

# Doctors Without Borders? The Returns to an Occupational License for Soviet Immigrant Physicians in Israel

Adriana D. Kugler\* and Robert M. Sauer†

March 2003

## Abstract

Re-licensing requirements for professionals that move across borders are widespread. In this paper, we measure the returns to an occupational license using data on Soviet physicians that immigrated to Israel. An immigrant re-training assignment rule provides an exogenous source of variation in licensing outcomes. Instrumental variables and quantile treatment effects estimates indicate large returns to an occupational license and negative selection into licensing status. We develop a behavioral model of optimal license acquisition which, together with the empirical results, suggests that stricter re-licensing requirements lead to lower average quality of service as well as practitioner rents in the market for physicians.

---

\*Universitat Pompeu Fabra and CEPR.

†The Hebrew University of Jerusalem.

# 1 Introduction

Restricted entry into an occupation through occupational licensing requirements is a widespread phenomenon. At least 18 percent of the work force in the United States is affected by occupational licensing, exceeding both minimum wage coverage and membership in unions (Kleiner (2000)). Occupational licensing is also widespread in many other countries. In the European Union, for example, occupational entry restrictions are thought to substantially affect incentives for internal migration and labor mobility between member states (Krueger (2000)).<sup>1</sup>

In the traditional theory of economic regulation, occupational licensing is generally thought of as an institution that allows practitioners to capture monopoly rents (see Friedman and Kuznets (1945), Stigler (1971) and Posner (1974)). Licensing is seen as a tool used by practitioners to restrict labor supply and drive up the price of labor. More recent theoretical analyses of occupational licensing, however, focus on the conditions under which occupational licensing can be socially beneficial. Licensing may improve the average quality of service offered by practitioners when the entry of less-competent practitioners is prevented, or when less-competent practitioners are forced to increase their investments in human capital (Leland (1979), Shaked and Sutton (1981) and Shapiro (1986)). The social loss due to excess wages may be outweighed by the social gains from higher quality of service.

The theoretical ambiguity over the net social benefits of occupational licensing is accompanied by an inconclusive empirical literature. Previous empirical studies, which mostly use data from the US and Canada, usually find higher mean earnings for individuals in regulated occupations, holding observed human capital levels constant (see, e.g., Benham, Maurizi, and Reder (1968), Muzondo and Pazderka (1980), Pashigian (1980), Kleiner and Kudrle (2000) and Kleiner (2000)). But the data used

---

<sup>1</sup>Licensing requirements in the US and Europe not only affect those in professional occupations (such as physicians, nurses, dentists, and lawyers), but also those in less skilled occupations such as barbers and cosmetologists (see Kleiner (2000) for more discussion).

in these studies generally do not permit identification of the causal effect of entry restrictions on earnings and thus inference on the presence of rents. Entry restrictions and self-selection into the regulated occupation are often confounded. Reliable evidence that licensing improves the average quality of service offered by practitioners is even more rare. The main difficulty in measuring quality effects is in obtaining accurate measures of practitioner quality.<sup>2</sup>

In this paper, the returns to acquiring an occupational license are measured using novel data on the early labor market outcomes of Soviet immigrant physicians in Israel. The data allow us to identify the returns to a license free of biases due to non-random selection into licensing status. Identification of the returns is possible for several reasons. First, Soviet immigrant physicians are a relatively homogeneous group of individuals in terms of education and experience. Second, many Soviet immigrant physicians did not get re-licensed and/or obtain employment in their original profession.<sup>3</sup> Third, and perhaps most important, the Israel Ministry of Health exogenously assigned Soviet immigrant physicians to one of two different re-licensing tracks with inherently different probabilities of acquiring a license.

The Israel Ministry of Health places Soviet immigrant physicians either on a re-training track that requires the passing of a general medical knowledge licensing exam (the exam track), or on a re-training track that exempts immigrant physicians from the exam and grants a temporary general practitioner license for six months (the observation track). The temporary license allows the practice of medicine under the

---

<sup>2</sup>Kleiner and Kudrle (2000) indirectly measure quality effects by comparing the dental health of individuals across states that vary in entry requirements for dentists. Angrist and Guryan (2003) examine the effect of teacher certification requirements on teacher quality as measured by educational background. Both studies find small quality effects.

<sup>3</sup>Pashigian (1980) notes that identification of the returns to an occupational license may be difficult for the simple reason that there may be very little variation in licensing status among individuals with similar education and training levels.

observation of native physicians. At the end of the six month period, immigrant physicians on the observation track receive a permanent license with near certainty. Assignment to re-training track follows a “20-year rule”. Immigrants with more than 20 years of previous physician experience are assigned to the observation track, those with less than 20 years must pass the re-licensing exam.<sup>4</sup> Track assignment is not a function of immigrant unobservables.

It is interesting to note that the institutional setting of physician re-licensing in Israel is not entirely unique. In the US, physicians that migrate across states must also be re-licensed and in many states exemption from a re-licensing exam is an exogenous function of previous physician experience. The “10-year rule” of state licensing boards requires migrant physicians that have not passed a national board exam within 10 years to take a Special Purpose Examination (SPEX) which tests their general medical knowledge. Physicians that have passed a national board exam within 10 years are exempt from the SPEX and are granted a license.<sup>5</sup> The results of this study on Soviet immigrant physicians are, therefore, generalizable.

According to OLS estimates, Soviet physicians that are re-licensed in Israel have substantially higher mean monthly earnings than their unlicensed counterparts. OLS estimates of the returns to a license range between 90 and 114 percent. However, OLS estimates are biased to the extent that licensing status is related to potential outcomes without a license. Instrumental variables estimates that exploit the assignment rule and isolate the returns to a license among compliers, i.e., individuals that would not have obtained a license had they not been assigned to the observation track, yield

---

<sup>4</sup>A small number of immigrant physicians in the data were subject to a later instituted “14-year rule”.

<sup>5</sup>The states that require the SPEX for migrant physicians who have not passed a national board test within ten years or who are not board-certified are Alabama, California, Illinois, Louisiana, Maryland, Minnesota, Mississippi, Montana, North Carolina, Nevada, New York, Oregon, South Carolina and Texas. See <http://www.ama-assn.org> for details.

an increase in mean monthly earnings that is higher than that estimated by OLS.<sup>6</sup> Instrumental variables estimates of the returns to a license range between 180 and 340 percent. The extremely large estimated returns under approximate “random” assignment are suggestive of the presence of rents.

The returns to an occupational license are also estimated using a quantile treatment effects (QTE) model (Abadie, Angrist and Imbens (2002)). The QTE model exploits the random assignment generated by the assignment rule, as opposed to conventional quantile regression, and is less sensitive than standard IV techniques to the inclusion of high earnings outliers and zero earnings for the unemployed. QTE estimates indicate that the returns to an occupational license are large at all examined quantiles. However, acquisition of a license more substantially increases the upper quantiles of the earnings distribution than the lower quantiles. The QTE model has an additional advantage in that it allows estimation of the counterfactual distribution of earnings without a license among those immigrants that obtained a license. The estimated counterfactual earnings distribution indicates negative selection into licensing status, i.e., immigrant physicians that acquired a license would have earned less without a license than immigrants that do not acquire one.

In order to interpret the OLS and IV estimates of the returns to a license and address the effects of re-licensing on the average quality of service, we develop a behavioral model of optimal license acquisition. The model links the theory with the empirical work by providing theoretical equivalents of the OLS and IV estimators used in estimation (Rosenzweig and Wolpin (2000)). The theoretical expressions illustrate why instrumental variables estimates may exceed OLS estimates in the context of optimal license acquisition. The model also has implications for the negative selection found in the data. Negative selection implies that stricter re-licensing requirements

---

<sup>6</sup>Compliers are individuals whose treatment status is affected by the instrument. The effect among compliers in this case is also the local average treatment effect (see Imbens and Angrist (1994) and Angrist, Imbens and Rubin (1996)).

leads to lower average quality of service in the licensed occupation. Re-licensing requirements for migrant physicians may, therefore, lead to both practitioner rents and the least skilled physicians choosing to be re-licensed.

The rest of the paper is organized as follows. The next section briefly describes the institutional setting of immigrant physician re-licensing in Israel. Section 3 formulates the model of optimal license acquisition. Section 4 describes the data and presents a graphical analysis of the correlation in the discontinuities in licensing and earnings outcomes which forms the basis of identification. Section 5 outlines the estimation strategy. Section 6 reports OLS, reduced form, IV and QTE estimates of the returns to a license. Section 7 summarizes and concludes.

## 2 Background

The recent mass immigration wave to Israel, from the former Soviet Union, contained an unusually large number of physicians. Between October 1989 and August 1993, approximately 12,500 Soviet physicians arrived in Israel, nearly doubling the potential supply of physicians. Before the arrival of the immigrant physicians, Israel already had one of the highest physician to population ratios in the world.<sup>7</sup> However, the demand for medical services substantially increased as the population grew by 10% during the period.<sup>8</sup>

According to Israeli immigration law, physicians that are licensed to practice medicine in a foreign country, and that have their foreign medical credentials recognized by

---

<sup>7</sup>The number of doctors per 100,000 Israelis in 1989 was 285. In the same year in the US, there were 216 doctors per 100,000 Americans.

<sup>8</sup>The 600,000 immigrants from the former Soviet Union that arrived between October 1989 and December 1995 eventually constituted 11% of the Israeli population. Weiss, Sauer and Gotlibovski (2003), Eckstein and Weiss (2002) and Eckstein and Cohen (2003) examine the general labor market assimilation of the recent arrivals.

the Israel Ministry of Health, must pass a re-licensing exam in order to legally practice medicine. However, immigrant physicians that practiced clinical medicine and that have substantial previous physician experience are exempt from the re-licensing exam. Until November 1992, the cutoff number of years required for exemption from the licensing exam was 20. The cutoff was subsequently lowered to 14 due to a perceived shortage of physicians. The lowering of the cutoff was abrupt and not publicized beforehand.

Immigrant physicians that are granted an exemption from the licensing exam must work under observation for six months in designated public hospitals or community clinics. During the six month work under observation period, immigrants receive a salary and minimal income support from the Ministry of Absorption. At the end of the six month period these immigrants receive a permanent license in general medicine with near certainty.

Immigrant physicians that are assigned to the exam track are eligible, but not required, to participate in a government sponsored examination preparation course. Over 90% of immigrants that are referred to the licensing exam choose to participate in a preparation course. Preparation courses last six months, are offered twice a year and are held in public hospitals throughout the country. In order to be accepted into a preparation course it is necessary to successfully complete a prior medical terminology language course that also lasts six months. Immigrant physicians that participate in the preparation course receive minimal income support from the Ministry of Absorption. A permanent license in general medicine is acquired after passing the exam.<sup>9</sup>

Upon successful completion of the re-licensing requirements, all immigrant physicians, independent of previous experience, must request to be recognized as specialists

---

<sup>9</sup>Approximately 14% of the immigrant physicians chose to re-train in alternative professions. Many of these immigrant physicians re-trained in paramedical professions such as gerontology, emergency medicine and alternative medicine.

in order to practice medicine in their former specialty. The Ministry of Health denies an overwhelming majority of these requests. Immigrant physicians whose requests are denied must fulfill a post-licensing residency requirement that includes successful completion of two specialty exams. The residency requirement can last a number of years depending upon medical specialty.<sup>10</sup> The status of specialist is not required for performing rounds in hospitals or treating patients in residential communities.

### 3 The Model

The decision of Soviet immigrant physicians to acquire a medical license in Israel can be described within a general model of optimal license acquisition. The model that we develop is similar to the training participation and earnings model described in Heckman, LaLonde and Smith (1999) but adds supply and average practitioner quality effects on mean wages in both unlicensed and licensed occupations.

The model assumes a continuum of workers of skill type  $\eta$ , where  $\eta$  is drawn from a distribution  $F(\cdot)$ . Individuals live for two periods and have a subjective discount rate  $r$ . In the first period, individuals choose whether to invest in acquiring a license or not. In the second period, all individuals work. Acquisition of a license in the first period involves both direct and indirect costs. The direct costs include the monetary equivalent of psychological costs of having to obtain a license, such as effort expended in studying for exams and/or meeting other licensing requirements. The direct costs also include tuition, fees and commuting expenses. The indirect costs are the foregone wages the individual could have earned in the unlicensed occupation in the first period. While direct costs are likely to be relatively lower for more skilled (higher  $\eta$ ) individuals, opportunity costs (foregone wages) of acquiring a license are

---

<sup>10</sup>Only a small percentage of immigrant physicians were in specialist residency at the time of the survey.

likely to be relatively higher.<sup>11</sup> The assumption that direct and indirect costs vary among individuals of different types generates selection into the licensed occupation.

The direct costs of acquiring a license are specified, without loss of generality, as  $\frac{C}{\eta}$ , reflecting the assumption that it is relatively easier for more highly skilled individuals to study for the licensing exam. Production functions in the licensed and unlicensed sectors,  $Y_L(\eta, N_L)$  and  $Y_U(\eta, N_U)$ , are assumed to be increasing in  $\eta$ , thus generating higher opportunity costs to acquiring a license for more highly skilled individuals. It is also assumed that there is diminishing returns with respect to employment,  $N_L$  and  $N_U$ , in both occupations.

Individuals seek to maximize lifetime income by choosing whether or not to acquire a license. Individuals choose to acquire a license and work in the licensed occupation in the second period, rather than work in the unlicensed occupation in both periods, if

$$\frac{w_L - w_U}{(1 + r)} \geq \frac{C}{\eta} + w_U. \quad (1)$$

$w_L$  and  $w_U$  are the wages in the licensed and unlicensed occupations and are defined as the marginal products of labor in the two occupations, respectively.<sup>12</sup> Equation (1) states that a license will be acquired if the discounted increase in earnings in the second period is greater than or equal to the sum of direct and indirect costs in the first period.<sup>13</sup>

The decision rule can also be expressed in terms of the maximum direct cost

<sup>11</sup>Direct costs could also be lower for higher skilled individuals if there is a positive correlation between skill level and pre-training assets. Highly skilled immigrants may be less liquidity constrained.

<sup>12</sup> $w_L$  and  $w_U$  are also functions of  $\eta$  and  $N_i$ ,  $i = L, U$ , but these arguments are dropped for convenience.

<sup>13</sup>Uncertainty in successfully meeting licensing requirements or in obtaining a job in the licensed occupation after completing the requirements can be thought of as factors that reduce the discounted wage premium.

component  $C$  that individuals are willing to incur to acquire a license. The maximum  $C$  is denoted as  $C_{\max}^{\eta}$ .  $C_{\max}^{\eta}$  equates lifetime income in the two occupations,

$$C_{\max}^{\eta} = \frac{\eta[w_L - (2 + r)w_U]}{(1 + r)}. \quad (2)$$

An individual of type  $\eta$  chooses to work in the licensed occupation if  $C_{\max}^{\eta} \geq C$  and chooses to work in the unlicensed occupation if  $C_{\max}^{\eta} < C$ .

$C_{\max}^{\eta}$  depends on  $\eta$  in the following way:

$$\begin{aligned} \frac{\partial C_{\max}^{\eta}}{\partial \eta} &= \frac{[w_L - (2 + r)w_U]}{(1 + r)} \\ &\quad - \frac{\eta[\frac{\partial w_L}{\partial \eta} - (2 + r)\frac{\partial w_U}{\partial \eta}]}{(1 + r)}. \end{aligned} \quad (3)$$

If higher skill reduces the direct costs of acquiring a license (the first term in (3)) by more than it increases foregone wages in the unlicensed occupation (the second term in (3)) then  $\frac{\partial C_{\max}^{\eta}}{\partial \eta} > 0$  and more highly skilled types are more willing to pay for the license. In this case, individuals with  $\eta \in [\underline{\eta}, \bar{\eta}]$  work in the licensed occupation and individuals with  $\eta \in [\underline{\eta}, \bar{\eta}]$  work in the unlicensed occupation, where  $\underline{\eta}$  is such that  $C_{\max}^{\underline{\eta}} = C$ . This case corresponds to positive selection into licensing status.

When there is positive selection, mean wages in the licensed and unlicensed occupations are, respectively,

$$\begin{aligned} E(w_L) &= \int_{\underline{\eta}}^{\bar{\eta}} \frac{\partial Y_L(\eta, (1 - F(\underline{\eta})))}{\partial N_L} f(\eta) d\eta, \\ E(w_U) &= \int_{\underline{\eta}}^{\bar{\eta}} \frac{\partial Y_U(\eta, F(\underline{\eta}))}{\partial N_U} f(\eta) d\eta. \end{aligned} \quad (4)$$

Note that stricter licensing requirements, or a higher  $C$ , unambiguously increase mean wages in the licensed occupation because  $\underline{\eta}$  increases. A higher  $\underline{\eta}$  reduces the supply of licensed workers ( $N_L = 1 - F(\underline{\eta})$ ), raising wages for all types. A higher  $\underline{\eta}$  also raises mean wages by increasing the lower bound of the integral that defines  $E(w_L)$ . That is, the average skill level of workers in the licensed occupation is increased. In the

case of positive selection,  $\frac{\partial E(w_L)}{\partial C} > 0$ , but  $\frac{\partial E(w_U)}{\partial C}$  is ambiguous in sign. The ambiguity on unlicensed earnings arises since more individuals enter the unlicensed occupation and this depresses unlicensed wages, but these individuals raise the average quality of unlicensed workers.<sup>14</sup>

If higher skill reduces the direct costs of acquiring a license by less than it increases foregone wages in the unlicensed occupation, then  $\frac{\partial C_{\max}}{\partial \eta} < 0$  and more highly skilled types are less willing to pay for the license. In this case, individuals with  $\eta \in [\underline{\eta}, \bar{\eta}]$  work in the licensed occupation and individuals with  $\eta \in [\bar{\eta}, \bar{\eta}]$  work in the unlicensed occupation. This case corresponds to negative selection into licensing status.

When there is negative selection, mean wages in the licensed and unlicensed occupations are, respectively,

$$\begin{aligned} E(w_L) &= \int_{\underline{\eta}}^{\bar{\eta}} \frac{\partial Y_L(\eta, F(\bar{\eta}))}{\partial N_L} f(\eta) d\eta, \\ E(w_U) &= \int_{\bar{\eta}}^{\bar{\eta}} \frac{\partial Y_U(\eta, (1 - F(\bar{\eta})))}{\partial N_U} f(\eta) d\eta. \end{aligned} \quad (5)$$

Note that stricter licensing requirements has an ambiguous effect on mean earnings in the licensed occupation. A higher  $C$  reduces  $\bar{\eta}$ , thus raising wages for all types in the licensed occupation, but a lower  $\bar{\eta}$  also reduces the upper bound of the integral that defines  $E(w_L)$ . In other words, stricter licensing requirements work to raise mean wages in the licensed occupation but the reduced average practitioner quality works to lower the average wages of practitioners. In the case of negative selection,  $\frac{\partial E(w_L)}{\partial C}$  is ambiguous in sign and  $\frac{\partial E(w_U)}{\partial C} < 0$ .

The theory outlined above can be linked to the empirical work by deriving theoretical expressions for the OLS and IV (or Wald) estimators used in estimation.<sup>15</sup> The

---

<sup>14</sup>The ambiguity can be resolved only under functional form specifications for the production functions and a distributional assumption on skill levels in the population.

<sup>15</sup>Rosenzweig and Wolpin (2000) advocate this approach in order to make transparent how the interpretation of IV estimates changes with alternative behavioral and market assumptions (see also Heckman (1997)).

OLS estimator is the difference in mean wages due to a difference in the probability of acquiring a license. According to the model, the difference in the probability of acquiring a license is due to differences in skill levels. The OLS estimator is:

$$\begin{aligned}
\frac{\partial E(w)}{\partial \Pr(C_{\max}^{\eta} \geq C)} &= \frac{\partial [E(w|L=1) \Pr(L=1) + E(w|L=0) \Pr(L=0)]}{\partial \Pr(C_{\max}^{\eta} \geq C)} \\
&= \frac{\partial [E(w|C_{\max}^{\eta} \geq C) \Pr(C_{\max}^{\eta} \geq C)]}{\partial \Pr(C_{\max}^{\eta} \geq C)} \\
&\quad + \frac{\partial [E(w|C_{\max}^{\eta} < C)(1 - \Pr(C_{\max}^{\eta} \geq C))]}{\partial \Pr(C_{\max}^{\eta} \geq C)} \\
&= E(w_L) - E(w_U).
\end{aligned} \tag{6}$$

In contrast, the IV estimator relies on the exogenous difference in  $C$  generated by different re-licensing regimes. According to the model, the two different re-licensing regimes, the exam track and the observation track, are a high  $C$  and a low  $C$ , respectively. The IV estimator is:

$$\begin{aligned}
\frac{\frac{\partial E(w)}{\partial C}}{\frac{\partial \Pr(C_{\max}^{\eta} \geq C)}{\partial C}} &= \frac{\partial E(w)}{\partial \Pr(C_{\max}^{\eta} \geq C)} \\
&\quad + \Pr(C_{\max}^{\eta} \geq C) \frac{\frac{\partial E(w_L)}{\partial C}}{\frac{\partial \Pr(C_{\max}^{\eta} \geq C)}{\partial C}} \\
&\quad + (1 - \Pr(C_{\max}^{\eta} \geq C)) \frac{\frac{\partial E(w_U)}{\partial C}}{\frac{\partial \Pr(C_{\max}^{\eta} \geq C)}{\partial C}}
\end{aligned} \tag{7}$$

where  $\frac{\partial \Pr(C_{\max}^{\eta} \geq C)}{\partial C} < 0$ . Notice that the IV estimator is equal to the OLS estimator of the returns to a license plus a correction term which is the weighted average of the change in earnings in the licensed and unlicensed occupations due to a change in  $C$ . In other words, the IV estimator corrects the OLS estimator with terms that are related to the difference in skill distribution between the two occupations and changes in earnings that are directly related to  $C$ .

In the case of positive selection into licensing status, the IV estimator may be greater or less than the OLS estimator. This is because  $\frac{\partial E(w_L)}{\partial C} > 0$  and the sign of

$\frac{\partial E(w_U)}{\partial C}$  is ambiguous. This is also true in the case of negative selection since the sign of  $\frac{\partial E(w_L)}{\partial C}$  is ambiguous even though  $\frac{\partial E(w_U)}{\partial C} < 0$ . Under positive selection, IV will be less than OLS if the increase in average skill levels in the unlicensed occupation is relatively stronger than the depression of wages due to an increase in supply. Similarly, under negative selection, IV will be greater than OLS if the decrease in average skill levels in the licensed occupation is relatively stronger than the increase in wages due to a decrease in supply.

## 4 The Data

The relevant population of immigrant physicians for this study is the subset of immigrants that arrived in Israel from the former USSR between October 1989 and June 1992, that submitted a request to the Israel Ministry of Health to start the process towards re-licensing, that had their medical credentials in the former USSR recognized, and that were referred to either the exam track or the observation track for re-training. Of the immigrants that declared at the airport, on the day of arrival, that they were physicians in the former USSR, 27% did not submit their credentials to the Ministry of Health.<sup>16</sup> Of the immigrants that submitted their credentials, 3% did not have their credentials recognized.<sup>17</sup> Of the immigrants that had their medical credentials recognized, 3% were not referred to one of the two re-training tracks. These latter immigrants were either required to complete a one year internship before being eligible for the exam track or were immediately granted recognition as specialists. The total number of immigrant physicians in this restricted population is 6,754.

Between the months of May and November of 1994, 731 of these 6,754 immigrant physicians were surveyed, in face-to-face interviews, by Russian-speaking enumerators

---

<sup>16</sup>The nonsubmitters are more likely than submitters to be over 55 years of age on arrival.

<sup>17</sup>Immigrants that did not have their credentials recognized are younger than those that had their credentials recognized.

using a questionnaire written in Russian. The survey was conducted under the auspices of the JDC-Brookdale Institute of Jerusalem, The Israel Ministry of Health and the Israel Ministry of Immigrant Absorption. The random sample of 731 immigrant physicians was stratified by assigned re-training track and geographical region. The goal was to interview 10% of the restricted population. A reserve list of immigrants was prepared, according to the same stratification rules, to substitute for those on the original list that could not be interviewed. In total, 1,002 immigrant physicians were approached for interviewing. In descending order of importance, those on the original list that were not interviewed were either not located, refused to be interviewed, return migrated, or had passed away.

#### **4.1 Descriptive Statistics**

Table 1 displays selected descriptive statistics for the sample by assigned re-training track. Of the 731 immigrant physicians in the sample, only 2 immigrants did not have a re-training track coded. Of the 414 immigrant physicians assigned to the exam track, 73% passed the re-licensing exam. Immigrants that were assigned to the exam track and that did not acquire a license either never took the exam or took the exam and failed. Of the 315 immigrant physicians assigned to the observation track, 89% worked under observation and acquired a permanent license. The 11% among this latter group that are coded as not having acquired a permanent license reported that they never looked for a place to begin work under observation.

The figures in Table 1 show that mean monthly earnings (including zeros for the unemployed), the employment rate and the rate of employment as a physician, at the time of the survey, are higher among immigrants assigned to the exam track. Individuals assigned to the exam track are, on average, 18 years younger and have 18 years less physician experience in the former USSR. These immigrants also have more children under the age of 18 living at home at the time of arrival. Note that a considerable proportion of immigrant physicians on the observation track are not

employed as physicians. Immigrants that are employed but not working as physicians are mostly working as post-secondary education teachers, social workers, qualified nurses, optometrists, medical technicians and paramedics. There is a small proportion of immigrant physicians working in less skilled occupations as unqualified nursemaids, cleaners in institutions, security guards, and skilled and unskilled workers in industry.<sup>18</sup>

In terms of gender composition, size of last city of residence in the former USSR (more than 1,000,000 inhabitants), continuation of studies in the former USSR towards an advanced medical degree and the number of months since arrival, the immigrants are quite similar by re-training track. There are only slight differences in marital status upon arrival, republic of origin and type of medical practice in the former USSR. There is a large difference in former specialist status. Note that over 95% of the immigrants in the sample arrived during the years 1990 and 1991.<sup>19</sup> Overall, the similarities in immigrant characteristics by assigned re-training track, except for characteristics that are related to age, constitute strong evidence of randomization.

## 4.2 Graphical Discontinuity Analysis

The Ministry of Health's re-training assignment rule can be used to construct instrumental variables estimates of the returns to an occupational license even though the assignment rule is a near deterministic function of years of previous physician experience and previous physician experience directly affects earnings in the host country. Identification relies on matching discontinuities (or nonlinearities) in the relationship between previous physician experience and licensing status and discontinuities in the

---

<sup>18</sup>Among immigrant physicians employed as physicians, 41% work for the government (local and national). The remainder work for HMO's and other private employers. Only 6% found physician work as a direct continuation of re-training.

<sup>19</sup>The percentage of immigrant physicians among all immigrants from the former USSR that arrived after 1991 is significantly smaller.

relationship between previous physician experience and earnings. The correlation between these discontinuities identifies the causal effect of acquiring a license on earnings as long as it is the assignment rule and not some other mechanism that is generating the discontinuities in licensing outcomes.<sup>20</sup>

In this subsection, the discontinuities that arise in licensing and labor market outcomes as a result of the re-training assignment rule are illustrated graphically. In Figure 1, the strong relationship between assigned re-training track and license acquisition is clearly seen. Figure 1 plots the proportion of immigrant physicians assigned to the observation track, the proportion acquiring a medical license and the proportion employed as physicians at the time of the survey, against years of physician experience in the former USSR. The proportion assigned to the observation track is zero until 14 years of experience. Between 14 and 19 years of experience the proportion fluctuates between 12 and 33 percent. At 20 years of experience the proportion sharply jumps up and fluctuates between 92 percent and 100 percent. After 26 years of experience, the proportion remains at 100 percent.<sup>21</sup>

Note that the proportion of immigrant physicians acquiring a license starts out quite high but then declines and stabilizes until 14 years of experience. Starting at 14 years of experience, the proportion acquiring a license jumps up together with jumps in the proportion assigned to the observation track. The proportion of immigrant physicians employed as physicians in Israel also starts out quite high and

---

<sup>20</sup>The regression discontinuity identification strategy originated with Campbell (1969). More recent applications include van der Klauuw (1996), Angrist and Lavy (1998) and Hahn, Todd and van der Klauuw (1998). See also Angrist and Krueger (2001) for a general discussion of the technique.

<sup>21</sup>Immigrant physicians that had 20 or more years of previous physician experience and that were not assigned to the observation track did not previously practice clinical medicine. Only 32 out of the 729 immigrants in the sample were assigned to the observation track according to the later 14-year rule. This is why the proportion assigned to the observation track and the proportion licensed between 14 and 19 years of experience is greater than zero and much lower than the proportion with more than 20 years of experience.

subsequently declines. However, the proportion employed as physicians does not appear to consistently jump together with the proportion assigned to the observation track.

Figure 2 plots mean monthly earnings at the time of the survey and the proportion acquiring a license against years of physician experience in the former USSR.<sup>22</sup> Note that mean monthly earnings declines sharply with both the proportion acquiring a license and years of previous physician experience. The downward trend in earnings is subsequently broken and reverses direction with sharp increases in the proportion acquiring a license.

The conclusions drawn from Figures 1 and 2 are tentative because they do not take into account the effect of other covariates on licensing and monthly earnings outcomes. It is possible that stronger correlations in discontinuities are being hidden by effects of other covariates. For example, immigrant physicians that pursued an advanced medical degree in the USSR have less previous physician experience and higher monthly earnings in Israel causing the trend in mean monthly earnings as depicted in Figure 2 to be biased downward. It is also possible that older immigrants find it more difficult to adapt to the new language, culture and institutions than younger immigrants, which would also bias the trend downwards. Biases due to omitted variables may affect licensing and monthly earnings outcomes differently in magnitude and direction.

Figure 3 plots the residuals from separate linear regressions, that have acquisition of a license and employment as a physician as dependent variables. The linear regressions include a large number of covariates (such as age upon arrival, dummies for advanced medical degrees and previous specialty status), but exclude previous

---

<sup>22</sup>Four year experience intervals are used to construct Figures 2 through 5 instead of the single-value intervals in Figure 1. The four year experience intervals help reduce the greater idiosyncratic variation in the monthly earnings data. The experience axis records the integer value of the interval midpoint.

physician experience. The figures now display sharper discontinuities in the licensing and employment as a physician outcomes. The correspondence between licensing status and obtaining employment as a physician is highly dependent on the inclusion of other covariates (compare to Figure 1).

Figure 4 plots license residuals and monthly earnings residuals against previous physician experience. The figures also display a stronger correlation, both in trend and discontinuities, between monthly earnings and licensing outcomes than in Figure 2. Both monthly earnings and the proportion acquiring a license fall sharply with experience and then either fall less sharply or jump up with changes in the proportion acquiring a license.

Figure 5 examines the relationship between monthly earnings, employment as a physician and previous physician experience in terms of residuals. The employment as physician residuals decline sharply with previous physician experience at low levels of experience but subsequently increase with monthly earnings residuals at both the 13 and 21 years of previous experience interval midpoints. The correlation in discontinuities between employment as a physician and monthly earnings appears relatively weaker than between license acquisition and monthly earnings (compare to Figure 4).

## 5 Estimation

### 5.1 Constant-Effects Model

The graphical analysis in the previous section suggests a link between licensing probabilities induced by the assignment rule and earnings, but does not provide a framework for formal statistical inference. In order to provide such a framework, we first consider a linear, constant-effects model that connects the earnings of immigrant  $i$  at time  $t$ ,  $Y_{it}$ , with the occupational licensing status of individual  $i$  at time  $t$ ,  $L_{it}$ , plus a vector  $X_i$  of immigrant characteristics at the time of arrival and a random error component

specific to individuals at time  $t$ ,  $\epsilon_{it}$ :

$$Y_{it} = X_i' \beta + t\delta + L_{it}\alpha + \epsilon_{it}. \quad (8)$$

The immigrant characteristics at the time of arrival, included in the vector  $X_i$ , are: a dummy for age on arrival (older than 50), dummies for year of arrival, gender, marital status, profession of spouse, number of children living at home under 18, size of last city of residence, Republic of origin, pursuit of an advanced medical degree, previous specialist status, previous type of medical practice and type of reported earnings (after-tax and/or after other deductions). Time in Israel (measured in months),  $t$ , is also included as a control variable in (8) and is, like the other elements of  $X_i$ , widely believed to be exogenous to potential labor market outcomes in Israel among those immigrants that arrived in the first three years of the immigration wave. All of the immigrant physicians in the sample arrived in Israel within this time frame.<sup>23</sup> The time in Israel variable generically captures changes in language ability, social networks and knowledge of local institutions.<sup>24</sup>

The interpretation of equation (8) is that it describes the earnings of immigrants under alternative assignments of licensing status, controlling for any effects of  $X_i$  and  $t$ . However, since  $L_{it}$  is not randomly assigned and is likely to be correlated with potential earnings, in this case  $\epsilon_{it}$ , OLS estimates of (8) do not have a causal interpretation. Instrumental variables estimates of (8) do have a causal interpretation as long as it is reasonable to assume that, after controlling for  $X_i$  and  $t$ , the association between assignment to the observation track and monthly earnings is solely due to

---

<sup>23</sup>In the empirical specifications, time in Israel is represented by a series of dummy variables. Time in Israel is strongly correlated with the size of the last city of residence in the former USSR. Immigrants that arrived earlier came from big cities in which there was greater access to information, government offices and consulates.

<sup>24</sup>Measures of English and Hebrew ability at the time of the survey and host country work experience are endogenous and strongly correlated with time in Israel. Language ability and host country work experience are thus not used in the analysis.

the association between observation track assignment and licensing status.

In IV estimation, the first stage relationship between licensing status, assignment to the observation track and  $X_i$  and  $t$  is:

$$L_{it} = X_i'\pi_0 + t\pi_1 + TR_i\pi_2 + \xi_{it}, \quad (9)$$

where  $TR_i = 1$  indicates assignment to the observation track and  $TR_i = 0$  indicates assignment to the exam track. The error term  $\xi_{it}$  is defined as the residual from the population regression of  $L_{it}$  on  $X_i$  and  $t$  and the instrument,  $TR_i$ . This residual captures other factors that are correlated with licensing status. These other factors are also probably correlated with  $\epsilon_{it}$ .

The key identifying assumption that underlies estimation using  $TR_i$  as an instrument is that any effects of previous physician experience on monthly earnings in Israel are adequately controlled by the smooth functions of previous physician experience included in  $X_i'\beta$  and “partialled out” of  $TR_i$  by the inclusion of smooth functions of previous physician experience in  $X_i'\pi_0$ . If this assumption is reasonable, then the discontinuities in earnings with previous physician experience, as depicted in the graphical analysis, is due to the acquisition of an occupational license.<sup>25</sup> The same discussion above carries through for measuring the effect of working as a physician in place of the effect of acquiring a license.

## 5.2 Quantile Treatment Effects Model

The constant-effects model specified above does not allow for differential effects of acquiring a license at different points in the monthly earnings distribution. This is especially problematic since the monthly earnings distribution has a mass point at zero. The effect of acquiring a license on participation may be substantially different from the effect of acquiring a license on conditional-on-positive mean earnings. An

---

<sup>25</sup>Card (1999) surveys evidence supporting the smoothness assumption in the relationship between experience and earnings.

alternative estimation strategy that is less sensitive to the inclusion of zero earnings for the unemployed, that is less demanding than formal sample-selection models, and that is less sensitive to high earnings outliers, is the quantile treatment effects model (see Angrist (2001) and Abadie, Angrist and Imbens (2002)). The quantile treatment effects model modifies conventional quantile regression for inclusion of an endogenous binary regressor.<sup>26</sup>

The quantile treatment effects model specifies a linear relationship between earnings and licensing status at each quantile. That is,

$$Q_\theta [Y_i|X_i, L_i, L_{1i} > L_{0i}] = X_i' \beta_\theta + L_i \alpha_\theta \quad (10)$$

where  $L_{1i}$  denotes licensing status when assigned to the observation track ( $TR_i = 1$ ) and  $L_{0i}$  denotes licensing status when assigned to the exam track ( $TR_i = 0$ ). The time in Israel subscript is suppressed for convenience. The coefficient  $\alpha_\theta$  has a causal interpretation because  $L_i$  is independent of potential earnings outcomes conditional on  $X_i$  and being a complier ( $L_{1i} > L_{0i}$ ).<sup>27</sup>

The parameters of the quantile treatment effects model are estimated by minimizing the sample analog of

$$E [\kappa_i \rho_\theta (Y_i - X_i' b_\theta - L_i a_\theta)] \quad (11)$$

where  $\rho_\theta$  is the “check function” (Koenker and Basset (1978)) and  $\kappa_i$  are weights that transform the conventional quantile regression minimand into a problem for compliers only. For computational reasons  $\kappa_i$  is replaced by an estimate of  $E [\kappa_i|X_i, L_i, Y_i]$  where

$$E [\kappa_i|X_i, L_i, Y_i] = 1 - \frac{L_i (1 - E [TR_i|Y_i, L_i, X_i])}{(1 - E [TR_i|X_i])} - \frac{(1 - L_i) E [TR_i|Y_i, L_i, X_i]}{E [TR_i|X_i]}. \quad (12)$$

The first step estimate of  $E [\kappa_i|X_i, L_i, Y_i]$  is obtained by separately estimating  $E [TR_i|Y_i, L_i, X_i]$  and  $E [TR_i|X_i]$ .

---

<sup>26</sup>See Chamberlain (1991) and Buchinsky (1994) for discussion and applications of traditional quantile regression.

<sup>27</sup>The proof is found in Abadie, Angrist and Imbens (2002).

## 6 Estimation Results

### 6.1 OLS Estimates

OLS estimates of the increase in mean monthly earnings (which include zeros for the unemployed) due to acquisition of a license are reported in Table 2.<sup>28</sup> Column (1) does not include any other covariates and yields a precisely estimated coefficient on licensed of 1279 New Israeli Shekel (NIS).<sup>29</sup> In 1994, the year in which earnings are reported, 1 NIS is approximately equal to .33 US dollars. The estimated increase in earnings of 1279 NIS corresponds to a percentage impact of 109%.<sup>30</sup>

Column (2) adds covariates to the regression, but excludes previous physician experience. The coefficient on licensed in this latter regression is a precisely estimated 1211, which corresponds to a percentage impact of 98%. Column (3) adds years of physician experience in the USSR and its square. The coefficient on licensed further decreases in strength to 1162 but is still precisely estimated. The percentage impact is 90%. It is interesting to note that Kleiner (2000) finds licensing effects on hourly earnings that are similar in magnitude when not controlling for observed human capital characteristics. Licensed dentists earn 91% more than unlicensed biological and life scientists. Licensed lawyers earn 94% more than unlicensed economists.

Column (4) reports the results of adding an indicator for being employed as a physician. The physician dummy is essentially an interaction between having acquired a license and being employed as a physician since it is illegal to be employed as a physician without having acquired a license. The coefficient on licensed turns

---

<sup>28</sup>We concentrate on monthly earnings because there is little variation in hours worked among immigrants as well as natives in Israel. There is very little part-time work.

<sup>29</sup>All standard errors are heteroscedasticity robust.

<sup>30</sup>The percentage impact is calculated as the ratio of the coefficient on licensed to the fitted value from the regression with the licensed dummy set to zero and other covariates set to the means among individuals with a license, when other covariates are included.

negative, is quite small in magnitude and is not precisely estimated. The coefficient on the physician dummy, however, is substantial. The OLS results do not indicate a significant return to a license when not employed as a practicing physician.<sup>31</sup>

Columns (5) and (6) repeat the specifications in Columns (3) and (4) for the subsample of immigrants that have previous physician experience between 14 and 26 years. This subsample of immigrants is referred to as the “discontinuity” sample. Restricting the analysis to the discontinuity sample helps control for differences in unobservables between immigrants of different ages (e.g., quality of medical education in the USSR) and isolates the subsample with the maximum variation in assigned re-training track. The experience levels 14 and 26 are the 45th and 75th percentiles, respectively, in the previous physician experience distribution.<sup>32</sup> The estimated coefficient on licensed in the discontinuity sample is larger than in the corresponding specification in the full sample. The estimated coefficient in the specification with a quadratic in previous physician experience and no indicator for physician employment is a precisely estimated 1254. The percentage impact is 114%. Column (6) reports the results for the specification which adds the physician employment indicator in the discontinuity sample. The estimated coefficient on licensed is positive but is negligible in magnitude and imprecisely estimated.<sup>33</sup>

---

<sup>31</sup>A significant coefficient on licensed in this latter specification would have been suggestive of a signalling value to a medical license and would cast doubt on the notion that licensing generates rents in the licensed occupation.

<sup>32</sup>The experience distribution is skewed to the right with a mean of 16, a standard deviation of 11 and a median of 18.

<sup>33</sup>The effect of license acquisition on employment probabilities is similar to the effect of observation track assignment on physician employment, which is considered below.

## 6.2 Reduced Form Estimates

Reduced form estimates of the effect of being assigned to the observation track are reported in Table 3. Columns (1), (2) and (3) of Table 3 report the effect of being assigned to the observation track on monthly earnings. Without controls for other regressors or previous physician experience, there is a negative association between assignment to the observation track and monthly earnings. The track variable is picking up the downward trend in mean earnings with previous physician experience. The association between being assigned to the observation track and monthly earnings becomes significantly positive with the addition of other regressors and previous physician experience and its square. The coefficient on track in this latter specification is 571 with a standard error of 255. The percentage impact is 14%. Column (4) reports the same specification as in Column (3) in the discontinuity sample only. The coefficient on track is stronger, 628, but somewhat less precisely estimated. The percentage impact increases to 23%.

Columns (5), (6) and (7) of Table 3 report the effect of being assigned to the observation track on licensing status. In all three linear probability models, assignment to the observation track increases the probability of acquiring a license. The estimated coefficient on track, without any other regressors, is .159. Including other regressors increases the estimated coefficient to .231. Adding previous physician experience and its square further increases the estimated coefficient on track to .338. Column (8) reports the same specification as in Column (7) in the discontinuity sample. The coefficient on track in this latter specification is .258. In all four specifications the coefficient on track is precisely estimated.

Columns (9), (10) and (11) of Table 3 report the effect of being assigned to the observation track on employment status as a physician in linear probability models. Without controls for previous physician experience, there is a negative association between track and employment status as a physician. Adding previous physician experience yields a positive coefficient on track, but the association is not statisti-

cally different from zero. The specification with previous physician experience in the discontinuity sample only, reported in Column (12), produces an imprecise negative association. The weak first stage relationship between employment status as a physician and assigned re-training track is mostly due to the importance of the other covariates.

Since there is a weak first stage relationship between employment status as a physician and assigned re-training track, it is not possible to consistently estimate the effect of being employed as a physician on earnings. The strong first stage linear relationship between acquisition of a license and assigned re-training track does allow consistent estimation of the causal effect of obtaining a license. The only drawback is that the effect of obtaining a license on earnings will include the returns to a medical license in nonphysician jobs. However, the OLS results in Table 2 indicate that returns to a medical license outside of the medical profession are negligible.

### 6.3 Instrumental Variables Estimates

Instrumental variables estimates of the effect of acquiring a license are reported in Table 4. Acquisition of a license is instrumented by assigned re-training track.<sup>34</sup> Columns (1), (2) and (3) of Table 4 report the estimated coefficients on licensed without any other regressors, with other regressors but excluding previous physician experience, and with other regressors and linear and quadratic terms for previous physician experience, respectively. The estimated coefficient on licensed with other regressors and linear and quadratic terms for previous physician experience is 1638 with a standard error of 706. The percentage impact is 182%. Correcting for non-random selection in licensing status yields a percentage impact that is approximately double the corresponding percentage impact produced by OLS (90%).

Considering that instrumental variables estimates in a regression discontinuity

---

<sup>34</sup>The instrumental variables estimates deviate somewhat from the ratio of the relevant reduced-form estimates in Table 3 due to different sample sizes.

design may be quite sensitive to the way in which the variable generating the discontinuity is controlled, Column (4) of Table 4 reports the results of including a third order polynomial in previous physician experience. The estimated effect of a license in this latter specification is 1865 with a standard error of 864. The percentage impact grows to 262%.

Column (5) of Table 4 reports the results of including linear and quadratic terms for previous physician experience in the discontinuity sample only. The estimated coefficient on licensed further grows to 1886, but is somewhat less precisely estimated. The percentage impact is 342%. The corresponding percentage impact according to OLS in Table 2 is 114%.<sup>35</sup>

There are several additional results to note that are not shown in Table 4 for the sake of brevity. First, there are no significant interactions between licensing status and other covariates, where licensing status is instrumented by assigned re-training track in the interaction terms as well. Second, difference-in-differences type specifications that control for cohort (subject to 14-year rule), having more than 14 years of previous physician experience and an interaction between these latter two dummies do not yield significant coefficients on the interaction terms. The implication is that the small subset of individuals that have between 14 and 19 years of experience and that are assigned to different re-training tracks do not differentially contribute to the identification of the returns to a license. Thus, it is not necessary to control for the different assignment regimes in the main empirical specifications.

There are three main potential threats to identification of the returns to an occupational license based on the immigrant re-training assignment rule. First, the

---

<sup>35</sup>Narrowing the range of the discontinuity sample to between 16 and 24 years of previous physician experience and including a linear term only in previous physician experience, yields a percentage impact of 570%. Further narrowing the bandwidth to between 18 and 22 years and dropping previous physician experience yields a percentage impact of 793%. Although these percentage impacts are large, the coefficients on licensed are not precisely estimated.

survey samples only immigrant physicians that submitted valid credentials. Since 27% of those who reported at the airport upon arrival that they were physicians in the former USSR did not submit credentials, the sample could be biased. However, most of these latter immigrants were very old upon arrival and most probably did not work at all. Second, assignment to the exam track and/or failure to pass the exam may have lead to out-migration. Information on the outcomes of these immigrants would be missing from the sample. However, it is likely that this problem is negligible. As mentioned in Section 2, return migration was one of the least important reasons for non-response to the survey. Only 3.7% of those approached to be interviewed were not interviewed because they had out-migrated or were absent from the country for an extended period of time. Third, physicians in the former Soviet Union may have decided not to immigrate to Israel (or delay immigration) based on knowledge of the assignment rule. This problem is also likely to be negligible. Immigrants that arrived in Israel in the first few years after the fall of the Soviet Union are widely believed to be panic migrants, not economic migrants. In fact, immigrant physicians were asked on the survey if they were aware of the re-licensing process upon arrival to Israel. Only 4% of the immigrant physicians in the sample responded that they had knowledge of re-licensing procedures.

Our interpretation of the large instrumental variables estimates of the returns to a license is that occupational licensing leads to practitioner rents. This interpretation is bolstered by the fact that there are negligible returns to a license outside of the medical profession. A potential problem with our interpretation is that the large returns to a license might be mostly due to the returns to specific work experience, or the normal rate of return to physician practice. However, it is unlikely that the normal rate of return to physician practice is of such a large magnitude. It is important to note in this context that previous empirical work on Soviet immigrants in Israel finds that there are virtually no returns to previous work experience among immigrant engineers and managers as well as unskilled workers (see, e.g., Weiss, Sauer and

Gotlibovski (2003)).<sup>36</sup> Consistent with these previous findings, interactions of licensing status with previous physician experience does not yield significant coefficients on the interaction terms.<sup>37</sup>

## 6.4 Quantile Regression and Treatment Effect Estimates

The top panel of Table 5 reports quantile regression and QTE estimates of the effect of licensing status on monthly earnings. Licensing effects are measured at the 0.15, 0.25, 0.50, 0.75 and 0.85 quantiles of the monthly earnings distribution. Quantile regression treats licensing status as exogenous and produces the largest percentage impacts of acquiring a license, 93% and 117%, at the 0.15 and 0.25 quantiles, respectively. The percentage impact steadily declines at higher quantiles, falling to 59% percent at the 0.85 quantile. At each quantile the coefficient on licensed is precisely estimated.

QTE estimates that correct for the endogeneity of licensing status yield substantially different results. The percentage impact of acquiring a license at the 0.15 and 0.25 quantiles are both 50%, considerably lower than the quantile regression estimates. The percentage impact at the 0.50, 0.75 and 0.85 quantiles are, on the other hand, considerably higher than the quantile regression estimates. The QTE model produces the largest percentage impact, 169%, at the 0.85 quantile. At each quantile the coefficient on licensed is precisely estimated.<sup>38</sup>

---

<sup>36</sup>See also Friedberg (2000).

<sup>37</sup>Previous physician experience is generally not significant even without interactions. The reason is that immigrant physicians that obtained jobs as physicians were placed at the bottom of the physician job ladder in public hospitals and community clinics, regardless of age and former specialty. Native physicians were simultaneously pushed up the job ladder and thus experienced an increase in wages (see Sussman and Zakai (1998)).

<sup>38</sup>The first step estimate of  $E[\kappa_i|X_i, L_i, Y_i]$  in the quantile treatment effects procedure is obtained by estimating  $E[TR_i|Y_i, L_i, X_i]$  and  $E[TR_i|X_i]$  in (5) with a probit. Predicted values of  $E[\kappa_i|X_i, L_i, Y_i]$  that are negative are set to zero leading to a reduced sample size. Standard errors

Note that the highest percentage impact of 169% at the 0.85 quantile is less than the percentage impact estimated in the corresponding specification in the constant-effects model in Table 4 (182%). This suggests that the licensing effect on mean earnings in the constant-effects model is relatively more sensitive to high earnings outliers than the inclusion of zero earnings.

The bottom panel of Table 5 reports licensing effects on median earnings in the discontinuity sample only. Effects at other quantiles are difficult to identify given the reduced variation in earnings and smaller sample size. The results indicate a large effect on median earnings, 239%. The corresponding percentage impact when treating licensed as exogenous is 108%. Both effects are precisely estimated. These percentage impacts stand in sharp contrast to the percentage impact on mean earnings in the discontinuity sample (342%).

The quantile regression and QTE estimates reported in Table 5 can be used to estimate the marginal distributions of monthly earnings without a license both for immigrants that acquired a license and immigrants that did not acquire a license. Potential earnings without a license for immigrants that acquired a license are obtained by using the QTE coefficients together with the covariate means among those that acquired a license and setting the licensing status dummy to zero. The counterfactual earnings of all immigrants with a license can be approximated by the counterfactual earnings of compliers only, under the assumption that compliers are a random sample of all immigrants with a license. The monthly earnings without a license for immigrants that did not acquire a license are also computed conditional on the mean of the covariates among immigrants that acquired a license, and with the licensing status dummy set to zero, but using the quantile regression coefficients.

The figures in the top panel of Table 6 show that licensed immigrants have lower potential earnings without a license than unlicensed immigrants at all examined quantiles. The negative selection bias is greatest in the tails and at the median of the

---

are computed by bootstrapping the first and second step estimations 100 times.

distribution, varying between 36% and 38%. The bottom panel of Table 6 shows that negative selection bias is also present at the median of potential earnings in the discontinuity sample.

In light of the model, the negative selection found in the empirical results suggests that the wages that high-skilled immigrant physicians earn as nonphysicians outweigh the lower direct costs that these immigrants face in acquiring a license. The sum of direct and indirect costs for highly skilled immigrant physicians exceeds the large discounted physician earnings premium. The increase in the direct costs of licensing through the requirement of having to pass a re-licensing exam leads to lower average quality of service in the market for physicians.

Although the single skill factor assumption in the model is important in reaching these conclusions, it should be remembered that most immigrant physicians that did not acquire a license work in skilled occupations. It is also important to note that the average age of the immigrants upon arrival is 43 and that the re-licensing process is relatively lengthy. As mentioned in the background section, immigrant physicians have to submit their credentials to the Ministry of Health, wait for an answer, successfully complete a six month medical terminology course, find a spot in an exam preparation course (or in a hospital for work under observation), complete the six month preparation course (or trial work period) and wait for the exam results (or decision of the committee of native physicians). Only after successful completion of these re-licensing requirements does the physician job search process begin.<sup>39</sup> The basic theory of human capital predicts that investment activity will decrease with age and the length of the investment period.

---

<sup>39</sup>Lengthy delays in obtaining a license in a new state is a frequent complaint of migrating physicians in the US (see the reports at <http://www.ama-assn.org>.)

## 7 Conclusion

This study estimates the returns to acquiring an occupational license among Soviet immigrant physicians in Israel. OLS estimates of the returns to a license range between 90 and 114 percent. Instrumental variables estimates of the returns range between 180 and 340 percent. The large IV estimates, which exploit the approximate random assignment of immigrants to different re-licensing tracks, are suggestive of the presence of rents accruing to practitioners. Quantile treatment effects estimates also indicate large returns to a license, though they are somewhat smaller than the returns estimated by IV. QTE estimates range between 147 and 240 percent at the median. QTE estimates also reveal negative selection into licensing status at all examined quantiles.

In order to interpret the OLS and IV estimates of the returns to a license and negative selection, we develop a behavioral model of optimal license acquisition. In the model, negative selection implies that the wages high-skilled immigrant physicians earn as nonphysicians outweigh their relatively lower direct costs of acquiring a license. The sum of direct and indirect costs of acquiring a license for highly skilled immigrant physicians exceeds the large discounted physician earnings premium. Stricter re-licensing requirements for migrant physicians may thus lead to lower average quality of service in the market for physicians as well as practitioner rents.

The implications of the study for health and immigration policy in Israel are straight-forward. In order to attract higher skilled immigrant physicians to choose to become physicians, the direct costs of acquiring a license should be lowered. This could be accomplished by abolishing the re-licensing exam requirement for acquisition of a general practitioner medical license, as has already been done for Western immigrant physicians in Israel. A second possibility is to more fully subsidize consumption during the re-training period. However, this could only be justified if there is a market failure, as would be the case under information asymmetries. In addition, the opportunity cost of diverting tax revenues toward higher re-training subsidies would

have to be taken into consideration in this latter alternative.

The social experiment that we exploit in this paper to identify the causal effects of license acquisition in the market for physicians in Israel is generalizable to other settings. For example, the “10-year rule” of state licensing boards in the US requires migrant physicians that have not passed a national board exam within 10 years to pass a general medical knowledge examination. Migrant physicians that have passed a national board exam within 10 years are exempt from the exam and are immediately granted a license. Future research could examine the earnings and quality effects of the “10-year rule” in the US using a similar methodology to the one employed in this study.

## References

- [1] Abadie, A., J.D. Angrist, and G. Imbens (2002), "Instrumental Variables Estimation of Quantile Treatment Effects," *Econometrica*, 70(1): 91-117.
- [2] Angrist, J.D. (2001), "Estimation of Limited Dependent Variable Models with Dummy Endogenous Regressors: Simple Strategies for Empirical Practice," *Journal of Business and Economic Statistics*, 19: 1-16.
- [3] Angrist, J.D. and J. Guryan (2003), "Does Teacher Testing Raise Teacher Quality? Evidence from Teacher Certification Requirements," NBER Working Paper No.9545.
- [4] Angrist, J.D. and A. Krueger (1999), "Empirical Strategies in Labor Economics," in *Handbook of Labor Economics*, Volume IIIA, eds., O. Ashenfelter and D. Card, Amsterdam: North-Holland, pp. 1277-1366.
- [5] Angrist, J.D. and V. Lavy (1999), "Using Maimonides Rule to Estimate the Effects of Class Size on Scholastic Achievement," *Quarterly Journal of Economics*, 114(2): 533-75.
- [6] Angrist J.D., G. Imbens and D.B. Rubin (1996), "Identification of Causal Effects Using Instrumental Variables," *Journal of the American Statistical Association*, 91: 444-472.
- [7] Benham, L., A. Maurizi and M.W. Reder (1968), "Migration, Location and Remuneration of Medical Personnel: Physicians and Dentists," *Review of Economics and Statistics*, 50(3): 332-347.
- [8] Buchinsky, M. (1994), "Changes in U.S. Wage Structure 1963-87: Application of Quantile Regression," *Econometrica*, 62: 405-458.
- [9] Campbell, Donald T. (1969), "Reforms as Experiments," *American Psychologist*, XXIV: 409-429.

- [10] Card, David (1999), "The Causal Effect of Schooling on Earnings," in *Handbook of Labor Economics*, Volume IIIA, eds., O. Ashenfelter and D. Card, Amsterdam: North-Holland, pp.
- [11] Chamberlain, G. (1991), "Quantile Regression, Censoring and the Structure of Wages," in *Advances in Econometrics Sixth World Congress*, ed., by C.A. Sims. Cambridge: Cambridge University Press.
- [12] Eckstein, Z. and Y. Weiss (2002), "The Integration of Immigrants from the Former Soviet Union in the Israeli Labor Market," in *Structural Changes in the Israeli Economy*, ed., A. Ben-Basat, MIT Press, forthcoming.
- [13] Eckstein, Z. and S. Cohen (2002), "Training and Occupational Choice of Immigrants," mimeo, Tel-Aviv University.
- [14] Friedberg, R. (2000), "You Can't, Take it With You? Immigration Assimilation and the Portability of Human Capital: Evidence From Israel," *Journal of Labor Economics*, 18, 221-251.
- [15] Friedman, M. and S. Kuznets (1945), *Income from Independent Professional Practice*, New York: National Bureau of Economic Research.
- [16] Hahn, J., P. Todd and W. van der Klaauw (2001), "Identification and Estimation of Treatment Effects with a Regression-Discontinuity Design," *Econometrica*, 69(1): 201-09.
- [17] Heckman, J.J. and R.J. LaLonde and J.A. Smith (1999), "The Economics and Econometrics of Active Labor Market Programs," in *Handbook of Labor Economics*, Volume IIIA, eds., O. Ashenfelter and D. Card, Amsterdam: North-Holland, pp. 1865-2097.
- [18] Heckman, J.J. (1997), "Instrumental Variables," *Journal of Human Resources*, 32(3), 441-62.

- [19] Imbens G. and J.D. Angrist (1994), "Identification and Estimation of Local Average Treatment Effects," *Econometrica*, 62: 467-475.
- [20] Koenker, R., and G. Bassett (1978), "Regression Quantiles," *Econometrica*: 46, 33-50.
- [21] Kleiner, M. (2000), "Occupational Licensing," *Journal of Economics Perspectives*, 14(4): 189-202.
- [22] Kleiner, M. and R.T. Kudrle (2000), "Does Regulation affect Economic Outcomes? the Case of Dentistry," *Journal of Law and Economics*, 43: 547-582.
- [23] Krueger, A.B. (2000), "From Bismarck to Maastricht: The March to European Union and the Labor Compact," *Labour Economics*, 7(2): 117-34.
- [24] Leland, H.E. (1979), "Quacks, Lemons, and Licensing: A Theory of Minimum Quality Standards," *Journal of Political Economy*, 87(6): 1328-1346.
- [25] Muzondo, T.R. and B. Pazderka, "Occupational Licensing and Professional Incomes in Canada," *Canadian Journal of Economics*, 13(4): 659-67.
- [26] Pashigian, B.P. (1980), "Has Occupational Licensing Reduced Geographical Mobility and Raised Earnings?" in *Occupational Licensing and Regulation*. S. Rotenberg, ed. Washington: American Enterprise Institute, pp. 165-179.
- [27] Posner, R.A. (1974), "Theories of Economic Regulation," *Bell Journal of Economics*, 5(2): 335-58.
- [28] Rosenzweig, M.R. and K.I. Wolpin (2000), "Natural "Natural Experiments" in Economics," *Journal of Economic Literature*, 38: 827-874.
- [29] Shaked, A. and J. Sutton (1981), "The Self-Regulating Profession," *Review of Economic Studies*, 48: 217-234.

- [30] Shapiro, C. (1986), "Investment, Moral Hazard and Occupational Licensing," *Review of Economic Studies*, 53(5): 843-862.
- [31] Stigler, G.J. (1998), *The Theory of Economic Regulation*, Cheltenham, U.K.: Elgar.
- [32] Sussman, Z. and D. Zakai (1998), "The Mass Immigration of Physicians and the Steep Rise in Wages of Veterans in Israel: A Paradox?," *The Economic Quarterly*, 45, 28-63 (in Hebrew).
- [33] van der Klaauw, Wilbert (1996), "A Regression-Discontinuity Evaluation of the Effect of Financial Aid Offers on College Enrollment," mimeo, New York University.
- [34] Weiss, Y., R.M. Sauer and M. Gotlibovski (2003), "Immigration, Search and Loss of Skill," *Journal of Labor Economics*, forthcoming, July 2003.

Table 1: Descriptive Statistics

Variable	Exam Track	Observation Track
% Licensed	72.71	88.57
% Employed	86.23	65.4
% Physician	58.7	37.14
Monthly Earnings (NIS)	2,552 (1,811)	1,703 (2,011)
Months in Israel	44.3 (6.2)	42.7 (7.4)
Age Upon Arrival	34.5 (5.0)	53.1 (7.4)
Previous Physician Experience	10.3 (4.8)	28.2 (7.6)
% Male	44.44	44.13
% Married Upon Arrival	84.3	79.36
No. of Children under 18 Upon Arrival	1.23 (0.75)	0.59 (0.76)
% from Russia	46.14	41.59
% from Ukraine	16.67	23.81
% from City > 1,000,000	52.17	53.33
% Advanced Medical Degree	26.81	25.4
% Former Specialist	40.34	85.1
% Former General Practitioner	22.95	18.73
% Former Pediatrician	16.18	12.7
% Former OBGY	7.49	5.71
% Arrived in 1990	77.3	67.62
% Arrived in 1991	20.05	26.03
N	414	315

Notes: The Table reports means and percentages by assigned re-training track. Standard deviations are in parentheses. Monthly earnings are in 1994 New Israeli Shekels (NIS) where 1 NIS equals 0.33 US dollars. There are 382 exam track earnings observations and 294 observation track earnings observations (including zeros for the unemployed).

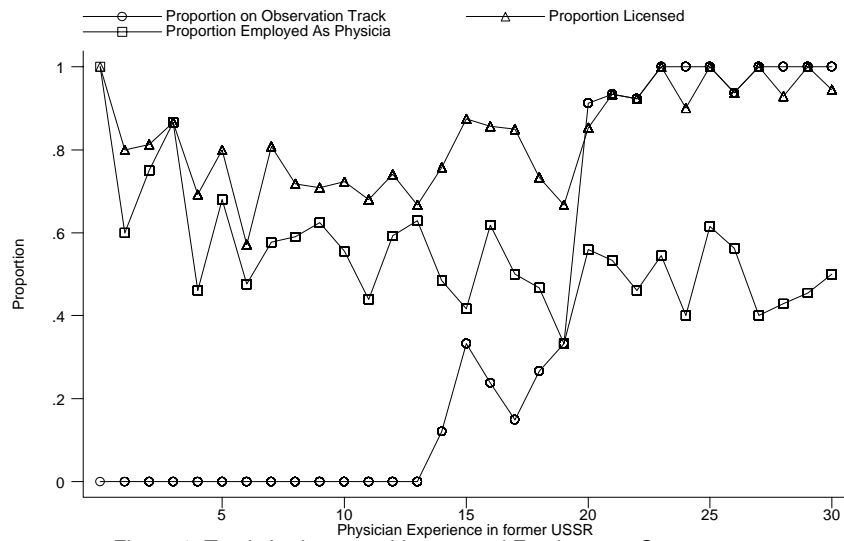


Figure 1: Track Assignment, License and Employment Outcomes

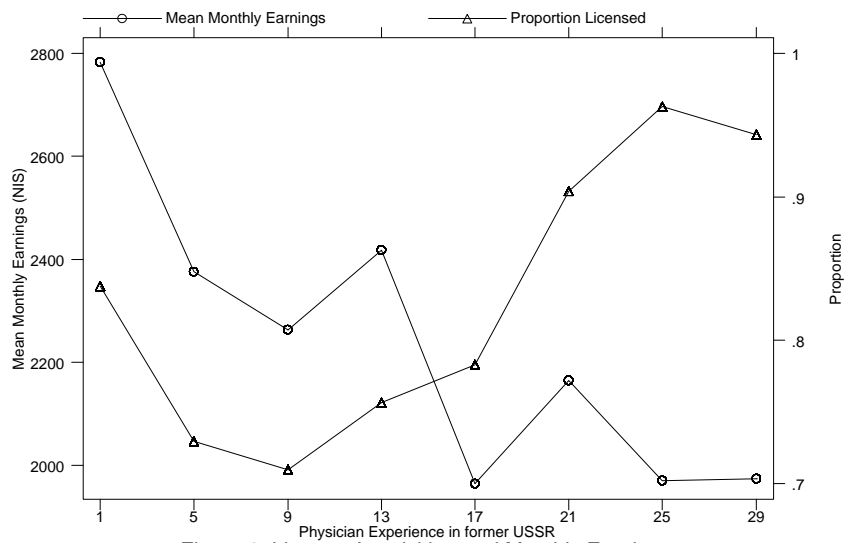


Figure 2: License Acquisition and Monthly Earnings

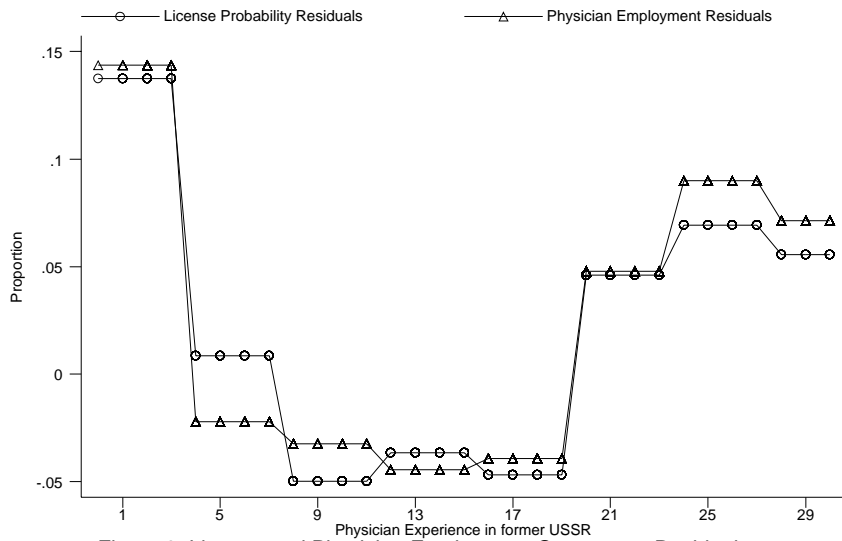


Figure 3: License and Physician Employment Outcomes - Residuals

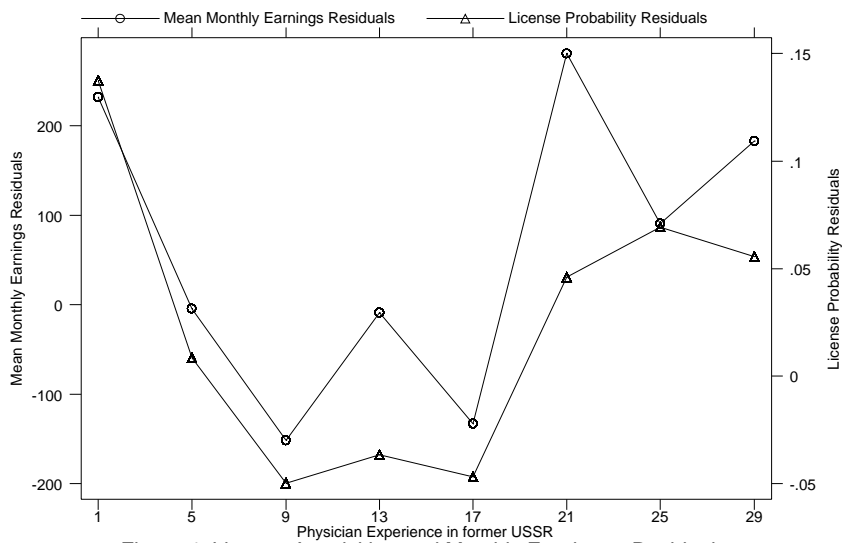


Figure 4: License Acquisition and Monthly Earnings - Residuals

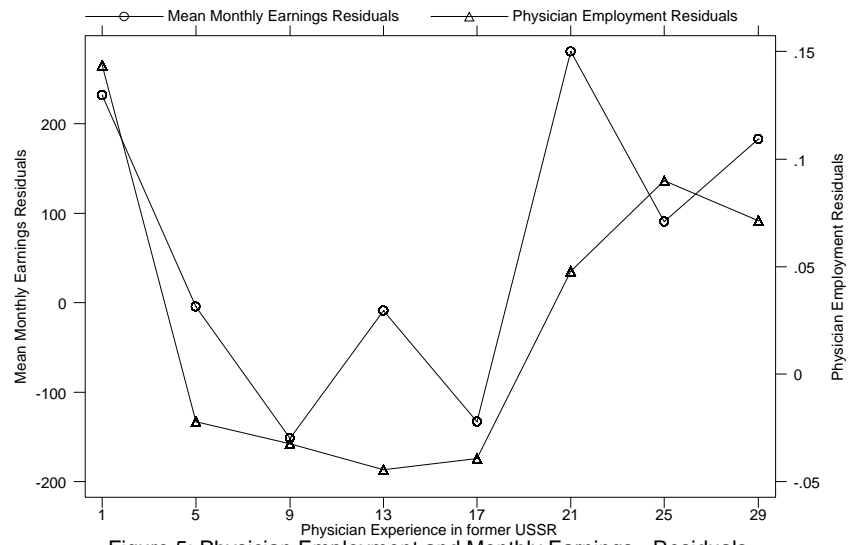


Figure 5: Physician Employment and Monthly Earnings - Residuals

Table 2: OLS Estimates of the Returns to a Medical License

Regressors	Full Sample				Discontinuity Sample	
	(1)	(2)	(3)	(4)	(5)	(6)
Licensed	1,279 (140)	1,211 (140)	1,162 (141)	-175 (138)	1,254 (373)	169 (358)
% Impact Physician	1.0948 –	0.9786 –	0.904 –	2,324 (158)	1.1366 –	1,885 (301)
Experience	–	–	5 (25)	56 (23)	1,111 (547)	928 (462)
Experience <sup>2</sup>	–	–	-2 (1)	-2 (1)	-27 (14)	-23 (12)
Other Regressors	NO	YES	YES	YES	YES	YES
Root MSE	1,876	1,672	1,648	1,390	1,631	1,447
R <sup>2</sup>	0.0711	0.2847	0.3073	0.5086	0.3227	0.4702
N	676	676	676	676	181	181

Notes: Robust standard errors are in parentheses. Other regressors include dummies for age upon arrival, year of arrival months in Israel, gender, marital status, profession of spouse, number of children, size of last city of residence, Republic of origin, advanced medical degrees, previous specialist status, previous type of medical practice and type of reported earnings (after-tax and/or after other deductions). The discontinuity sample in columns (5) and (6) uses the subsample of observations between 14 and 26 years of previous physician experience.

Table 3: Reduced Form Estimates of the Effect of Track on Monthly Earnings,  
License Acquisition and Physician Employment

	Monthly Earnings				Licensed				Physician Employment			
	Full Sample		Disc. Sample		Full Sample		Disc. Sample		Full Sample		Disc. Sample	
Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Track	-849 (149)	42 (207)	571 (255)	628 (371)	0.1587 (0.0283)	0.2305 (0.0308)	0.3383 (0.049)	0.2853 (0.0679)	-0.2155 (0.0365)	-0.0939 (0.0529)	0.0404 (0.069)	-0.0978 (0.1008)
% Impact	-0.3325	0.0094	0.1409	0.2262	-	-	-	-	-	-	-	-
Experience	-	-	-14 (28)	765 (530)	-	-	-0.0053 (0.008)	-0.2198 (0.1009)	-	-	-0.0161 (0.008)	-0.0218 (0.1515)
Experience <sup>2</sup>	-	-	-1 (1)	-19 (14)	-	-	-0.0002 (0.0)	0.0052 (0.0025)	-	-	0.0001 (0.0)	0.0011 (0.0038)
Other Regressors	NO	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	YES
Root MSE	1,900	1,740	1,705	1,675	0.3961	0.3908	0.3854	0.3269	0.4891	0.4676	0.4639	0.4821
R <sup>2</sup>	0.0469	0.2257	0.2589	0.2857	0.038	0.0879	0.1153	0.226	0.0456	0.1506	0.1664	0.1755
N	676	676	676	181	729	729	729	203	729	729	729	203

Notes: Robust standard errors are in parentheses. Other regressors include dummies for age of arrival, year of arrival, months in Israel, gender, marital status, profession of spouse, number of children, size of last city of residence, Republic of origin, advanced medical degrees, previous specialist status, previous type of medical practice and type of reported earnings (after-tax and/or after other deductions). The discontinuity sample in Columns (4), (8), and (12) uses the subsample of observations between 12 and 26 years of previous physician experience. The licensed and physician regressions are linear probability models.

Table 4: 2SLS Estimates of the Returns to a Medical License

Regressors	Full Sample				Disc. Sample
	(1)	(2)	(3)	(4)	(5)
Licensed	-5,244 (1,516)	178 (863)	1,638 (706)	1,865 (864)	1,886 (1,043)
% Impact	-0.827	0.0857	1.8185	2.6171	3.4221
Experience	–	–	-1 (25)	45 (77)	1,210 (619)
Experience <sup>2</sup>	–	–	-1 (1)	-4 (4)	-30 (16)
Experience <sup>3</sup>	–	–	–	4 (6)	–
Other Regressors	NO	YES	YES	YES	YES
Root MSE	3,245	1,722	1,659	1,672	1,646
R <sup>2</sup>	–	0.2417	0.2982	0.2883	0.3099
N	676	676	676	676	181

Notes: Robust standard errors are in parentheses. Licensed is instrumented with Track. Other regressors include dummies for age upon arrival, year of arrival, months in Israel, gender, marital status, profession of spouse, number of children, size of last city of residence, Republic of origin, advanced medical degrees, previous specialist status, previous type of medical practice and type of reported earnings (after-tax and/or after other deductions). The discontinuity sample in Column (5) uses the subsample of observations between 14 and 26 years of previous physician experience.

Table 5: Quantile Regression and Treatment Effects Estimates

	Quantile Regression Estimates					Treatment Effects Estimates				
	0.15	0.25	0.5	0.75	0.85	0.15	0.25	0.5	0.75	0.85
A. Full Sample										
Licensed	359 (130)	644 (163)	997 (143)	1,455 (178)	1,507 (320)	119 (4)	257 (63)	1,115 (65)	1,589 (267)	2,774 (212)
% Impact	0.9316	1.1748	0.8316	0.7825	0.588	0.4959	0.4992	1.4664	1.0764	1.6884
Pseudo R <sup>2</sup>	0.1626	0.2467	0.2397	0.2116	0.2055	0.119	0.1744	0.2315	0.1579	0.1748
N	676	676	676	676	676	548	548	548	548	548
B. Discontinuity Sample										
Licensed	–	–	1,093 (520)	–	–	–	–	1,793 (310)	–	–
% Impact	–	–	1.0761	–	–	–	–	2.3863	–	–
Pseudo R <sup>2</sup>	–	–	0.1897	–	–	–	–	0.2413	–	–
N	–	–	181	–	–	–	–	164	–	–

Notes: Other regressors include a quadratic in previous physician experience, dummies for age upon arrival, year of arrival, months in Israel, Republic of origin, advanced medical degrees, previous specialist status, previous type of medical practice and type of reported earnings (after-tax and/or after other deductions). The discontinuity sample is the subsample of observations between 14 and 26 years of previous physician experience. Bootstrapped standard errors are in parentheses. The bootstrapped standard errors when licensed are treated as endogenous and adjusted for the first step estimation.

Table 6: Earnings Quantiles without a License

	Quantiles				
	0.15	0.25	0.5	0.75	0.85
A. Full Sample					
Licensed Immigrants	239	515	760	1,476	1,643
Unlicensed Immigrants	385	548	1,199	1,859	2,563
% Selection Bias	-0.379	-0.0597	-0.3656	-0.2059	-0.359
B. Discontinuity Sample					
Licensed Immigrants	–	–	751	–	–
Unlicensed Immigrants	–	–	1,016	–	–
% Selection Bias	–	–	-0.2606	–	–

Notes: The table reports monthly earnings quantiles without a license for immigrants that acquired a license and for immigrants that did not acquire a license. Earnings without a license for immigrants that acquired a license are calculated using quantile treatment effect estimates. Earnings without a license for immigrants that did not acquire a license are calculated using quantile regression estimates. The discontinuity sample is the subsample of observations between 14 and 26 years of previous physician experience.