialist, certified nurse anesthetist, administrator, consultant, instructor, or researcher), her or his employment setting (e.g., hospitals, nursing home, educational setting, ambulatory care), whether consulting with agencies occupies more than 50% of the RN's time in the principal nursing position, and whether she or he works full-time or part-time as a nurse.

NSSRN provides data on the year the nurse received his or her first nursing degree, and we use this variable to create potential experience in nursing: the year of observation minus the year the nurse received the first degree. For foreign-trained nurses, NSSRN provides information on the year the nurse received a U.S. nursing license in the 2000, 2004, and 2008

[8]In our sample, 0.6% of the RNs (848 observations) reported having worked more than 4,201 hours; 1.2% of the RNs (1,735 observations) reported working less than 250 hours in the previous year; and 0.2% of the sample (295 observations) reported having been paid less than the minimum wage.

[9]These states are California, Florida, Hawaii, Illinois, Maryland, Nevada, New Jersey, New York, Texas, and Virginia. The other one-third of foreign-trained nurses were distributed widely across the remaining states.

survey years. For earlier survey years, this information is less precise; for instance, the 1988 and 1992 surveys provided the year only for nurses who received a U.S. license in the previous eight years and simply noted that the license was received more than eight years earlier for everyone else. Therefore, to study how returns to nursing experience in the United States and experience acquired abroad differ, we conducted analyses limited to samples drawn from the 2000, 2004, and 2008 surveys.

Data on the state unemployment rates are taken from the Bureau of Labor Statistics and are merged with the NSSRN data by state and year.[10] Data on the 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, number of hospital outpatient visits, number of hospital admissions, and working-age population in the state, as well as total state population by state and year and this information is merged with the micro-level NSSRN data. All wage data are converted into constant dollars using the consumer price index.

## Research Design

Our first objective is to obtain estimates of the differential in wages between U.S.- and foreign-trained nurses. We begin with the following regression model:

$$W_{ijt} = \alpha_0 + \lambda IM_{ijt} + \sum_k \beta_k X_{ijt} + \varphi^* D_{tj} + v_{ijt} \quad (1)$$

$$i = 1, \ldots, N$$

$$j = 1, \ldots, 51$$

$$t = 1988, 1992, 1996, 2000, 2004, 2008$$

In Equation (1), $W_{ijt}$ is the natural logarithm of hourly real wage of registered nurse $i$ living in state $j$ in year $t$; $IM$ is an indicator of whether the RN is foreign-trained; and $X$ is a vector of nurse attributes. The vector $X$ includes the following demographic, educational, and potential experience variables: sex, whether currently married (versus other), race (whether respondent is white versus other), educational degree in nursing (a set of dummy variables indicating diploma, associate's degree, bachelor's degree, or higher), age at first nursing degree (dummy variables indicating < 20, 20–24, 25–29, 30–34, 35–39, 40–60 years), and potential experience measured as years since the RN received the first nursing degree (specified as a quadratic).[11] We also include variables intended to control for the nursing occupation and place of work. The occupation variables are a set of dummy variables indicating that the respondent works as staff nurse, as administrator, or in another position, and whether consulting with agencies occupies

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

[11]Estimated effects were similar in models in which experience was included as a cubic function.

more than 50% of his or her time in the principal nursing position. Categorical variables identifying the employment setting are indicators for hospital, nursing home, ambulatory care, educational setting, and others. Further, we control for whether the RN works in nursing full-time or part-time, year of observation (a dummy variable for each survey year), and geographic location (a dummy variable for each state of residence, state-dummy variables interacted with whether the nurse lives in a Metropolitan Statistical Area [MSA], and an indicator that MSA information is missing).

The variable $D_{tj}$ denotes a vector of the following demand-side variables: state unemployment rate, proportion of the elderly in the state population, proportion of the population that is black, log of the state working-age population, per capita number of inpatient days and its squared term, per capita number of outpatient visits and its squared term, per capita hospital admissions and its squared term. Demand-side factors are important to include because of the possibility that immigrants are attracted to locations because of unmeasured demand-side factors. To address this issue more fully, in some models we include dummy variables for each state-year combination that control for all unmeasured state-year factors that may affect wages of U.S.- and foreign-trained nurses.

The coefficient $\lambda$ in Equation (1) measures the estimated difference in log wages between foreign- and U.S.-trained nurses. Arguably, two workers with similar qualifications with the same wage are likely, although not certain, to be close substitutes (see Appendix). As noted, we estimate Equation (1) on samples stratified by educational attainment (whether the nurse has a diploma or associate's degree in nursing or a bachelor's or higher degree). Standard errors are computed by clustering on the state of residence.

A restriction embedded in Equation (1) and found in all past research in this area is that the return to an additional year of experience is the same for foreign- and U.S.-trained nurses. There are plausible reasons, however, to expect that experience prior to the arrival may be less valuable in the U.S. market because of differences between the United States and sending countries in the organization, financing, and delivery of health care. Indeed, language and other barriers could also cause the return to U.S. experience to differ by nativity. To test these hypotheses, we modify the specification in Equation (1) as follows:

$$(2)\quad W_{ijt} = \tilde{\alpha}_0 + \tilde{\lambda} IM_i + \gamma_1 EXP_i + \gamma_2 (EXP_i * IM_i) + \gamma_3 (US\_EXP_i * IM_i) + \sum_k \tilde{\beta}_k X_{ijt} + \tilde{\varphi} * D_{tj} + v_{ijt}$$

The key difference between Equation (2) and Equation (1) is that we allow the return to experience (*EXP*) to differ by whether the nurse is foreign-trained, and among foreign-trained nurses, we allow the returns to experience acquired in the United States (*US_EXP*) to differ from returns to

experience accumulated before arrival.[12] Allowing the returns to experience to differ is related to the issue of defining appropriate skill groups. The question we are mainly interested in is whether, within a skill group, foreign nurses are a good substitute for U.S. nurses. Consider the case in which experience prior to arrival in the United States is not valued by U.S. firms: in this situation comparing foreign and U.S. nurses within a skill group defined by total experience (e.g., since time of degree) is likely to indicate that foreign nurses have lower wages than U.S. nurses. In contrast, if skill group is defined for nurses with the same experience in the United States, then there may be smaller wage differentials and more evidence that foreign-trained nurses are close substitutes for U.S. nurses.

Finally, as Ottaviani and Peri (2012) and Card (2009) have noted, a theoretically consistent test of whether immigrant and native workers are perfect substitutes is whether relative wage differences between the two depend on relative supplies. Following closely the theoretical model in these articles, we test whether foreign-trained and U.S.-trained nurses are perfect substitutes using the following equation:

$$(3)\quad W_{ijt} = \alpha_0 + \lambda_1 IM_i + \lambda_2 * SHARE_{jt} + \lambda_3 (IM_i * SHARE_{jt}) + \sum_k \beta_k X_{ijt} + \varphi * D_{tj} + \nu_{ijt}.$$

In Equation (3), $SHARE_{jt}$ is the natural logarithm of the share of nurses that are foreign-trained in a state. The equation includes an interaction between the dummy variable indicating the nurse is foreign-trained and the share of all nurses that are foreign-trained in a state. The test for whether foreign-trained nurses are perfect substitutes for U.S.-trained nurses is if $\lambda_3 = 0$, which implies that relative wages are independent of relative supplies. The intuition is straightforward. If foreign-trained and U.S.-trained nurses are perfect substitutes, then increases in the foreign share of nurses will affect both groups equally and leave relative wages unchanged.

The analysis underlying Equation (3) is conducted on a sample of nurses drawn from 10 states that include two-thirds of all foreign-trained nurses. These states are California, Florida, Hawaii, Illinois, Maryland, Nevada, New Jersey, New York, Texas, and Virginia. A well-known problem affecting Equation (3) is that the share of foreign-trained nurses may be endogenous—for example, because immigrants are attracted to states where wages are high. We address this problem in three ways. First, we include explicit controls for demand-side factors such as the number of inpatient days per capita, number of outpatient visits per capita, per capita hospital admissions, share of elderly persons in the state population, and share of black persons in the state population. Second, we use an instrumental variables procedure that uses lagged share of foreign-trained nurses as an instrument to predict the

[12]Note that total experience (*EXP*) includes U.S. experience (*US_EXP*) for foreign-trained nurses. So the return to U.S. experience is the sum of the three gamma coefficients in Equation (2). When we discuss the results, we provide predicted wages by experience level, which makes it easy to observe whether the returns to experience differ by whether experience was acquired before or after entering the United States.

current share of foreign-trained nurses. We experiment with two lags: share of nurses lagged by four years and share of nurses lagged by eight years. Kaestner and Kaushal (2012) provided a discussion and presented evidence of the validity of this approach. In brief, the evidence in that article suggested that this approach is reasonable, although the validity of the exclusion restriction cannot be definitively shown. Third, we estimate Equation (3) with state-year dummy variables and instrument for the interaction between foreign-trained and log share (*IM*SHARE*). In this case, the share of foreign-trained (*SHARE*) and the demand-side variables (*D*) drop out of the model because these vary only by state-year. This is a very powerful way to control for the likely cause of endoegenity—unmeasured, contemporaneous demand-side factors.

## Results

Table 1 presents the descriptive statistics for selected variables for the samples of U.S.- and foreign-trained nurses. Several comparisons are noteworthy. First, foreign-trained nurses are somewhat more likely to be working in nursing than U.S.-trained nurses: 91% versus 87%. Second, the foreign-trained are somewhat more likely to hold at least a bachelor's degree (52%) than are U.S.-trained (43%) nurses, and this is primarily attributable to the high rate of bachelor's among Filipino nurses. Third, foreign-trained nurses are older and have more experience than the U.S.-trained; on average, foreign-trained nurses have 21 years of experience in nursing as compared to 17 years of experience for U.S.-trained nurses. Among foreign-trained nurses, 7.3 years of this experience is acquired prior to arrival in the United States. The foreign-trained are also more likely to be working full-time (84%) than are the U.S.-trained (72%). Fourth, the two groups differ significantly in terms of their place of work as well as the type of work they perform. Seventy-eight percent of the foreign-trained nurses work as staff nurses, and 73% work in a hospital setting. The corresponding proportions for U.S.-trained nurses are 67% and 63%, respectively. The difference between U.S.- and foreign-trained nurses remains qualitatively the same when samples are restricted to 10 states with the largest number of foreign-trained nurses.

The descriptive data in Table 1 highlight some of the key differences between U.S.- and foreign-trained nurses that are likely to affect their wage differential. In the analyses that follow in Tables 2 and 3 we adjust for these and other observed differences in characteristics between the two groups of nurses within two broader skill categories: nurses without a bachelor's degree and nurses with a bachelor's or higher education.

In the analysis presented in Table 2, the dependent variable is log real wage earned by a registered nurse in all nursing occupations in the past year. The sample is restricted to RNs who worked more than 250 hours and less than 4,201 hours the previous year and earned more than the federal minimum wage. Self-employed RNs are excluded from the analyses. We present results from four models that sequentially add additional control variables. Model 1 includes controls for demographic characteristics, education,

*Table 1.* Sample Means and Proportions by Place of Training

| | *All nurses* | | *Top 10 states in foreign-trained nurses* | |
|---|---|---|---|---|
| *Variable* | *U.S.-trained* | *Foreign-trained* | *U.S.-trained* | *Foreign-trained* |
| Currently works in nursing | 0.87 | 0.91+ | 0.85 | 0.92+ |
| Education | | | | |
| Diploma | 0.21 | 0.40+ | 0.19 | 0.35+ |
| Associate degree | 0.36 | 0.08+ | 0.36 | 0.07+ |
| Bachelor's degree | 0.33 | 0.46+ | 034 | 0.51+ |
| More than bachelor's | 0.10 | 0.06+ | 0.12 | 0.06+ |
| Age < 30 years | 0.12 | 0.08+ | 0.11 | 0.07+ |
| Age = 30–44 years | 0.45 | 0.46 | 0.44 | 0.47+ |
| Age = 45–54 years | 0.29 | 0.30+ | 0.30 | 0.30 |
| Age = 55–64 years | 0.14 | 0.15+ | 0.15 | 0.15 |
| Years since first nursing degree | 17 | 21+ | 17 | 21+ |
| Years since first U.S. license | | | | |
| 0–< 5 years | 0.15 | 0.19+ | 0.15 | 0.19+ |
| 5–8 years | 0.14 | 0.16+ | 0.14 | 0.17+ |
| > 8 years | 0.71 | 0.64+ | 0.71 | 0.64+ |
| Employment | | | | |
| Full-time in nursing | 0.72 | 0.84+ | 0.74 | 0.87+ |
| Part-time in nursing | 0.28 | 0.17+ | 0.26 | 0.13+ |
| Nursing occupation | | | | |
| Administration | 0.15 | 0.10+ | 0.15 | 0.10+ |
| Staff nurse | 0.67 | 0.78+ | 0.67 | 0.79+ |
| Other | 0.18 | 0.12+ | 0.18 | 0.11+ |
| Employment setting | | | | |
| Hospital | 0.63 | 0.73+ | 0.63 | 0.75+ |
| Nursing home | 0.07 | 0.09+ | 0.05 | 0.09+ |
| Educational setting | 0.02 | 0.03+ | 0.02 | 0.03+ |
| Ambulatory care | 0.09 | 0.05+ | 0.10 | 0.04+ |
| Other setting | 0.19 | 0.10+ | 0.20 | 0.09+ |
| Number of observations | 145,496 | 5,012 | 39,052 | 3,308 |

*Data source:* NSSRN: 1988, 1992, 1996, 2000, 2004, and 2008.
*Notes:* Number of observations corresponds to the RNs working as registered nurses. + indicates that the mean values for foreign- and U.S.-trained nurses are statistically different at 10% confidence interval.

potential experience, and demography. Specifically, the control variables are age (categorical) when the first nursing degree was received, gender, race, marital status, year of observation, and years since first nursing degree (included as a quadratic function), state of residence, state of residence interacted with whether the nurse lives in an MSA, and a dummy variable if MSA information is missing.[13] Model 2 adds controls for nursing occupation and place of work to Model 1. The occupational variables are whether the RN is an administrator, a staff nurse, or does another type of work; and a

[13]In our sample, 5.5% of the U.S.-trained nurses and 7.2% of the foreign-trained nurses are male; 28% of the U.S.-trained and 26% of the foreign-trained nurses are unmarried. Because marriage is likely to raise men's wages but lower women's wages, the differential in gender composition and marital status of the two samples may also result in a wage difference. In additional analyses, we included an interaction of male with whether the nurse was married. While, as expected, the coefficient of the interaction was positive, the difference in wages of foreign- and U.S.-trained nurses were the same as reported in Table 2.

dummy indicator if consulting with agencies occupies more than 50% of the nurse's time in the principal nursing position. Employment setting controls are categorical variables indicating whether the RN works in a hospital, nursing home, educational setting, ambulatory care, or other settings, and whether the nurse works full-time. Model 3 adds demand-side variables to Model 2. These variables are state unemployment rate, proportion of the elderly in the state population, proportion of blacks in the state population, log of state working-age population, per capita number of inpatient days and its squared term, per capita number of outpatients visits and its squared term, per capita hospital admissions and its squared term. The final specification, Model 4, adds unrestricted state-year dummy variables to Model 2.

Estimates in Table 2 indicate that the hourly wage of foreign-trained nurses with a diploma or associate degree is 3.3% higher than the hourly wage of similar U.S.-trained nurses, after adjusting for demographic characteristics, education, potential experience, and geographic controls. Inclusion of controls for occupation and place of work in Model 2 brings the wage difference down to 2%. It is notable that controlling for the occupation and place of work has a very small effect on estimated wage differentials. Many observers have argued that immigrant nurses work in very different settings than do U.S.-trained nurses, and that may explain their higher wages (Polsky, Ross, Brusch, and Sochalski 2007; Cortes and Pan 2012). Descriptive data support this hypothesis, but our analysis shows that wage differentials are more or less the same whether we examine within or between employment settings and occupations. The estimated difference remains at 2% in Model 3, which includes controls for demand-side variables, and Model 4, which replaces measured state-year variables with 306 unrestricted state-year effects.[14] The hourly wage of foreign-trained nurses with a bachelor's degree or higher degree is virtually the same as those of similar U.S.-trained nurses in Models 1 to 4: the estimated wage differentials are less than 1% and not statistically significant.

One difference between U.S.- and foreign-trained nurses is that the latter are more likely to work in a hospital setting, although as figures in Table 1 indicate, the difference is not that large (73% to 63%). While the regressions in Table 2 control for work setting, it is possible that the effect of other covariates may differ for those working within the hospital setting. In Panel 1 of Table 3, therefore, we repeat the analysis in Table 2 after restricting the sample of nurses to those who worked in a hospital. The wage gap between foreign- and U.S.-trained nurses without a bachelor's degree is now small, 1% or less, and not statistically significant. For nurses with a bachelor's or higher degree, as in Table 2, the wage gap is negligible in Models 1 to 4.[15]

As documented in Table 1, foreign-trained nurses are more likely than U.S.-trained nurses to work full-time. Thus, one source of difference in their

[14]While we have used data that has detailed information about nurse characteristics, the remaining wage difference could be attributable to missing variables such as difference in nontraditional work schedules—about which we have no information.

[15]We also conducted the analysis in Table 2 with log annual real earnings as the dependent variable. The results are similar to those in Table 2 and are presented in Table A.1.

*Table 2.* Estimates of the Difference in Real Wage of Foreign-Trained and U.S.-Trained Registered Nurses

| | *RNs with associate degree or diploma* | | | | *RNs with bachelor's degree or higher* | | | | *All nurses* |
|---|---|---|---|---|---|---|---|---|---|
| | *Model 1* | *Model 2* | *Model 3* | *Model 4* | *Model 1* | *Model 2* | *Model 3* | *Model 4* | *Model 4* |
| *Foreign-trained* | 0.033*** | 0.020** | 0.020** | 0.019* | 0.005 | 0.006 | 0.005 | 0.003 | 0.011 |
| | (0.009) | (0.009) | (0.010) | (0.010) | (0.009) | (0.009) | (0.009) | (0.010) | (0.008) |
| Number of observations | 80,109 | 80,109 | 79,826 | 79,826 | 61,762 | 61,762 | 61,537 | 61,537 | 141,363 |
| **Model covariates** | | | | | | | | | |
| Demographic, education, experience, geography | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Occupation and employment setting | No | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes |
| Demand-side variables | No | No | Yes | No | No | No | Yes | No | No |
| State-year effects | No | No | No | Yes | No | No | No | Yes | Yes |

*Data source:* NSSRN: 1988, 1992, 1996, 2000, 2004, and 2008.

*Notes:* The dependent variable is the natural logarithm of the real wage of a registered nurse in all nursing occupations in the previous year. The sample is restricted to RNs who worked more than 250 hours and less than 4,201 hours in the previous year, were not self-employed, and earned more than the federal minimum wage. Each cell in row 1 presents an estimate from a separate regression. Demographic characteristics include age when first nursing degree received (dummy variables indicating < 20, 20–24, 25–29, 30–34, 35–39, 40–60 years), gender, dummy variables for whether the respondent is white and whether currently married, and each survey year. Education is highest degree in nursing measured as a set of dummy variables indicating diploma, associate degree, bachelor's degree, or more than a bachelor's. Experience is measured as years since first nursing degree specified as a quadratic. Geographic controls include dummy variables for state of residence and interactions of these with dummy variables for whether person lives in an MSA or MSA information is missing. Nursing occupation is measured by dummy variables for the following categories: administrator, staff nurse, and other, and a dummy indicator if the RN is a consultant. Employment setting controls are dummy variables indicating whether the RN works in a hospital, nursing home, educational setting, ambulatory care, or other settings and whether the nurse works full-time in nursing. Demand-side variables are state unemployment rate, proportion of the elderly in state population, proportion of blacks in state population, log of state working-age population, per capita number of inpatient days and its squared term, per capita number of outpatient visits and its squared term, per capita hospital admissions and its squared term. Robust standard errors clustered on state of residence are in parentheses.

*$p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

*Table 3.* Estimates of the Difference in Real Wage of Foreign-Trained and U.S.-Trained Registered Nurses by Workplace Setting, Hours of Work, and Relative Size of the Foreign Nurse Population in a State

| | *RNs with associate degree or diploma* | | | | *RNs with bachelor's degree or higher* | | | | *All nurses* |
|---|---|---|---|---|---|---|---|---|---|
| | *Model 1* | *Model 2* | *Model 3* | *Model 4* | *Model 1* | *Model 2* | *Model 3* | *Model 4* | *Model 4* |
| **Panel 1: RNs in hospital setting** | | | | | | | | | |
| Foreign-trained | 0.001 | 0.010 | 0.010 | 0.009 | –0.002 | 0.013 | 0.012 | 0.010 | 0.010 |
| | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.009) | (0.008) |
| *N* | 51,298 | 51,298 | 51,298 | 51,298 | 38,280 | 38,280 | 38,280 | 38,280 | 89,578 |
| **Panel 2: RNs who worked >1,500 hours in the previous year** | | | | | | | | | |
| Foreign-trained | 0.031*** | 0.022** | 0.022** | 0.021** | -0.001 | 0.005 | 0.004 | 0.003 | 0.012 |
| | (0.010) | (0.009) | (0.009) | (0.010) | (0.008) | (0.009) | (0.009) | (0.009) | (0.008) |
| *N* | 63,614 | 63,614 | 63,385 | 63,385 | 48,977 | 48,977 | 48,786 | 48,786 | 112,171 |
| **Panel 3: RNs in top 10 states in foreign-trained nurses** | | | | | | | | | |
| Foreign-trained | 0.045*** | 0.034** | 0.033** | 0.034** | 0.010 | 0.013 | 0.013 | 0.011 | 0.021** |
| | (0.011) | (0.011) | (0.011) | (0.011) | (0.009) | (0.009) | (0.009) | (0.010) | (0.009) |
| *N* | 21,515 | 21,515 | 21,413 | 21,413 | 18,522 | 18,522 | 18,450 | 18,450 | 39,863 |
| **Model covariates** | | | | | | | | | |
| Demographic, education, experience, geography | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Occupation and employment setting | No | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes |
| Demand-side variables | No | No | Yes | No | No | No | Yes | No | No |
| State-year effects | No | No | No | Yes | No | No | No | Yes | Yes |

*Notes:* See notes to Table 2. The top 10 states in foreign-trained nurses are California, Florida, Hawaii, Illinois, Maryland, Nevada, New Jersey, New York, Texas, and Virginia.
*$p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

wages could be due to this circumstance. Therefore, in Panel 2 of Table 3 we present estimates from an analysis restricting samples to nurses who worked in nursing for at least 1,500 hours in the preceding year. Estimated effects are similar to those presented in Table 2: small (2%), positive wage gap for nurses with less than a bachelor's degree, and virtually no wage differences among nurses with a bachelor's or more. Thus our primary results are not driven by differences in hours worked between the two groups.

Finally, we obtained estimates of wage differentials using a sample of nurses restricted to the top 10 states in terms of the presence of foreign-trained nurses. Foreign-trained nurses, like other foreign-born persons, have a propensity to settle in a few states, and it is in these states that their presence is most likely to affect the labor market opportunities of domestic nurses as well as the quality of nursing services. Estimates in Panel 3 of Table 3 are roughly similar to those in the earlier analysis: adjusting for covariates, foreign-trained nurses without a bachelor's degree have a somewhat higher wage (3.4%) than similar U.S.-trained nurses. The average wage of foreign-trained nurses with a bachelor's or higher education is virtually the same as those of similar U.S.- trained nurses.

Next we examine whether returns to experience in nursing differ between U.S.- and foreign-trained nurses. Estimates are presented in Table 4. As in the earlier analysis, we study returns to experience within the two skill groups defined by education in nursing. We reject the hypothesis that the return to experience is the same for foreign-trained and U.S.-trained nurses in both educational categories. Estimates suggest that return to experience for the foreign-trained compared with that for the U.S.-trained (in Model 2, Table 4) is low in the initial years of experience and increases over time (the coefficient for experience and foreign-trained interaction is negative and the coefficient for experience-squared and foreign-trained is positive).

To fully comprehend the implications of these specifications on the wage gap between foreign- and U.S.-trained nurses, in the bottom panel of Table 4 we present estimates of the wage gap at three points on the experience profile of these two groups: 5 years of experience, 10 years of experience, and 20 years of experience. Estimate of wage gap is positive and significant for the low-educated group and negligible for the high-educated group, across the three points of experience. Notably, however, while some evidence suggests that the return to experience differs between the foreign- and U.S.-trained, the differences are trivial, as indicated by the similarity of the wage gap at different points in the experience distribution.

Model 3 allows the returns to experience in the United States to differ from those acquired abroad. Experience post U.S. arrival of foreign-trained nurses is defined as years since immigration to the United States. Because years since immigration is not detailed in the pre-2000 NSSRN samples, the analysis in Model 3 is based on 2000, 2004, and 2008 data.[16] The return to foreign experience for the foreign-trained is less than the initial return to

[16]See Table A.2 for estimates from Models 1–2 using NSSRN 2000, 2004, and 2008 data.

*Table 4.* Returns to Experience: Foreign-Trained and U.S.-Trained Registered Nurses

| | *RNs with associate degree or diploma* | | | *RNs with bachelor's degree or higher* | | |
|---|---|---|---|---|---|---|
| | *Model 1* | *Model 2* | *Model 3* | *Model 1* | *Model 2* | *Model 3* |
| Foreign-trained | 0.0189** | 0.0477** | 0.0332 | 0.0022 | 0.0069 | 0.0239 |
| | (0.0094) | (0.0226) | (0.0436) | (0.0098) | (0.0240) | (0.0307) |
| Experience | 0.0152*** | 0.0153*** | 0.0165*** | 0.0166*** | 0.0168*** | 0.0178*** |
| | (0.0005) | (0.0005) | (0.0007) | (0.0006) | (0.0006) | (0.0007) |
| Experience squared | –0.0003*** | –0.0003*** | –0.0003*** | –0.0003*** | –0.0003*** | –0.0003*** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Experience*Foreign-trained | | –0.0043* | –0.0113** | | –0.0032 | –0.0150*** |
| | | (0.0022) | (0.0050) | | (0.0020) | (0.0043) |
| Experience squared*Foreign-trained | | 0.0001** | 0.0002* | | 0.0001*** | 0.0003** |
| | | (0.0001) | (0.0001) | | (0.0000) | (0.0001) |
| Experience post U.S. arrival | | | 0.0124*** | | | 0.0193*** |
| | | | (0.0040) | | | (0.0035) |
| Experience squared post U.S. arrival | | | –0.0002** | | | –0.0004*** |
| | | | (0.0001) | | | (0.0001) |
| *p* value of test of joint significance of experience*foreign-trained and experience squared*foreign-trained | | 0.09 | | | 0.006 | |
| *N* | 79,996 | 79,996 | 37,179 | 61,676 | 61,676 | 34,155 |
| **Predicted difference in real wage of foreign- and U.S.-trained nurses** | | | | | | |
| Total experience = 5 years | | 0.044** | | | 0.005 | |
| | | (0.021) | | | (0.023) | |
| Total experience = 10 years | | 0.046** | | | 0.006 | |
| | | (0.021) | | | (0.023) | |
| Total experience = 20 years | | 0.048** | | | 0.009 | |
| | | (0.022) | | | (0.023) | |
| Experience = 5 years; U.S. experience | | | 0.035 | | | 0.029 |
| For foreign-trained = 2 years | | | (0.041) | | | (0.029) |
| Experience = 5 years, U.S. experience | | | 0.034 | | | 0.027 |
| For foreign-trained = 5 years | | | (0.041) | | | (0.029) |

*(continued)*

*Table 4.* Continued

| | *RNs with associate degree or diploma* | | | *RNs with bachelor's degree or higher* | | |
|---|---|---|---|---|---|---|
| | *Model 1* | *Model 2* | *Model 3* | *Model 1* | *Model 2* | *Model 3* |
| Experience = 10 years, U.S. experience | | | 0.037 | | | 0.032 |
| For foreign-trained = 2 years | | | (0.041) | | | (0.030) |
| Experience = 10 years, U.S. experience | | | 0.036 | | | 0.030 |
| For foreign-trained = 5 years | | | (0.041) | | | (0.030) |
| Experience = 10 years, U.S. experience | | | 0.033 | | | 0.026 |
| For foreign-trained 10 years | | | (0.041) | | | (0.029) |
| Experience = 20 years, U.S. experience | | | 0.040 | | | 0.035 |
| For foreign-trained = 5 years | | | (0.043) | | | (0.030) |
| Experience = 20 years, U.S. experience | | | 0.037 | | | 0.031 |
| For foreign-trained = 10 years | | | (0.043) | | | (0.030) |
| Experience = 20 years, U.S. experience | | | 0.035 | | | 0.027 |
| For foreign-trained 15 years | | | (0.043) | | | (0.030) |

*Notes:* See notes to Table 2. Each column is based on a separate regression. Model 1 corresponds to Model 4 in Table 2. Additionally, Model 2 allows the effect of experience to differ for the U.S.- and foreign-trained, and Model 3 allows the effect of U.S. experience and foreign experience to differ for the foreign-trained. Experience is defined as number of years since the first nursing degree. In Model 3, experience post U.S. arrival of foreign-trained nurses is defined as years since immigration to the United States. Models 1 and 2 are based on 1988, 1992, 1996, 2000, 2004, and 2008 data; Model 3 is based on 2000, 2004, and 2008 data because for earlier years, data on years since immigration to the United States are not detailed enough for us to carry out the analysis.
*$p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

their experience in the United States, but this difference too declines over time (the coefficient for foreign experience and foreign-trained interaction is negative, and the coefficient for foreign experience-squared and foreign-trained is positive). While statistically significant, the differences in the return to experience according to whether it was obtained in home country or in the United States have little impact on wage gaps between foreign-trained and U.S.-trained nurses. All estimates of wage gap (shown at bottom of Table 4 for estimates from Model 3) for both skill groups are modest and statistically insignificant. These results along with those in Tables 2 and 3 suggest that foreign- and U.S.-trained nurses are approximately equally productive, as measured by wages, and therefore likely to be close substitutes (see Appendix A for the analytical argument to support this statement).

To formally assess whether U.S.-trained and foreign-trained nurses are perfect substitutes, we follow Ottaviano and Peri (2012) and Card (2009) and estimate Equation (3). We use the NSSRN data to estimate the share of foreign-trained nurses by state and year. Because many states in our sample have very few foreign-trained nurses, to minimize measurement error we restrict the analysis to the top 10 states in terms of foreign-trained nurses. Further, because of sample size limitations, we conduct this analysis on all nurses and not by education group. To address the issue of the likely endogeneity of the location choices of foreign-trained nurses, we use the share of foreign-trained nurses lagged by four years and by eight years to predict their contemporaneous share. OLS and IV estimates are presented in Table 5 along with *F*-statistics associated with excluded instruments from the first-stage model. Note that we instrument for foreign share and the interaction between the immigrant dummy variable and foreign share by lagged foreign share and the interaction between immigrant dummy and lagged foreign share.

Of interest here is the coefficient on the interaction term between foreign-trained and foreign share. If foreign-trained and U.S.-trained nurses are perfect substitutes, then the coefficient on the interaction term should be zero, implying that increases in the share of foreign-trained nurses will have the same effect on the wages of both U.S.- and foreign-trained nurses. The IV estimates of the coefficient on the interactions term between foreign-trained and foreign share in Panel 1 are insignificant and very close to zero, which suggests that U.S.-trained and foreign-trained are perfect substitutes. The coefficient on the main effect of foreign share is negative (not significant) in Column 2 and positive (significant) in Column 3; theory suggests that these estimates should be negative.

*F*-statistics associated with the excluded instruments are 7 for foreign share and 18 for the foreign share interacted with foreign-trained in the model where the instruments are foreign share lagged by four years and its interaction with the foreign-trained dummy. The corresponding *F*-statistics are smaller when the instruments are lagged by eight years. The relatively small *F*-statistics on the excluded instruments indicate that we have weak instruments to predict foreign share, particularly when the lag is eight years. This will tend to bias estimates toward the OLS, which is reflected in the estimates

*Table 5.* Estimates of the Difference in Real Wage of Foreign-Trained and U.S.-Trained Registered Nurses Test of Perfect Substitute Hypothesis

| | *Panel 1* | | | *Panel 2* | | | *Panel 3* | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Model 1 OLS* | *Model 2 IV* | *Model 3 IV* | *Model 1 OLS* | *Model 2 IV* | *Model 3 IV* | *Model 1 OLS* | *Model 2 IV* | *Model 3 IV* |
| Foreign-trained | –0.047 | 0.003 | 0.020 | –0.068 | –0.013 | 0.003 | –0.053 | –0.027 | –0.002 |
| | (0.054) | (0.094) | (0.112) | (0.053) | (0.085) | (0.110) | (0.042) | (0.055) | (0.073) |
| Foreign-trained*log (foreign share) | –0.027 | –0.008 | 0.001 | –0.035 | –0.014 | –0.006 | –0.029 | –0.018 | –0.007 |
| | (0.022) | (0.036) | (0.043) | (0.021) | (0.033) | (0.042) | (0.017) | (0.022) | (0.029) |
| Log (foreign share) | 0.037* | –0.227 | 0.108*** | | | | 0.016* | 0.044 | 0.010 |
| | (0.018) | (0.267) | (0.039) | | | | (0.008) | (0.037) | (0.021) |
| **Marginal effect of foreign-trained**[a] | | | | | | | | | |
| At 25th percentile of share distribution | 0.038 | 0.028 | 0.017 | 0.042 | 0.031 | 0.022 | 0.037 | 0.029 | 0.020 |
| At 50th percentile of share distribution | 0.025 | 0.024 | 0.017 | 0.025 | 0.024 | 0.019 | 0.026 | 0.022 | 0.017 |
| At 75th percentile of share distribution | 0.017 | 0.022 | 0.018 | 0.015 | 0.020 | 0.017 | 0.015 | 0.015 | 0.015 |
| Model includes year-state interactions | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes |
| Joint *F*-stat of excluded instruments: | | | | | | | | | |
| Foreign share | | 6.7 | 0.19 | | | | | 0.77 | 1.36 |
| Foreign-trained*Foreign share | | 17.8 | 13.98 | | 29.97 | 28.27 | | 37.17 | 23.06 |
| *N* | 39,863 | 39,863 | 33,253 | 39,863 | 39,863 | 33,253 | 39,863 | 39,863 | 33,253 |

*Notes:* See notes to Table 2. Estimates in Models 1 and 2 are based on NSSRN data for 1988, 1992, 1996, 2000, 2004, and 2008; estimates in Model 3 are based on NSSRN data for 1992, 1996, 2000, 2004, and 2008. The sample of analysis is RNs in the top 10 states in terms of the number of foreign-trained nurses. Models in Panel 1 have all the controls of Model 3 in Table 2. Additionally, models in Panels 2 and 3 include dummy variables for state-year interactions, and models in Panel 3 further control for year-education effects and education-state effects. In Panels 1 and 2, foreign share is defined as share of nurses who are foreign-trained by state and year; in Panel 3, foreign share is share of nurses who are foreign-trained by state, year, and education (whether they have at least a bachelor's degree in nursing or not). In Panels 1 and 3, foreign share and foreign share interacted with foreign-trained are instrumented with lagged foreign share and lagged foreign share interacted with foreign-trained. In Panel 2, the variable foreign share interacted with foreign-trained is instrumented by lagged foreign share interacted with foreign-trained. The lagged instruments have a four-year lag in Model 2 and an eight-year lag in Model 3.

[a]The percentile of share distribution is for the top 10 states. Robust standard errors clustered on state of residence are in parentheses.

*$p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

on foreign share in Column 3. Given the possibility of weak instruments, we are cautious in drawing too strong a conclusion from these estimates.

To address the weak-instrument problem and to more fully address the endogeneity of foreign share, we re-estimate the model (Equation 3) including a full set of state-by-year dummy variables (Panel 2). This approach still allows us to estimate the coefficient on the interaction between foreign share and the foreign-trained dummy variable and more fully controls for unmeasured demand-side factors that may affect both the share of immigrants and relative wages. This is a powerful way to control for the endogeneity of unmeasured demand-side factors that affect immigration and wages and is our preferred specification. In these regressions, we are able to control for all time-varying (observed and unobserved) demand variables. Note that because foreign share varies by state-year, it drops out from the regression. In fact, it is plausible that, conditional on the state-year controls, it is no longer necessary to instrument for foreign share, so OLS estimates may be valid.

Estimates in Panel 2 of Table 5 indicate that a larger share of immigrants (supply) lowers the wages of foreign-trained more than those of U.S.-trained, but estimates of the interaction term are relatively small and not significant. The OLS estimate is slightly larger than the IV estimates. The predicted wage differentials, estimated at the 25th, 50th, and 75th percentiles of the share of distribution of foreign-trained nurses are modest at all three points and smaller in areas with a larger share of foreign-trained nurses. However, IV estimates of the coefficient on the interaction term are virtually zero, and wage differentials between U.S.- and foreign-trained nurses are similar at all points in the distribution of the share of foreign-trained nurses. These estimates are also suggestive that foreign-trained nurses are very close substitutes for U.S.-trained nurses. Again, we note that the instruments are weak, but the method of estimation (OLS or IV) does not greatly affect the inference with respect to the substitution hypothesis (all estimates are negative, small, and not statistically significant).

In Panel 3 of Table 5, we re-estimate the model but define foreign share by education (defined as whether the nurse has a bachelor's degree in nursing), state, and year. The specification also includes controls for state-education and year-education effects. In this case, we are able to estimate the main effect of foreign share and the interaction between foreign share and foreign-trained. Estimates in this panel are similar to those in the other two panels. Estimates of the coefficient on the interactions term between foreign-trained and foreign share are negative but small and insignificant, which suggests that U.S.-trained and foreign-trained are close substitutes.

## Conclusion

We investigated whether foreign- and U.S.-trained nurses are close substitutes by studying the differences in their wages and how their wages are affected by changes in supply. Regression estimates suggest that foreign-trained nurses without a bachelor's degree enjoy a small wage premium of 1 to 3% over

similar U.S.-trained nurses after adjusting for demographic, workplace, work type, and geographic differences. We find no statistically significant or numerically important difference in wage among foreign- and U.S.-trained nurses with a bachelor's degree. We also find that while returns to total years of experience for foreign-trained and U.S.-trained nurses, both with and without a BA, are statistically different, numerically the difference is quite modest. In specifications that allow the effect of U.S. experience for foreign-trained nurses to differ from the effect of experience they acquired abroad, the difference in wages at various experience levels and combinations of experience abroad and in the United States is small and statistically insignificant for both nurses with and those without a BA. Overall, for all nurses combined, the similarity of wages suggests that foreign- and U.S.-trained nurses are approximately equally productive, and this suggests that they are likely to be close substitutes.

We formally tested the proposition that foreign-trained and U.S.-trained nurses are perfect substitutes and could not reject the hypothesis that they are, although we did find that wages of foreign-trained nurses were slightly lower when the share of foreign-trained nurses in a state increased. In combination with the other evidence we presented, we conclude that foreign-trained and U.S.-trained nurses are strong substitutes for each other with very similar productivities as measured by wages. Therefore, immigration of nurses will likely adversely affect the wages of U.S. nurses.[17] Concerns that the quality of patient care will be reduced by immigration, however, are inconsistent with our findings.

## Appendix A

Two inputs can be perfect substitutes and not have equal wages because of varying productivities. When two inputs have the same wage, however, particularly when units are measured in the same scale, then it is very likely, although not certain, that the two inputs are perfect substitutes. The following demonstrates this.

Consider a CES Production Function with two types of labor: natives (N) and immigrants (I):

$$Y = [\gamma_N L_N^{\rho} + \gamma_I L_I^{\rho}]^{k/\rho}$$

Assuming competitive labor markets (firms take wage as given), cost minimization yields:

$$\frac{w_N}{w_I} = \frac{\gamma_N}{\gamma_I}\left(\frac{L_N}{L_I}\right)^{(\rho-1)}$$

[17]Our assessment of this hypothesis was hampered by weak instruments. It is important to note that the assessment of whether foreign- and U.S.-trained nurses were perfect substitutes did not rely as much on the instrumental variables procedure.

Empirically, we observe wage ratio equal to 1. For this to be the case, natives and immigrants are perfect substitutes with equal productivities:

$$1 = \frac{w_N}{w_I} = \frac{\gamma_N}{\gamma_I}\left(\frac{L_N}{L_I}\right)^{(\rho-1)}$$
$$\rho = 1$$
$$\gamma_N = \gamma_I$$

or, the following is true:

$$\frac{\gamma_I}{\gamma_N} = \left(\frac{L_N}{L_I}\right)^{(\rho-1)}$$

If nurses are positively selected, the ratio of productivities could be inversely related to the ratio of relative supplies. However, differences in immigrant and native productivity would have to be equal (by chance) to a function of differences in relative supplies, which seems unlikely.

Note that a wage ratio not equal to 1 can still imply perfect substitutes:

$$2 = \frac{w_N}{w_I} = \frac{\gamma_N}{\gamma_I}\left(\frac{L_N}{L_I}\right)^{(\rho-1)}$$
$$\rho = 1$$
$$\gamma_N = 2\gamma_I$$

$$.5 = \frac{w_N}{w_I} = \frac{\gamma_N}{\gamma_I}\left(\frac{L_N}{L_I}\right)^{(\rho-1)}$$
$$\rho = 1$$
$$\gamma_N = .5\gamma_I$$

In these cases, the two inputs are perfect substitutes that have different productivities.

*Table A.1.* Estimates of the Difference in Annual Real Earnings of Foreign-Trained and U.S.-Trained Registered Nurses

| | *RNs with associate degree or diploma* | | | | *RNs with bachelor's degree or higher* | | | | *All nurses* |
|---|---|---|---|---|---|---|---|---|---|
| | *Model 1* | *Model 2* | *Model 3* | *Model 4* | *Model 1* | *Model 2* | *Model 3* | *Model 4* | *Model 4* |
| Foreign-trained | 0.086*** | 0.025* | 0.025* | 0.023 | 0.065*** | 0.007 | 0.007 | 0.004 | 0.015 |
| | (0.017) | (0.014) | (0.014) | (0.014) | (0.014) | (0.011) | (0.011) | (0.012) | (0.010) |
| *N* | 80,838 | 80,838 | 80,544 | 80,544 | 62,470 | 62,470 | 62,234 | 62,234 | 142,778 |
| **Model covariates** | | | | | | | | | |
| Demographic, education, experience, geography | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Occupation and employment setting | No | Yes | Yes | Yes | No | Yes | Yes | Yes | Yes |
| Demand-side variables | No | No | Yes | No | No | No | Yes | No | No |
| State-year effects | No | No | No | Yes | No | No | No | Yes | Yes |

*Data source:* NSSRN 1988, 1992, 1996, 2000, 2004, and 2008.
*Notes:* See notes to Table 2.
*$p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

*Table A.2.* Returns to Experience: Foreign-Trained and U.S.-Trained Registered Nurses

| | *RNs with associate degree or diploma* | | *RNs with bachelor's degree or higher* | |
|---|---|---|---|---|
| | *Model 1* | *Model 2* | *Model 1* | *Model 2* |
| Foreign-trained | 0.0129 | 0.0392 | 0.0090 | 0.0119 |
| | (0.0112) | (0.0460) | (0.0108) | (0.0296) |
| Experience | 0.0164*** | 0.0165*** | 0.0175*** | 0.0177*** |
| | (0.0006) | (0.0007) | (0.0007) | (0.0007) |
| Experience squared | –0.0003*** | –0.0003*** | –0.0003*** | –0.0003*** |
| | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Experience*Foreign-trained | | –0.0042 | | –0.0029 |
| | | (0.0042) | | (0.0028) |
| Experience squared*Foreign-trained | | 0.0001 | | 0.0001* |
| | | (0.0001) | | (0.0001) |
| *N* | 37,204 | 37,204 | 34,175 | 34,175 |
| **Predicted difference in real wage of foreign- and U.S.-trained nurses** | | | | |
| Total experience = 5 years | | 0.036 | | 0.010 |
| | | (0.042) | | (0.028) |
| Total experience = 10 years | | 0.037 | | 0.011 |
| | | (0.043) | | (0.028) |
| Total experience = 20 years | | 0.039 | | 0.013 |
| | | (0.045) | | (0.029) |

*Notes:* See notes to Tables 2 and 4. Estimates are based on NSSRN data for 2000, 2004, and 2008.
*$p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

## References


Aiken, Linda H., Sean P. Clarke, Douglas M. Sloane, Julie A. Sochalski, Reinhard Busse, Heather Clarke, Phyllis Giovannetti, Jennifer Hunt, Anne Marie Rafferty, and Judith Shamian. 2001. Nurses' reports on hospital care in five countries. *Health Affairs* 20(3): 43–53.

Aiken, Linda H., Sean P. Clarke, Robyn B. Cheung, Douglas M. Sloane, and Jeffrey H. Silber. 2003. Educational levels of hospital nurses and surgical patient mortality. *Journal of the American Medical Association* 290: 1617–23.

Berliner, Howard S., and Eli Ginzberg. 2002. Why this hospital nursing shortage is different. *JAMA* 288: 2742–44.

Blakeney, Barbara. 2006. International nurse migration: Crisis or opportunity. Paper presented at meeting of National Nurse Association. May 17.

Brush, Barbara, Julie Sochalski, and Anne M. Berger. 2004. Imported care: Recruiting foreign nurses to U.S. health care facilities. *Health Affairs* 23(3): 78–87.

Card, David. 2009. Immigration and inequality (Richard T. Ely Lecture). *American Economic Review: Papers & Proceedings 2009.* 99(2): 1–21.

Chen, Peggy G., David I. Auerbach, Ulrike Muench, Leslie A. Curry, and Elizabeth H. Bradley. 2013. Policy solutions to address the foreign-educated and foreign-born health care workforce in the United States. *Health Affairs* 32(11): 1906–13.

Cortes, Patricia, and Jessica Pan. 2012. The relative quality of foreign nurses in the U.S. CREAM Discussion Paper No. 31/12. London: Centre for Research and Analysis of Migration.

Flynn, Linda, and Linda H. Aiken. 2002. Does international nurse recruitment influence practice values in U.S. hospitals? *Journal of Nursing Scholarship* 34(1): 67–73.

Hirsch, Barry T., and Edward J. Schumacher. 1995. Monopsony power and relative wages in the labor market for nurses. *Journal of Health Economics* 14(4): 443–76.

———. 2005. Classic or new monopsony? Searching for evidence in nursing labor markets. *Journal of Health Economics* 24(5): 969–89.

Glaessel-Brown, Eleanor E. 1998. Use of immigration policy to manage nursing shortages. *Journal of Nursing Scholarship* 30(4): 306–401.

Joel, Lucille A. 1996. Immigration: Why is it still up for discussion? *American Journal of Nursing* 96(1): 7.

Kaestner, Robert, and Neeraj Kaushal. 2012. Effect of nurse immigration on employment and earnings of U.S. nurses. *Journal of Urban Economics* 71(2): 219–29.

Kaushal, Neeraj, and Michael Fix. 2006. The contributions of high-skilled immigrants. *Insight Policy Briefs*, July, No. 16. Washington, DC: Migration Policy Institute.

Kline, Donna S. 2003. Push and pull factors in international nurse migration. *Journal of Nursing Scholarship* 35: 107.

Lafer, Gordon. 2005. Hospital speedups and the fiction of a nursing shortage. *Labor Studies Journal* 30(1): 27–46.

Lovell, Vicky. 2006. Solving the nursing shortage through higher wages. Institute for Women's Policy Research Publication C363A. Washington, DC: Institute for Women's Policy Research.

Ottaviano, Gianmarco, and Giovanni Peri. 2012. Rethinking the effects of immigration on wages. *Journal of the European Economic Association* 10(1): 152–97.

Polsky, Daniel, Sara J. Ross, Barbara L. Brush, and Julie Sochalski. 2007. Trends in characteristics and country of origin among foreign-trained nurses in the United States, 1990 and 2000. *American Journal of Public Health* 97(5): 895–99.

Schumacher, Edward J. 2011. Foreign-born nurses in U.S. labor markets. *Health Economics* 20(3): 362–78.

Staiger, Douglas, David I. Auerbach, and Peter I. Buerhaus. 2012. Registered nurse labor supply and the recession—Are we in a bubble? *New England Journal of Medicine* 366: 1463–65.

Trucios-Haynes, Enid. 2002. Temporary workers and future immigration policy conflicts: Protecting U.S. workers and satisfying the demand for global human capital. *Brandeis Law Journal* 40: 967.