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THE RATIONALE OF THE MIGRANT SHARE AS A WAGE DETERMINANT: THEORY AND EVIDENCE

By

Per Lundborg

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ABSTRACT

I present a microeconomic foundation for why the migrant share affects host country wages. In the model, only immigrants with low reservation wages, predominantly those from low wage countries, affect bargained wages. A higher migrant share lowers wages but only temporarily. Immigrants with high reservation wages, like those from high wage countries or assimilated immigrants from low wage countries, do not give rise to adverse effects. The model is then tested using individual data on physicians with clearly defined medical specialization and work experience and bargained salaries. As predicted by the model, immigration of physicians from low wage countries has considerably larger negative effects than immigrants from high wage countries. Immigrants from low wage countries have only short run but no long run adverse effects on natives' wages.

JEL: J53, J61

Key words: Immigration, bargaining, institutions.

*Professor Per Lundborg, The Swedish Institute for Social Research, Stockholm University, 106 91 STOCKHOLM, Sweden, e-mail: per.lundborg@sofi.su.se, Phone +46 8 162310.

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To capture the wage effects of immigrant supply shocks the common strategy is to specify the share of immigrants in overall worker supply of type j as $M_j/(M_j + N_j)$ where M_j is the number of immigrated workers and N_j is the supply of native workers. While this empirical specification can be rationalized based on changes in demand and supply and despite a stronger focus on factor demand theory in recent years, it nevertheless lacks a microeconomic foundation. In particular, a question left unanswered in the literature is why and how a rational wage setter changes the wage depending on the migrant share. One of the purposes in this paper is to present a wage theory that incorporates the migrant share as a wage determinant in a bargaining framework and explore its empirical implications.

It is well known that studies on the wage effects of immigration are inconclusive in the sense that results vary considerably. When researchers have identified exogenous supply shocks in natural experiments like the cases of "the Mariel boat lift" (Card (1990)) or labor reallocations following the Katrina disaster (De Silva et al (2010)), only small effects are found. Other studies that do not explicitly focus on obviously exogenous supply shifts yield widely differing results. Borjas (2003) stands out in the literature as he presents evidence that US immigration 1980-2000 lowered average wage by approximately 3 percent and wages of the least educated by 9 per cent. Supply effects have not necessarily been properly identified implying that the conclusion should be treated as lower bounds.[1] Card (2012) argues that these results depend not only on less attractive assumptions of fixed capital supply but also on assumptions of four skill groups and perfect substitutability between immigrants and natives. Other assumptions in these respects are found in studies by Ottavio and Peri (2012) and Manacorda et al (2012) and yield minor effects on wages. Dustmann et al (2013), argue that when the skill composition of immigrants differs from that of natives and with elastic capital supply, the effect on native workers average wage *should* be expected to be zero or even positive.

This paper takes a different view and asks why and how the migrant share should affect rationally based wage setting and to understand how immigration affects natives' wages a structured model needs to be specified. Wage bargaining is widespread in the major immigration countries of Europe and in the US labor market as noted in survey evidence provided in Hall and Krueger (2008). However, the literature is, to the best of my knowledge,

[1] Borjas (2003) footnote 8, p. 1349.

silent on how bargaining determined wages are affected by immigration. I shall present a bargaining model in which the migrant share enters as a determinant of the individual worker's wage.

The model predicts that it is only immigrants having low relative reservation wages who could be argued to have a negative impact on natives' wages. These immigrants are predominantly those from low wage countries. The prediction is in line with what appears to be the common attitude among workers that immigration from low wage countries constitutes more of a threat to wages than does immigration from high wage countries. The crucial aspect in the model is that only immigrants with lower reservation wages than natives exert a downward pressure on natives' wages in their bargaining process. Assuming that reservation wages of immigrants approach those of natives in the long run only recently arrived immigrants from low wage countries should have adverse wage effects on natives. A concomitant result is that immigration only has short run wage effects and tapers off as the immigrants from low-wage countries get assimilated and raise their reservation wages. Immigration from high wage countries or from low wage countries and who immigrated a long time ago should leave the wage unaffected.

These theoretical results are shown to be aptly supported by the empirical results using Swedish data for the penetration of foreign physicians with well-defined medical specializations. With a large number of controls, I show that immigration of physicians from low wage countries have strong negative effects on native physicians' bargained salaries, while immigration from high wage countries have no or only very small effects.

1. A model of wage bargaining and immigration

A standard wage regression of the penetration of immigrant labor can be thought of as emanating from the following demand function for some skill group in period *t* before immigration: $\log w_t = D_t + \mu log N_t + \epsilon$. An exogenous influx of labor immigrants results in a wage change that equals $\Delta \log w_t = \Delta D_t + \mu \log[\frac{(N_t(1+n_t)+M_t)}{N_t}] + \epsilon \approx \Delta D_t + \mu(n_t + m_t^*) + \epsilon$ where $m_t^* = M_t/N_t$ and n_t is the percentage change in natives equal to $n_t = S_t + \Omega \Delta \log w_t + \xi$. On reduced form the wage equation is $\Delta \log w_t = X_t + \mu^* m_t^* + \epsilon^*$ where $X_t = (\Delta D_t + \mu S_t)/(1 - \epsilon\Omega)$ and $\epsilon/(1-\epsilon\mu)$. Using $log\ m_t^*$ rather than m_t^* as an approximation,

this equation can be transformed into an equation $w_t = \alpha m_t + \ldots$[2]. While empirical work in recent years has received a closer link to factor demand theory the literature is nevertheless deficient in the sense that it does not offer a microeconomic foundation for why rational wage setters would consider the migrant share as a wage determinant. Below I show how this can be achieved.

I assume that wages are determined in bargaining between the individual worker and representatives of the employer. Assume that the wage rate of worker *i*, w_i, is expressed as a fraction of the individual's productivity P_i, i.e. $w_i \in (0, P]$. Productivity is thought of as effort times the price of the individual's service. Setting effort to unity, productivity will equal the consumers' value of the worker's service.

The wage is assumed to be determined by the outcome of asymmetric Nash bargaining (Binmore et al (1986)). In this bargaining, the individual worker maximizes the difference between the wage and the expected alternative wage, A_i. This represents the expected wage obtainable outside the firm and is assumed identical for all individuals with the same characteristics. The employer maximizes the positive difference between productivity and pay and the maximization problem is solved by:

$$(1) \qquad w_i = \arg\max\left[(w_i - A_i)^{\beta}(P_i - w_i)^{(1-\beta)}\right],$$

where β is the parameter representing the underlying bargaining power of workers, with $0 < \beta < 1$. The payoff in case of disagreement is assumed to be zero for both the employee and the employer. Maximization yields the well-known solution

$$(2) \qquad w_i^* = \beta P_i + (1-\beta)A_i\,.$$

The determination of A_i is of central importance. Like in the standard model, the unemployment rate is assumed to affect the alternative wage as a determinant of the probability of employment. The unemployment risk of the individual native worker *i* is assumed to be determined by the natives' average unemployment rate, u_n, in the absence of immigration. The rate is taken as exogenous by the individual.

To get the employment probability, I also include the immigration rate. I assume that immigrants differ from natives only in one crucial respect, namely that immigrants'

[2] Using that $\log(M/N) \approx (M-N)/(0.5(M+N)) = 2(2m-1)$ for low migration shares.

reservation wages are lower than natives'. This is a natural assumption to make for immigrants from low wage countries applicable to e.g. the accession to the EU of the new member countries from Eastern Europe or for any flow of workers from low-wage countries to the US or the EU. Immigrant workers' low relative reservation wages implies that immigrants are more willing than natives to accept jobs at a lower wage level. For upcoming vacancies, a large stock of immigrants with low reservation wages will then reduce natives' perceived probability of employment and hence lower the alternative wage. Thus, I add the share of immigrants multiplied by one minus the relative reservation wage and the alternative wage is then specified as:

$$(3) \quad A_i = \left(1 - \frac{M_i}{M_i+N_i}(1-\mathrm{w^r}) - u_n\right)\overline{w}_i = (1 - m_i(1-\mathrm{w^r}) - u_n)\overline{w}_i$$

where M_i is the number of immigrated workers similar to *i*, N_i is the supply of native workers similar to worker *i* and w^r is the *relative* reservation wage, i.e. immigrants' reservation wage divided by natives'. $\overline{w}_i$ is the average wage for similar workers. $(1 - m(1-\mathrm{w^r}) - u_n)$ is now the perceived probability of obtaining a job at wage $\overline{w}_i$.

Since workers with identical productivity and characteristics are paid the same wage,

$$(4) \qquad w_i^* = \overline{w}_i$$

holds at the market equilibrium. Using (3) and (4) in (2), yields:

$$(5) \qquad \beta < w_i^* = \frac{\beta P_i}{1-(1-\beta)(1-\mathrm{m}(1-\mathrm{w^r})-\mathrm{u_n})} \leq P_i.$$

Thus, the wage is restricted between β and productivity. Equation (5) states that the native workers can extract the maximum share of productivity, $w_i^* = P_i$, at full employment (u_n=*0*) *and* either with no immigrated workers (M_i=m_i=0), or with a stock of immigrants with identical reservation wages as natives, w^r=1.[3] As unemployment approaches 1, and with a positive migrant share (and w^r<1), the wage approaches $\frac{\beta P_i}{1+m(1-w^r)}$. In an immigration country with full employment (u=0 and m>0 with $w^r < 1$), the wage equals $\frac{\beta P_i}{1-(1-\beta)(1-m(1-\mathrm{w^r}))}$.

[3] If the relative reservation wage is exceeds unity, e.g. in the case of immigrants from countries of higher wages, one could think of a positive effect on wages of immigration that would be consistent with a productivity boost due to complementarity. However, I have parameterized the productivity level and ruled out this possibility.

2. Comparative static results

In this section, I explore how changes in immigration and reservation wages affect the bargained wage. Differentiating (5) with respect to the migrant stock m, given $w^r<1$, yields $\frac{\partial w}{\partial m} = -\frac{(1-w^r)(1-\beta)w}{1-(1-\beta)(1-m(1-\mathrm{w}^{\mathrm{r}})-u_n)} = -\frac{(1-w^r)(1-\beta)w^2}{\beta P_i}<0$ or, expressed as an elasticity:

$$\frac{\partial w}{\partial m}\frac{m}{w} = -\frac{(1-w^r)(1-\beta)wm}{\beta P_i}. \quad (6)$$

Like unemployment, immigration exerts a restricting effect on wages expressed as the fraction of productivity accruing to the worker. An increase in the stock of immigrant workers lowers the native worker's wage if immigrant workers' reservation wage is lower than native workers' reservation wages, i.e. $w^r < 1$. The effect is independent of the unemployment level. The second order derivative is positive, $\frac{\partial^2 w}{\partial m^2} = -\frac{(1-w^r)^2(1-\beta)^2\frac{\partial w}{\partial m}}{\beta P} > 0$. The relation between wages and the stock of migrants can be represented by the solid downward sloping line in Figure 1:

Figure 1 in here

It is straightforward to derive the effect of an increase in immigrants' relative reservation wage as

$$\frac{\partial w}{\partial w^r} = \frac{m(1-\beta)w^2}{\beta P} > 0, \quad (7)$$

stating that, given the stock of migrants, the rise in the reservation wage raises the wage level of natives. Immigration of workers with a high reservation wage, like immigrants from countries of relatively high wages, will therefore have a less adverse wage effect than immigration of workers with a low reservation wage, like immigrants from low-wage countries. The broken line Figure 1 represents the case with a higher reservation wage and indicates a higher wage at any migrant stock. It also indicates that with a higher relative reservation wage a migrant share increase will have a more modest wage dampening effect and that a larger migrant stock is required for the wage to come down to its minimum level of β.

The second order derivative of (7) is positive, $\frac{\partial^2 w}{\partial w^{r2}} = \frac{2m(1-\beta)w\frac{\partial w}{\partial w^r}}{\beta P} > 0$, implying that, for a given level of migrant stock, the positive wage effects become larger with higher reservation wages. This is depicted in Figure 2 for the migrant stock level m_1.

Figure 2 in here

For a given level of relative reservation wages, a larger migrant stock, m_2, shifts the intercept in Figure 2 downwards. A comparison of Figures 1 and 2 shows that the highest wage level, $w = \frac{\beta}{1-(1-\beta)(1-u_n)}$, is reached either at a zero migrant stock or at any positive migrant stock with unit relative reservation wages. The latter conclusion implies that immigrants with low reservation wages (recent immigrants from low wage countries) may exert a downward pressure on natives´ wage, while immigrants with high reservation wages (recent ones from high wage countries and workers having immigrated a long time ago) will not exert a downward pressure on natives' wages.

3. Putting numbers on theory

One may proceed by considering the effects of higher unemployment and refer to empirical estimates of the wage curve. Differentiate (5) to get the elasticity of wage with respect to unemployment:

$$\frac{\partial w}{\partial u}\frac{u}{w} = \frac{-(1-\beta)u}{[1-(1-\beta)(1-m(1-w^r)-u_n)]} = \frac{-(1-\beta)uw}{\beta P}. \quad (8)$$

The slope of the wage curve has a more or less generally accepted value of -0.10 (Blanchflower and Oswald (1996)). Rewriting the wage elasticity $\frac{-(1-\beta)u_n w}{\beta P} = -0.10$ as $\frac{-(1-\beta)w}{\beta} = \frac{-0.10}{u_n}$ and using this expression in (6) yields:

$$\frac{\partial w}{\partial m}\frac{m}{w} = \frac{-(1-w^r)m*0.10}{u_n}. \quad (6')$$

No assumption about the unknown β-parameter is necessary. Table 1 summarizes the elasticities as the migrant share is varied for different relative reservation wages and unemployment levels.

Table 1 in here

Assume that markets recently have been opened up so that the migrant stock level initially is low, at, say, 2 per cent (m=2) and that the relative reservation wage consequently is low, at, say, 50 per cent ($w^r = 50$) and that unemployment is at, say, 5 per cent (u=5). This yields an elasticity of -0.02 implying that an increase in immigration that raises the supply of workers by ten per cent would lower wages by 0.2 per cent.

Consider instead a situation long after opening up of free immigration. The migrant stock has now increased to 15 per cent (m=15), the relative reservation wage to 90 per cent ($w^r = 90$) while unemployment is constant at five per cent. This yields an elasticity of -0.03. The effect is now stronger since I assumed that migrant stock had increased much more than relative reservation wages. Assume instead that the migrant stock had risen to only 5 per cent, (m=5), while the relative reservation wage and unemployment remain at 90 per cent and five per cent, respectively. I then obtain a much lower elasticity of -0.01. Thus, what matters is how migration and relative reservation wages change over time. Should the migration rate be fifteen per cent and relative reservation wage fifty per cent, the elasticity is considerably higher (at the same unemployment rate) namely 0.15.

To conclude: One should expect higher (in absolute terms) elasticities the *larger* is the migrant stock, the *lower* is unemployment, and the *lower* are the immigrants' relative reservation wages. It is also notable that the general level of most elasticities in the table is broadly in line with those found in empirical work, i.e. negative but close to zero.

4. Model dynamics: Opening up for free immigration

So far I have assumed that both migration and relative reservation wages are exogenous in the model. In this section I analyze how wages develop over time as a high wage country opens up for free immigration from a low wage country. In this section I therefore discuss the model in terms of this enlargement.

When the EU opened up for free immigration from new member countries having considerably lower wages there was a general expectation of a long run real wage convergence. Such a convergence occurred when the EU opened up for free immigration from

southern European countries in the 1980's. When Eastern European countries entered in 2004 and 2007 real wage convergence was again expected.

When labor markets open up for free immigration, the real wage differences are initially large and large flows can therefore be expected since migration is a function of real wage differences. As long as wages are relatively low in the home country, the relative reservation wages are initially low. However, over time, as real wages even out, migration flows decrease and relative reservation wages will approach unity implying counteracting effects on the wage. It therefore becomes of some interest to understand the wage profile over time.

To proceed with the analysis, I could assume that both migration and relative reservation wages are functions of real wage differences across the emigration and immigration countries, and that, in turn, real wage differences are functions of time. A more straightforward approach is simply to assume that migration rises at a decreasing rate with time, $m(t)$, where $\partial m/\partial t>0$ and $\partial^2 m/\delta\partial\, t^2 <0$ and reservation wages rise at an increasing rate with time, $w^r(t)$, where $\partial w^r/\partial t>0$ and $\partial^2 w^r/\partial t^2>0$. Both effects come implicitly via higher real wage growth in the emigration country. Therefore, I rewrite (5) as:

$$(5') \qquad \beta < w_i^* = \frac{\beta}{1-(1-\beta)(1-m(t)(1-\mathrm{w^r(t)})-u_n)} \leq 1.$$

Differentiating (5') with respect to time yields:

$$(9) \qquad \frac{\partial w}{\partial t} = \frac{[-\frac{\partial m}{\partial t}(1-\mathrm{w^r})+\frac{\partial \mathrm{w^r}}{\partial t}m](1-\beta)w}{1-(1-\beta)(1-m(1-\mathrm{w^r})-u_n)} \gtreqless 0$$

There are two counteracting effects in brackets in the numerator that determine the sign. The first term, $-\frac{\partial m}{\partial t}(1-w^r)$, states that, as long as the relative reservation wage is lower than one, an adverse effect on wages obtains with the arrival of more migrants over time. The second term in brackets, $\frac{\partial \mathrm{w^r}}{\partial t}m$, states that, over time, the reservation wages of the migrant stock, m, tend to converge to those of natives and hence that w^r rises yielding a positive effect on wages. The relative strength of these to forces determines how wages develop over time. If $\frac{\partial m}{\partial t}(1-\mathrm{w^r}) > \frac{\partial \mathrm{w^r}}{\partial t}m$, the wage falls and if $\frac{\partial m}{\partial t}(1-\mathrm{w^r}) < \frac{\partial \mathrm{w^r}}{\partial t}m$, the wage rises. At some point in time, when

$$(10) \qquad \frac{\partial m}{\partial t} = \frac{\partial \mathrm{w^r}}{\partial t}\frac{m}{(1-\mathrm{w^r})}$$

the two forces are equally strong and the wage does not change. In the long run, the wage will return to its original level. The wage drop due to immigration of substitutable labor, is thus of a temporary kind.

Could it be safely stated that Equation (10) is fulfilled at some point in time i.e. that there exists a point when the downward wage trend is replaced by an upward trend? Yes, initially, before free immigration, m=0, and in the long run $(1 - w^r)$ =0. Hence the right hand side of (10) goes from zero to infinity in time. Since m rises monotonously in t there exists a point where the wage effect turns from being negative to positive.

This is illustrated in Figure 3 in which I measure w, m and w^r along the vertical axis since all these variables are restricted between 0 and 1. The migrant stock curve starts out at origin at t=0 and approaches asymptotically some level <1. The reservation wage curve starts out at some positive level at t=0 and reaches one after some time of higher growth in the emigration country. The wage is initially at the level $\frac{\beta}{1-(1-\beta)(1-u_n)}$ but as immigrants with low reservation wages enter, the wage starts to fall according to the wage curve w. The drop, though, comes to a halt. At time t_1 the slope of the m-curve $\frac{\partial m}{\partial t}$ equals $\frac{\partial w^r}{\partial t}\frac{m}{(1-\mathrm{w^r})}$ implying that the wage effect shifts from negative to positive. Eventually, the reservation wages become unity and the wage rate is back to its original level.

Figure 3 in here

This implies that the negative wage effect of immigration of substitutable labor is temporary and occurs without workers changing employment as a result of the inflow of immigrants.

The basic mechanism is that unassimilated immigrants exert a downward pressure on natives' wages while the assimilated ones do not. Assimilation in the labor market is here represented by the reservation wages having equalized with those of natives. Labor immigrants who arrived to European countries or the US more than, say, fifteen or twenty years ago, might be expected to have assimilated in this respect and could be expected to have no or very limited impact on natives' wages of today. Moreover, the assimilation period would depend on the wage level at the country of origin and the education level of the migrants. It is therefore an empirical question as to how immigrants should be expected to affect natives' wages and earnings.

5. Empirical applications

Some clear results from the theoretical section are here taken to data for empirical evaluation. The first is that the variation in the migrant share matters to natives' wages only to the extent that the immigrants have low relative reservation wages. Reasonably, these are the immigrants who have arrived from low wage countries and are not yet assimilated in the richer host country. Secondly, any variation in the migrant share due to changes in the stock of assimilated immigrants from low wage countries should have no effect. Finally the variation in the migrant share due to changes in the stock of immigrants from high wage countries should have no effect. These theoretical implications are now tested.

Great care is needed in selecting data. Much of the recent literature focuses on groups of workers, along the wage distribution as in Dustmann et al (2013) or two skill groups of workers as in Katz and Murphy (1992), Ottaviano and Peri (2012) of Mannacorda, et al (2012) or four as in Borjas (2003) or Borjas and Katz (2007). The ideal approach is to estimate the wage effects of a group with some special and well defined skill. Physicians represent a specific skill particularly since they specialize in different medical fields. Due to a long education with limited admission to medical school the native workforce is relatively fixed implying low levels of native work flows that could contaminate the comparison of outcomes across skill groups. There is hardly any substitution between physicians and other professions other possibly in the very long run. This leaves immigration as the dominating force of supply change on the national level, though not on the regional one.

Large variation in data is required for proper identification. This is achieved in Swedish register data as these include each physician's field of specialization, be they immigrated or native born, implying information on whether the physician is a surgeon, geriatrician, specialized as a general physician, etc. Moreover, graduation year is accessible in most cases to determine their years of experience. Finally with variation over the years, the data exhibits a very large variation for identification.

The period to analyze is also of great importance, particularly for two reasons. A requirement for a proper testing of the predictions emanating from the theoretical model is that the actual

wage is set in individual bargaining. By 2004, Swedish physicians had fully replaced the former collective bargaining with individual bargaining, fitting well the assumptions underlying the theoretical model. Secondly, the inflows of physicians from low wage countries need to be large enough. In the same year that individual bargaining was in place the EU allowed ten new EU member countries and two more member countries entered in 2007.[4] For these reasons I use data from 2004 and up to 2011. The average wage in the new member countries was by the time of accession considerably lower than in Sweden. Sweden opened her borders unconditionally from the start.

I do not only have access to data on immigrated physicians from the new EU countries but also from other low wage regions and from regions where wages are on similar or higher levels than those of the native physicians. More specifically, it means that I have access to immigrants from low wage EU countries of alternative periods of stay in Sweden, immigrants from other low wage regions of long and short stay in Sweden, and immigrants from high wage regions of different duration in Sweden. This opens up for a rich and versatile empirical test of the theoretical propositions.

A further consideration is the geographical level at which to perform the analysis. To identify the effects of interest many studies exploit the geographical variation by estimating models on the regional level. The randomness of this allocation can, however, be questioned. While there is little to suggest that physicians of a particular specialization would tend to cluster at specific regions, inflows could be more intense into regions where relative wages are particularly high thus causing a spurious correlation between the wage and the migrant share. Still, there could be changes in the migrant shares across regions that would reflect regional wage differences. Therefore, my main focus is on estimations on the national level. The detailed data on physicians allow for a great deal of variation also on the national level to identify the effects of shocks to the migrant shares across specialization, experience level and years. Still, comparing the results from estimating the model on the two levels may add some insights as to the adjustability of the labor market of physicians to the variation in the migrant share.

[4] In 2004, the three Baltic countries joined the EU along with Poland, Czech Republic, Slovakia, Hungary, Slovenia, Malta and Cyprus. In 2007, Bulgaria and Romania joined.

Finally, relevant dependent variables are needed. The primary variable is the full time equivalent monthly pay of each individual physician, including any extra pay besides the salary that also is part of the bargaining outcome. Besides this variable, another useful dependent variable is the total wage income of the native physicians that captures not only the wage effect but also a possible labor supply effect of immigration. A possibility is that an inflow of physicians with a special expertise could reduce the extent of overtime work among native physicians, thus reducing the overall wage income. The effect on supply would then come out as the differential effect of wage income and wages.

Individuals having graduated from medical school are separated into categories of generalists (with or without medical internship) and nine categories of specialists (surgeons, internal physical doctors, pediatricians, geriatricians, general physicians, psychiatrists, radiologists, clinical laboratory specialists, and other specialists), a total of ten groups. Basic human capital theory suggests that experience differences across individual doctors could affect substitution conditions. Work experience is likely to add significantly to the skills, and hence to the earnings, both of generalists and of specialists. In most cases the year of graduation is available, but if not, experience is defined as age minus 25, which is assumed to be the year of graduation from medical school. I then define the following experience levels in years: junior experience having less than six years, median experience having more than five but less than 25 years of experience, while senior experience classifies doctors having more than 24 years in the profession. With the groups of educational specialization and years of experience I am able to capture in great detail the substitution effects between immigrated and native doctors.

A final advantage with the data is that it circumvents the downgrading problem since immigrated physicians, like natives, will enter the labor market of their specialization. In some studies downgrading is a problem since allocating the immigrants according to their formal education has been shown to be misleading.[5]

Table 2 shows the average values of the most important variables:

Table 2 in here

By the time of the accession in 2004 there were large salary differences between Sweden and the EU10 countries. While the average pay in Sweden for specialists amounted to $76, 000,

[5] See Dustman et al (2013) and Dustmann and Preston (2012).

the corresponding figure in Poland was $20, 000, in Hungary $27, 000, and in the Czech Republic $35, 000.[6]

Figure 4 shows the penetration of immigrated physicians as shares of all physicians in Sweden after accession of the new EU10 countries in 2004. The figure expresses the shares of all foreign born physicians, physicians from low wage regions, physicians from high wage regions and physicians from the new EU member countries.

Figure 4 in here

There has been a strong increase in the share of foreign born physicians, from less than 21 per cent to more than 26 per cent during the seven years. There are trend increases from both high wage regions and low wage regions (excl EU10) but the strongest increase pertains to physicians from the new EU members. By definition, this was zero in 2003 but had grown to 2.23 per cent in 2011. In 2011, 48.7 per cent of the immigrated EU physicians were from Poland.

6. Model specifications

Let the dependent variable w_{ijrt} be the log of monthly real wages of physicians of skill specialization *i*, experience *j*, active in region *r* during time period *t* determined at the individual level. The monthly wage is the full time equivalent wage, covering the whole public sector and a sample from the private sector. Since the migrant share *m* is the crucial variable in the theoretical model, this share, rather than the supply of immigrants, enters the equation. A basic specification is:

$$w_{ijrt} = \alpha m_{ijrt} + \beta Z_t + s_i + x_j + \pi_t + \chi_r + (\chi_r * \pi_t) + (s_i * \pi_t) + (x_j * \pi_t) + (\chi_r * s_i) + (x_j * s_i) + (\chi_r * x_j) + \varepsilon_{ijrt} \quad (11)$$

where I have left out index for variations across individuals on the dependent variable (w_{ijrt}) and on the vector of personal characteristics of each individual (Z_t) at time *t*. This vector includes gender, age, age^2. The variables s_i, x_j, χ_r and π_t are controls for differences in

[6] See Rampell (2009). The figure for Sweden refers to 2002.

doctors' specialization, their experience, region and over time. These four controls give rise to six interaction terms given in parentheses.

Through all regressions, the dependent variable is determined on the individual level and as noted, the dependent variable will also be represented by the log of annual real earnings.

Concerning the migrant share, there are two possible specifications. The first is to specify the migrant share on the national level as m_{ijt}. Each cell varies by specialization, experience and time but not across the regions. Hence, earnings are assumed to be affected by the migrant share irrespective of in which region there is a change in the share. On this level, the individual cannot "escape" the effects of an increase in the migrant share unless he or she leaves the country. This would then reflect what we normally think of as a closed labor market.

The second specification is for the regional level, i.e. m_{ijrt} as in (11), with the migrant share varying also over the regions. Since an increase in the migrant share on the regional level may give rise to regional mobility, negative effects of increases in the migrant share, if any, may be avoided. It is therefore of interest to compare the effects on the national and regional levels. Note that I use individual data implying that the only variable that changes between the national and regional level is the migrant share, while the other independent variables and the dependent variable are the same. Hence, the estimation on the national level also has region and interaction variables involving regions as determinants.

7. Results

Before performing a more direct test of the theoretical predictions, I first investigate the wage effects when the migrant share includes all immigrants. The first column and first row in the result parts of Table 3 shows the results of the variation in the number of all immigrated physicians using as the dependent variable the log monthly wage of native born physicians on the national level. There is a negative significant effect of -0.04. This estimate cannot, however, be interpreted as an elasticity of the effect of a labor supply hike on wages. With *m* being the percentage increase in supply of physicians due to immigration I can define the elasticity of wages with respect to a supply increase of immigrated doctors as $\partial lnw_{ijrt}/\partial m_{ijrt} = \alpha/(1+m_{ijrt})^2$. With this correction the elasticity obtains as -0.03, i.e. a rather

limited effect: A ten per cent increase in immigration lowers the wage of native physicians by 0.3 per cent.

I next divide the immigrants into those arriving from low wage and those from high wage countries.[7] Rows 2 and 3 in column 1 show that the differences are not very large between estimates when the migrant shares are defined by these groups. After corrections the elasticities obtain as -0.04 for those from low wage countries and -0.05 for those from rich. This similarity is as expected since I have not defined the groups based on possible assimilation and the immigrants from low wage countries include also physicians having been in the country a long period of time.

A first indication of the theoretical propositions obtains as I investigate if the migrant share of doctors from the new and relatively poor EU countries and who have not been in the country a long time yields a significantly different estimate when compared to those above. These immigrated physicians started to arrive in 2004 and have at the most been in Sweden for seven years (in the last data year, 2011). Row 4 shows that the elasticity, in line with the theoretical model, is considerably higher. The estimate, -0.26, yields after correction a similar elasticity of -0.25 and implies that a ten per cent immigration increase lowers natives' wages by 2.5 per cent. This is a substantial effect and about five times higher than the one obtained for physicians from low wage regions irrespective of time in the country (-0.04).

So far, the results are in line with the model's predictions. A more exact test, however, obtains by splitting all immigrated physicians from low wage countries into those who have been in the country for a short period (unassimilated) and those who have been here longer (assimilated). To the extent that the former, as newcomers, have lower reservation wages than the latter, assimilated, groups one should find significantly different estimates. Row 5 shows the estimates of the share of immigrated physicians from low wage regions who have been in Sweden for at the most five years and row 6 for those who have been in Sweden six years and longer. In the first group, almost all immigrants from the new EU countries are included as a sub group and, as expected, the estimate is not very different from that in Column 4: -0.27. The implied elasticity is -0.26. Performing the same regression but for immigrants from low

[7] Low wage countries are those in Africa, Latin America, Asia, the Soviet Union, and the countries joining the EU in 2004 and 2007. High wage countries are those in the EU15 countries and in North America, plus Norway and Iceland.

wage regions having been in the country longer shows an estimate that is not significantly different from zero. This qualitative difference in the effects of immigrants from low wage regions depending on time in the host country is in line with what the theory predicts. While immigration has a negative wage effect, this tapers off with time in the new country.

As shown in row 3 of Table 3, the migrant share based on immigrants from high wage countries yields an estimate similar to the one for low wage regions. The question arises if "recently" arrived immigrants from high wage countries would give rise to a higher estimate like the case is for recent immigrants from low wage countries do. That would go against the basic predictions. Row 7 shows that the estimate, when limiting also these immigrants to those who arrived less than six years ago, is -0.13 and where the elasticity is -0.12. While this is indeed higher than for high wage country immigrants in general (.05, see row 3) it is still considerably lower than that obtained for immigrants from low wage countries with the same number of years in the country (-0.26, Row 4).

It can be argued, though, that there would be some variation in the underlying reservation wages for immigrants from high wage countries. Also some physicians from these regions must be expected to have a low reservation wage. Reservation wages are not observable but are likely to be reflected in the actual wages. It is therefore of interest to see if the result is robust with respect to the actual level of the salary. I therefore calculate the mean wage by year, region, medical specialization and experience level and run an identical regression limited to those immigrants having a salary at least as high as the mean salary of the relevant cell. Row 8 shows that the estimate (-0.04) is not significantly different from zero. This implies that the slightly higher estimate in row 7 is driven by the immigrants at the lower tail of the wage distribution which reasonably are immigrants from the countries where wages are the lowest among the ones classified as high wage countries.

Estimating the model on the national level is the closest one gets to the notion of the textbook's "closed labor market". Much of the literature performs estimates on the regional level. It may be of interest to compare the national level estimates to those on the regional level using data for the 21 different Swedish regions. Due to regional adjustment, one should expect to obtain lower estimates.

In Table 3, column 2 shows the regional level results of the migrant share when all immigrants are included which corresponds to column 1. The elasticity is now considerably

lower, -0.01, and is not significantly different from zero. A significant effect obtains when I limit the data to immigrants from the new EU countries (see row 4), but, as may be expected, this is considerably lower, -0.05, than that found on the national level (-0.26).

When dividing the immigrants from low wage countries into recent immigrants and early immigrants, setting the limit at six years, I again find a significant effect for the recently immigrated physicians; the estimate comes out as -0.03, while a non-significant effect obtains for the early immigrants.

A regression of the effects of immigrants from rich regions yields an estimate that is not significant. This is irrespective of how long the immigrants have been in the host country.

As one could expect the estimates are considerably lower on the regional level presumably since at this level there is scope for some adjustment to increasing immigration of physicians through regional internal migration. Of more interest to the paper, though, is that the results on both levels are in line with the predictions of the theory namely that the variation in the migrant share crucially hinges on how these are defined. The results not only indicate that recently arrived physicians exert a negative wage effect on native doctors but also, and maybe more importantly, that this effect is of a short run nature and tends to go away with increasing assimilation.

Immigration may not only affect wages but also wage incomes through the labor supply. Table 3, column 3, presents the income effects on the national level and column 4 on the regional level. Column 3 shows that the overall effect of changes in the migrant share as all immigrated physicians are included is -0.09 which is about twice as large as the effect on wages (column 1). Thus, overall immigration of physicians seems to have a negative impact on native doctors' labor supply. With full employment this could represent reduced overtime or, maybe less likely, that some native physicians switch to part time work.

A considerably stronger effect on wage income obtains as I estimate the effect of the EU10 migrant share, presented in Column 2. The estimated effect is -1.77. With the wage effect limited to -0.26, (row4, column 1) this labor supply effect could be interpreted as an effect of employers creating job openings for physicians from the EU10 area in order to limit the bottlenecks in physicians' labor market. As there is a negative income effect, the major part of this is due to reduced labor supply.

The effects of variation in the migrant share of early immigrants from low wage regions or from high wage regions are considerably lower, with elasticities of -0.23 and -0.28, respectively (see column 3 and 4). As for the wage effects, the quantitative income effects come out at quite similar levels. Thus, also for income the divide seems to be between recent immigrants from low wage regions on the one hand and immigrants from high wage countries or from low wage countries who arrived some time ago.

8. Conclusions

While the literature on the wage effect of immigration for a long time lacked theoretical underpinnings, much of the recent literature is based on estimation of elasticities of substitutions that are connected with the effect of immigration on native wages.[8] The literature is still, however, silent on how rational wage setters take aboard the migrant share when they set the wage. Based on the comprehensive use of bargaining in wage formation in the immigration countries this paper presents a bargaining model that focuses on a possible mechanism through which the migrant share can affect wage setting of native workers.

The basic mechanism, formalized in the model, rests on the notion that immigrated workers with lower reservation wages than native workers are, by definition, willing to accept job offers at a lower cost to the employer than is the native worker. Immigrated workers having higher reservation wages than natives are not willing to accept job offers at a lower cost. Hence, the native workers' unemployment risk rises with the migrant share only to the extent that this share increases due to immigration of workers with low reservation wages. Though there could be some selection of workers with low reservation wages from high wage countries, these workers predominantly arrive from low wage countries. A higher unemployment risk tends to lower the bargained wage.

With time in the country, however, the reservation wages of immigrated workers can be expected to increase and approach the level of the native workers. Thus, while immigrants from low wage countries will tend to reduce wages in the short run any variation of the migrant share that is due immigrants having been in the country long enough for reservation

[8] Borjas (2003), Ottaviano and Peri (2011), Manacorda et al (2011).

wages to have increased to the level of the native peers, there will be no adverse effect. The native wage will, ceteris paribus, in the long run return to the initial level.

These theoretical insights are testable. While a basic variable, the reservation wage, is unobservable, one may convincingly assume that reservation wages are lower the lower wages are in the country of origin. I apply the model to the immigration of physicians from low wage and high wage countries to Sweden. A primary reason for selecting physicians is that, in line with the theoretical model, their wages are the outcome of a bargaining process on the individual level. Moreover, highly detailed data on specialization, experience, etc. are available allowing for a large variation in the data which is necessary for identification.

Many workers tend to worry about their wages as immigrants arrive to compete for vacancies and the most controversial issues concern immigrants from low wage countries. This fear may emanate partly from the amount of workers but partly also from the fact that their home wages, and thus their reservation wages as they enter the host country, are low. I document differential wage effects for physicians if employers fill vacancies with immigrated workers from the low wage countries compared to from the high wage countries. In line with the model, I find that the effects on natives' wages crucially hinge on the composition of the migrant stock and that the propositions of the model are supported. While immigration of physicians from low wage regions in the short run tends to lower native physicians' salaries by an elasticity of -0.27, there is no effect if the variation in the immigrant share emanates from physicians who immigrated years ago. Accounting for supply effects I find considerably stronger effects on workers' income.

Other studies, based on immigration of broader groups of immigrants have found stronger effects from estimates on the national level than on the regional level, the reasons for which are not fully clarified. It is notable that a major difference in this respect holds also for estimation of immigration of workers with a carefully specified profession like in this case.

RERENCES

Binmore, K., A. Rubinstein, and A. Wolinsky (1986):"The Nash Bargaining Solution in Economic Modeling," *Rand Journal of Economics*, 17 (summer), 176-188

Blanchflower, D. and A. Oswald (1996): *The Wage Curve*, Massachusetts Institute of Technology, USA.

Borjas, G. J. (2003):"The Labor Demand Curve *Is* Downward sloping: Reexamining the Impact of Immigration on the Labor Market", *Quarterly Journal of Economics*, November, 1335-1374

Borjas, G. J. and L. F. Katz (2007):"The Evolution of the Mexican-Born Workforce in the United States," In George J. Borjas (ed.) *Mexican Immigration*, University of Chicago press, 13-56

Bratsberg, B., E. Barth, and O. Raaum (2006):"Local Unemployment and the Relative Wages of Immigrants: Evidence from the Current Population Surveys, *the Review of Economics and Statistics*, May, 88(2), 243-263.

Card, D. (1990):"The Impact of the Mariel Boatlift on the Miami Labor Market," *Industrial and Labor Relations Review* XLIII, 245-257.

Card, D. (2012):"Comment: The Elusive Search for negative Wage Impacts of Immigration", *Journal of European Economics Association*, 10(1), 211-215.

de Silva, D. G., R. P. Mccomb, Y. Moh, A. R. Schiller, and A. J. Vargas.(2010) "The Effect of Migration on Wages: Evidence from a Natural Experiment." *American Economic Review*, 100(2): 321–26.

Dustman, C., T. Frattini, and I. P. Preston (2013);"The Effect of Immigration along the Distribution of Wages," *Review of Economic Studies*, 80, 145-173.

Dustmann, C. and I. P. Preston (2013);"Estimating the Effect of Immigration on Wages: A Comment", *Journal of the European Economic Association*, 10 665-695.

Hall, R., and A. Krueger (2008):"Wage formation between Newly hired Workers and Employers: Survey Evidence, NBER Working Paper Series, no 142329, September.

Katz, L. F. and K. M. Murphy (2007):"Changes in Relative Wages, 1963-1987: Supply and Demand Factors, *Quarterly Journal of Economics*, 107, 35-78

Manacorda, M., A. Manning and J. Wadsworth (2012):"The Impact of Immigration on the Structure of Wages: Theory and Evidence from Britain, *Journal of the European Economic Association*, February, 10(1), 120-151.

Ottaviano, G. I. P. and G. Peri (2012):"Rethinking the Effect of Immigration on Wages," *Journal of the European Economic Association*, February, 10(1), 152-197.

Rampell, C. (2009);"How Much do doctors in Other Countries Make? Economix, *New York Times*, July 7. See: http://www.google.se/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CC0QFjAA&url=http%3A%2F%2Feconomix.blogs.nytimes.com%2F2009%2F07%2F15%2Fhow-much-do-doctors-in-other-countries-make%2F&ei=aDYoU-TuLMbnywPPuYGwBA&usg=AFQjCNGffF3GYKP8oZf82gV-Q9MELDN6Kg&sig2=3-GABlZ8inMY84zx2-utHg.

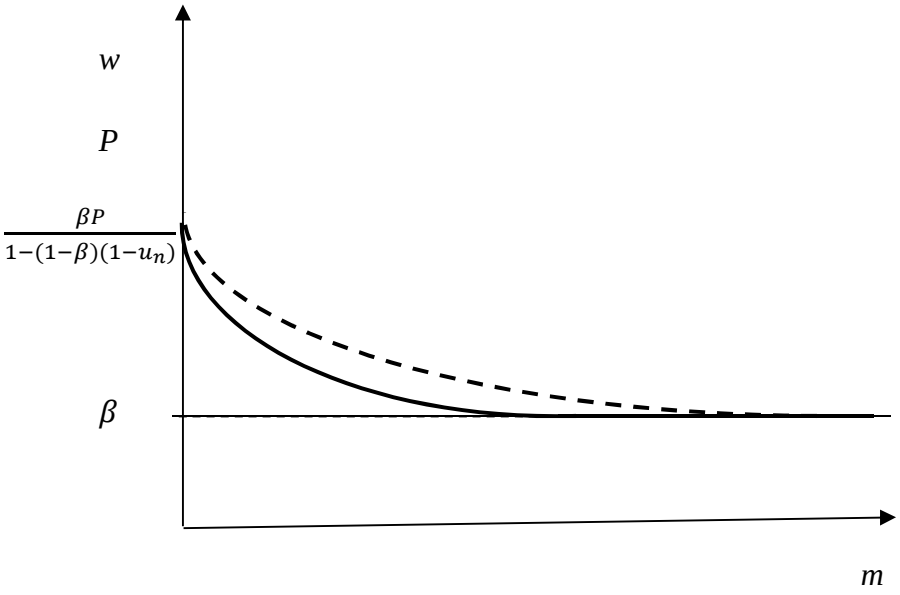

Figure 1. Wages and immigration stock at different relative reservation wages.

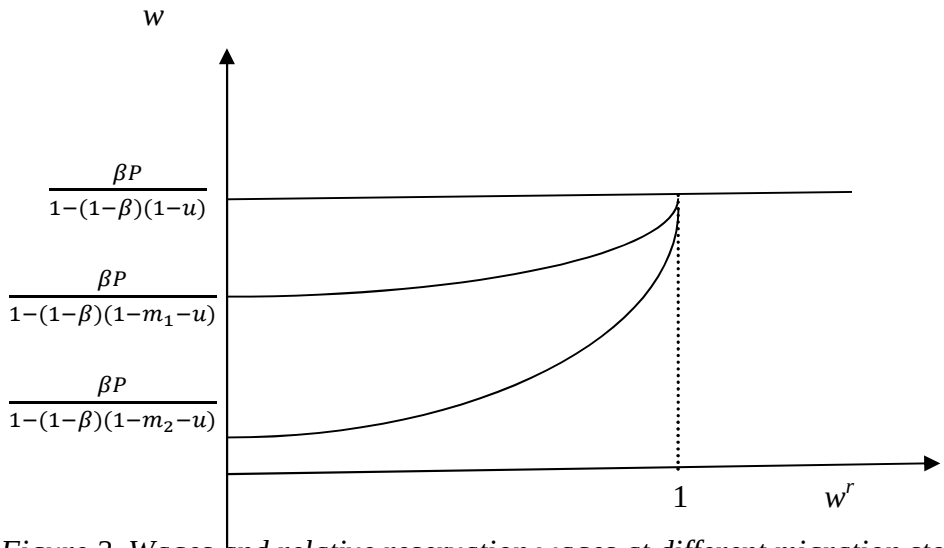

Figure 2. Wages and relative reservation wages at different migration stocks.

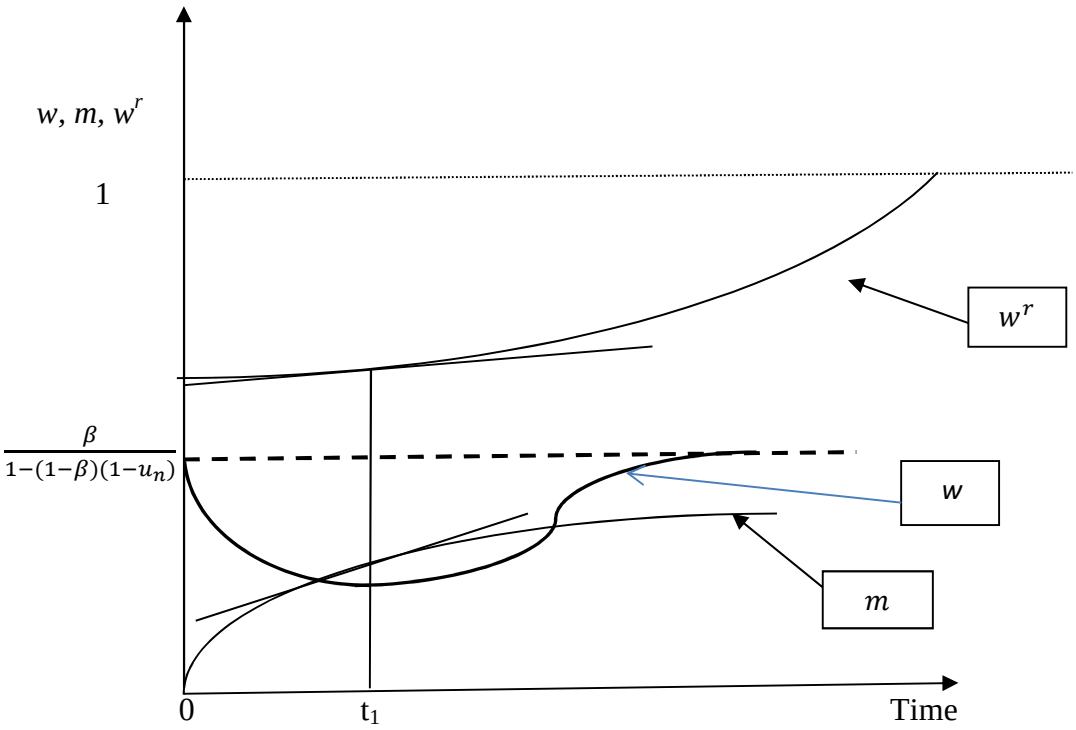

Figure 3. Effects of immigration on wages over time.

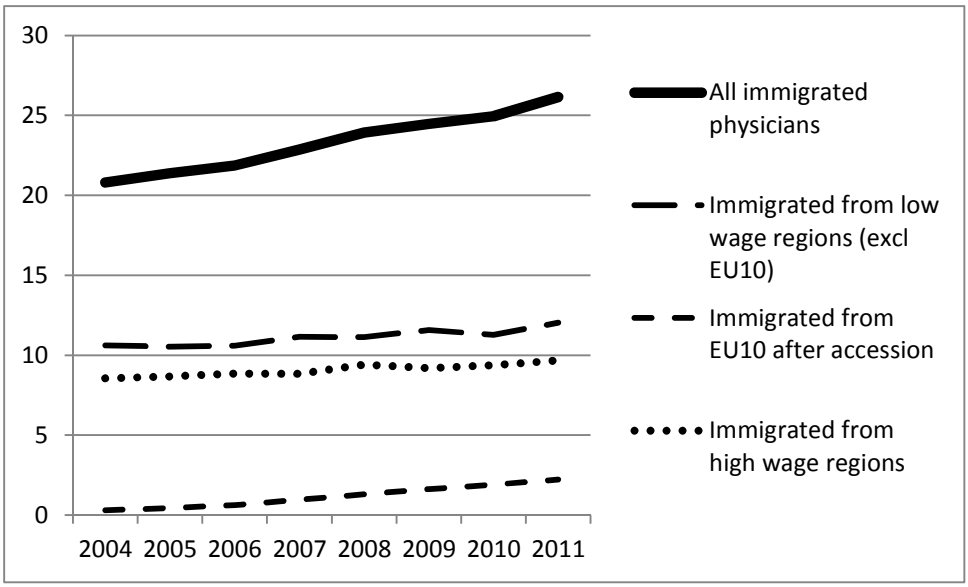

Figure 4. Penetration of foreign born physicians into the Swedish labour market for physicians. Percentage shares of all physicians 2004-2011.

Note: Low wage regions include countries represented in data from Africa, South America, Asia, and the Soviet Union. High wage regions include Norway, Denmark, Finland and Iceland, other EU15 countries, North America, and Oceania.

	$w^r=50$	$w^r=50$	$w^r=50$	$w^r=70$	$w^r=70$	$w^r=70$	$w^r=90$	$w^r=90$	$w^r=90$
	u=3	*u=5*	*u=10*	*u=3*	*u=5*	*u=10*	*u=3*	*u=5*	*u=10*
m=2	-0.033	-0.02	-0.01	-0.02	-0.012	-0.006	-0.007	-0.004	-0.002
m=5	-0.083	-0.05	-0.025	-0.05	-0.03	-0.015	-0.017	-0.01	-0.005
m=15	-0.25	-0.15	-0.075	-0.15	-0.09	-0.045	-0.05	-0.03	-0.015

Table 1. Relations between elasticities and relative reservation wages, unemployment and immigrant share. Simulated effects.

	All immigrated physicians	*Native born physicians*	*Immigrated from EU10 after accession*	*Immigrated from all low wage regions*	*Immigrated from all low wage regions during the last 6 years*	*Immigrated from high wage regions*
Total number 2004-2011	80, 178	261, 276	4, 090	42, 318	10, 708	30, 982
Age	45.67	48.97	38.57	45.18	38.31	46.46
Share women	46.87	44.16	53.74	45.88	44.37	45.24
Real monthly wage	47, 158	49, 769	45, 562	45, 960	41, 069	49, 019
Real annual earnings	518, 687	546, 587	522, 904	510, 826	409, 094	531, 135
Not specified specialization[1]	0.36	0.21	0.66	0.36	0.70	0.34
Surgeons[2]	0.12	0.12	0.07	0.11	0.07	0.14
Internal medicine	0.06	0.05	0.06	0.07	0.04	0.06
Pediatricians	0.02	0.02	0.01	0.02	0.01	0.02
Geriatricians	0.01	0.01	0.00	0.01	0.00	0.01
Specialists as general physicians	0.13	0.13	0.07	0.13	0.05	0.12
Psychiatrists	0.04	0.04	0.05	0.04	0.03	0.04
Radiologists	0.02	0.02	0.02	0.02	0.02	0.02
Clinical lab0. specialists	0.01	0.01	0.01	0.01	0.08	0.01
Other fields of specialization	0.04	0.05	0.02	0.04	0.01	0.04
Other medical education	0.18	0.32	0.02	0.18	0.05	0.20

Table 2. Averages of selected variables.

Notes: [1]Physicians with or without completed internship. [2] Includes specialists in anesthesia and intensive care.

	Real monthly wages		Real income	
Migrant share by immigration category**	**National level**	**Regional level**	**National Level**	**Regional level**
All immigrated physicians (0.68, 0.69)	-0.0431 (-0.0210)	-0.0090 (-0.0060)	-0.0872 (-0.0471)	-0.0180 (-0.0057)
Physicians from low wage countries (0.81, 0.81)	-0.0543 (-0.0251)	-0.0003 (-0.0002)	-0.0479 (-0.0622)	-0.0005 (-0.0005)
Physicians from high wage countries (0.85, 0.85)	-0.0626 (-0.0254)	-0.0091 (-0.0083)	-0.3297 (-.0717)	.0165 (0.0243)
Physicians from new EU countries (low wage)(0.98, 0.98)	-0.2573 (-.0656)	-0.0472 (-.0205)	-1.7692 (-0.2116)	-0.1963 (-0.0586)
Physicians from low wage countries. 1-5 years in Sweden (0.94, 0.96)	-0.2731 (-0.0382)	-0.0342 (-0.0128)	.1311 (0.1237)	.0779 (0.0399)
Physicians from low wage countries. 6 years or more in Sweden (0.85, 0.85)	.0414 (0.0294)	-0.0110 (-0.0087)	-0.2752 (-0.0709)	-0.0002 (-0.0200)
Physicians from high wage countries. 1-5 years in Sweden (0.96, 0.96)	-0.1277 (-0.0434)	-0.0190 (-0.0153)	.4923 (0.1692)	.0807 (0.0443)
Physicians from high wage countries and higher than average wages. 1-5 years in Sweden (0.96,0.96)	-0.0595 (-.0551)	.0172 (0.0183)	.4928 (0.1925)	.1035 (0.0520)
N	205, 336	205, 336	251, 944	251, 944

Table 3. The impact of share of immigrated physicians on native physicians' wages and income. National and regional levels. Robust fixed effects regressions. Standard deviations in parentheses under estimates.

Notes: *) All regressions include the following controls: age, age^2, gender, medical specialization, experience level, region, year, and the following interaction variables: (region*year), (specialization*year), (experience level*year), (region*specialization), (experience level*specialization), and (region*experience level).

**) To arrive at elasticities of wages w.r.t. supply of immigrants, the estimates should be corrected with the terms in parentheses where the first terms concerns the estimates on national level and the second the regional level.