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ABSTRACT

High Skilled Migration and the Exertion of Effort by the Local Population*

The design of optimal immigration policy, particularly in the face of the spiralling demand for highly skilled workers, such as IT workers and engineers, is a topical issue in the policy debate as well as the economic literature. In this Paper, we present empirical evidence from firm-level data collected in 2000 on the demand in Europe for highly skilled workers in general and abroad and their determinants. Major findings are that the fraction of highly skilled recruited from the international labour market is very small, and it seems that foreign and domestic workers are very similar in terms of formal education, that is subject of specialization, and job characteristics. We suggest an efficiency wage model that can explain why firms recruit foreign workers in small numbers and are willing to pay migrants the same wage as local workers and at the same time are willing to pay for moving costs, for example, that are specific to immigrating workers.

JEL Classification: F22, J41, J61 and L20

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1. Introduction

Much attention has been paid to labour supply in the migration literature. In this context, wage differentials between natives and immigrants and the probability of migrating have been focal points of empirical studies¹. To date, however, little is known about the demand side of this relationship. This aspect of the labour market is, however, particularly interesting with regard to the ongoing globalisation of labour markets. In addition to trade, labour movements and corresponding transfers of know-how in the form of human capital are integral parts of the process of globalisation from a firms' perspective. To date it is not clear why firms transfer their domestic workers, skilled in the firms' production process, abroad, and/or hire skilled foreign workers with knowledge of foreign markets and production techniques.

We are only aware of three studies collecting firm level data on highly skilled workers: Lowell (1999) for the U.S., List (1996) for Germany and an EU Report (1992). Most relevant for the purpose of our analysis is the EU Report, which finds that the recruitment rates of graduates in the EU are highest in large organisations, in Germany and France and the engineering and chemical sectors. All three studies however suffer from low response rates and small sample sizes. The conclusions of the EU report, for example, are based on 286 observations from 12 EU countries. Such studies also suffer from difficulties of how to define 'highly skilled' in a coherent way in order to facilitate meaningful comparison across the countries and how to define the firm unit in order to enable meaningful comparison across countries and sectors.

¹ See e.g Chiswick (1978) for the US, Bell (1997) for the UK, Dustmann (1993) for Germany. On the probability to migrate see e.g DaVanzo (1983) for the US.

The aim of this paper is therefore to investigate the demand side of the immigration of highly skilled workers. We first present empirical evidence on the international recruitment experiences of firms from the new IZA International Employer Survey 2000. This collects data on 850 large firms employing highly skilled workers in four EU countries: France, Germany, Great Britain and The Netherlands and five economic sectors – chemical, manufacturing, IT, research and development and finance. These sectors are particularly important for the recruitment of highly skilled workers. In our study ‘highly qualified’ is defined as holding a university degree and *foreign* highly qualified as a worker with a university degree, who obtained his/her qualifications abroad and who is a foreign citizen. Those workers that are not foreign workers using our definition are labelled domestic. In addition to country, sector and employment characteristics, the data provides a wealth of information on firm characteristics and why firms hire foreign highly skilled workers. We find that about one third of firms hire foreign workers and only a small fraction of the highly skilled – on average just under 4% - are foreign.

The final part of the paper develops a theoretical model, which offers an explanation for why firms recruit foreign highly skilled workers, why in small numbers, and why firms might wish to pay them the same wages as the local population, while at the same time compensating them for migration costs. Firms do so in order to signal to domestic workers that they are replaceable. Hence the foreign highly skilled workers in their home country represent a ‘reserve army’, playing the role of the unemployed in the standard efficiency wage scenario. The threat of replacement seeks to boost the effort exerted by domestic workers.

The remainder of the paper is organized as follows: In section 2, we introduce our data - the IZA International Employer Survey 2000, describe the

immigration policies currently in place in the four countries we consider and outline possible motives for the mobility of foreign workers. Section 3 presents the extent of the recruitment of foreign workers by firms by country and sector. Section 4 considers the determinants of the demand profile of foreign workers – where foreign workers originate and how they differ, if at all, from domestic workers in terms of educational background and the functions they perform. Section 5 looks further at the costs to firms of recruiting foreign highly skilled workers. Section 6 develops our theoretical model and finally, section 7 concludes.

2. Data and Background Information

2.1 IZA International Employer Survey 2000

For the empirical analyses we use firm level data on the migration of highly skilled workers to selected industrial sectors within Europe. It is a survey collected in 2000 from 850 firms employing highly skilled workers within four neighbouring European Countries - West-Germany, France, the U.K. and the Netherlands. In order to ensure a sufficiently large number of firms employing highly skilled foreign workers in our sample, the sampling strategy used to collect the data targeted only those firms with more than 100 employees, focusing on the five most important economic sectors for the employment of highly skilled workers: chemical, manufacturing, IT, research and development and finance². Data was collected through a telephone interview with the individual responsible for the recruitment of highly qualified workers. ‘Highly qualified’ being defined

² These sectors were identified as particularly important for the recruitment of highly skilled workers through the use of a pre-test.

as ‘holding a university degree’ and ‘*foreign* highly qualified’ as ‘workers with a university degree, who obtained their qualifications abroad and who are foreign citizens’. Workers that are not foreign, using our definition, are labelled ‘*domestic*’³. Where the respondent was in charge of recruitment for more than one country, he/she was asked to restrict answers to refer to the domestic firm only, in order to exclude foreign based units of multinationals. Our definition of firm size therefore refers to domestic units only. Dropping those firms for which there is missing information on sector or firm size reduces our sample of firms to 770. For a more detailed data description, please see the appendix.

2.2 Mobility incentives for foreign workers

Table 1 about here

Our empirical analysis considers the experiences of firms within four of the six largest politically and economically most important countries within the EU. To provide some background information for these four countries, tables 1 and 2 present macroeconomic indicators on population size, percentage of foreign population, employment by sector, education level, unemployment rate for the highly skilled and average wage. Comparison of the four countries in table 1 reveals that in percentages of total population, Germany and France have the largest foreign-born populations. The service sector is the most important employer of both domestic and foreign workers (skilled and unskilled) in the four countries, but the industrial sector is relatively more important in Germany.

³ Hence, those with domestic citizenship and higher education from abroad, or foreign citizenship and domestic higher education are included in the group of domestic highly qualified workers.

Table 2 about here

Information regarding unemployment rates, average wages and per capita GDP are useful in the consideration of possible incentives for foreign workers to migrate to these countries. Unemployment rates for university graduates vary across our four countries (see table 2). Countries with relatively low unemployment rates (such as the UK and the Netherlands) may experience a greater inflow of highly qualified workers from abroad. Similarly countries with relatively high per capita income or average wage (such as Germany or the Netherlands) may be more attractive to potential immigrants. Table 2 suggests that migrants from the Eastern European countries may well be attracted to the four countries we study by the relatively higher wages available there. For migrants from other EU countries the incentives are less clear.

The domestic education system and the resulting distribution of domestic educational outcomes may also be an important determinant of demand for foreign highly qualified workers. Holding labour demand constant, an increase in the proportion of domestic highly qualified workers may lead to a decrease in the recruitment of foreign highly qualified workers by firms. Alternatively, one might expect a positive correlation between highly qualified and foreign highly qualified workers within countries with high fractions of graduates and a close tie between the education system and organization within firms. Panel B of table 1 indicates that Germany has the lowest fraction of tertiary educated population (18.7%). Followed by France and United Kingdom, with the largest fraction reported for the Netherlands (23.9%).

2.2 Immigration Policies

The mobility of potential immigrants is regulated however by immigration policy. Heterogeneity in immigration policies between EU member countries is low. Citizens of the European Economic Area (EEA), which includes the EU member countries, have a right to free movement across the EEA and do not require work permits to work. In principal, the cost to firms of recruiting EU member country workers are therefore low, but arguably still higher than recruiting domestic workers. Key determinants of these higher costs may include cultural differences, language skills, and the interpretation of foreign qualifications.

Immigration policy for non-EU citizens is ultimately set by national governments. Potential non-EU immigrants must acquire a work permit to work in an EU-member country. Generally, applications for work permits are made by firms on behalf of the potential non-EU employee in order to fill a specific post. Hence, firm specific requirements play a major role in attracting non-EU workers to Europe. The work permit system is characterized by a turnover of labour – that is workers working for temporary periods in their host country and then returning home⁴. This may prevent foreign workers settling in a country for long – avoiding any dependence on unemployment systems or state provided pensions in future periods. Costs to European firms of recruiting foreign non-EU member country workers can therefore be assumed to be higher than recruiting either EU foreign or domestic workers. Key determinants of these higher costs include perhaps most importantly visa and work-permit requirements.

⁴ The proportion of work permit holders settling permanently is about one quarter in the UK, for example. See: OECD (2001), table III 40.

3. Mobility and the demand for foreign workers

Tables 3 and 4 about here

From the new IZA IES we derive statistics to describe the employment of foreign highly skilled workers. Tables 3 and 4 present summary statistics for our sample of firms broken down by country and sector respectively. The second line of each table presents the percentage of firms recruiting foreign highly skilled workers.

The first important result is that an average of one third of the firms from our four countries employ foreign highly skilled workers. Table 3 shows that this percentage is somewhat smaller for firms in the Netherlands, but very similar for Germany, France and the UK. Table 4 indicates that the percentage of firms employing highly skilled workers varies to a greater extent by sector, with firms in the financial and manufacturing sectors being less likely, and firms in the research and development sector being significantly more likely to employ the foreign highly skilled.

Looking at firms with foreign workers and firms without foreign workers separately one finds that the fraction of highly qualified workers in general is considerably larger within the former group of firms. This result holds across all countries and sectors. This suggests that firms differ in terms of organization and technology that create higher skill demands. Within each sector we see that France has the largest fraction of highly qualified workers. The corresponding numbers for the Netherlands are particularly low.

Figure 1 about here

Figure 1 summarises the recruitment of foreign workers as a percentage of the total number of highly skilled, within country and sector cells⁵. The second important, and surprising, result arising from the data is that the percentage of foreign workers employed by firms is generally much lower than one might anticipate – the average percentage being 3.67%. Figures shown here are representative. Figure 1 highlights that the proportion of foreign highly skilled workers varies considerably, however, by country and sector. The fraction is highest at around 9% in the research and development sectors of our four countries, along with the chemical industry in the Netherlands and is significantly larger than the proportions employed in the manufacturing and financial sectors. The UK financial sector employs a particularly low proportion of foreign workers (.28%).

4. The demand profile

Our data does not allow us to estimate labour demand elasticities⁶. Taking (unweighted)⁷ averages across firms' responses a picture of the average highly qualified worker can be derived, distinguished by domestic and foreign workers according to our definition. Of main interest are the questions (1) what is the country of origin of highly qualified foreign workers and do foreign highly skilled workers come from within the EU or from outside?, (2) within which fields are

⁵ We present means here, but the distributions are right skewed and hence the median is even smaller.

⁶ In the previous literature the impact of changes in the supply of foreign workers on the change in wages of domestic workers has been evaluated in order to investigate whether foreign and domestic workers are substitutes or complements (see e.g. Bauer et al. 1998, for a survey see Greenwood, et al. 1986 and Bauer et al. 2000.). On the whole, no significant elasticities are found. In this literature, heterogeneity across individuals and firms is usually captured by cost-benefit variables and individual characteristics. In addition, heterogeneity across firms may be measured by soft variables on tastes or subjective determinants of the demand for foreign highly qualified workers. These are often correlated with the former.

⁷ We could weight the results for firm size, or number of (foreign) highly qualified workers.

foreign highly skilled workers qualified?, (3) what functions are they hired for? And (4) do they differ with respect to other specific human capital?

Table 5 about here

4.1 Country of origin

In the survey questionnaire a country specific list of the most likely countries of origin of foreign highly skilled workers was detailed. Here, neighbouring countries, countries with the same national language, and historical links, such as former colonies, were considered in the list of suggestions for each of our four European member countries. Firms were asked whether one or several of the suggested origin countries applied in the case of their foreign workers. In addition, firms were asked where most of their foreign highly qualified workers originated. Grouping the suggested countries into EU and non-EU we find that EU countries offer a relatively important labour market for the firms in our sample. More than 30 percent of firms replied that they had mostly recruited from EU countries. If they recruited at all from non-EU countries, these countries still accounted for less than half of the foreign skilled workforce.

Table 5 presents a country of origin and country of destination matrix. Examining the countries of origin in detail, we find high rates of inter-country recruitment between the four countries in our survey (see panel A). Between 40-60 % of firms with foreign workers report that they have recruited from one of our sample countries. Recruitment from the Netherlands, the smallest country in our sample, is less, at approximately 20%. Panel B shows that Germany and the Netherlands, in particular, have recruited foreign highly qualified workers from Eastern Europe. Surprisingly the US is less often cited by UK firms than

India/Pakistan, Other Asia or North Africa as an origin country of the foreign highly skilled (see panel C).

4.2 Subject field and function

Evidence from our survey reveals that foreign and domestic highly skilled workers look very similar with respect to both their functions and fields of study. Turning to information from only those firms that recruit foreign workers, the comparison of the fields of study of domestic and foreign workers reveals no significant differences between the two groups (see table 6). This important finding suggests that jobs are as likely to be filled by foreigner as domestic workers. For both foreign and domestic workers alike we find that 33% studied engineering, and approximately 16% maths and natural sciences. 14 % of nationals and a slightly higher 19 % of foreign workers studied IT. 14 % of nationals and 10 % of foreign workers studied Economics. Very few workers studied law. Patterns of subject specialisation are very similar for domestic and foreign workers by country and sector (for brevity, not reported here) but we find country and sectoral variation in the relative popularity of certain subjects. In the UK and Germany, for example, a high proportion of skilled workers have studied engineering. In France and the Netherlands, other fields are more important.

Table 6 about here

Firms were also asked for which functions workers were recruited. Although for brevity not reported here, results reveal that firms mainly recruit highly qualified workers for functions in research and development (37%), other functions (17-20%, foreign-domestic) and marketing and sales functions (15-

16%). 10–12 % recruit for IT functions and functions in manufacturing. As with subject specialisation, the functions performed by foreign and domestic highly skilled workers are not found to be statistically different.

4.3 Other specific human capital

The dataset contains information on human capital characteristics such as knowledge of languages and international experience. Firms recruiting *foreign* workers cited foreign workers' knowledge of foreign markets, foreign languages and knowledge of English as the most important reasons for recruiting foreign workers. The lack of good domestic candidates is a problem motivating foreign recruitment for around 50% of firms, and skills required for the job not being produced by the domestic education system for around 20% of firms.

Table 7 about here

Evidence for *domestic* workers suggests that language skills and knowledge of foreign markets are similarly valuable skills within this group of workers. Table 7 presents firms' responses to four subjective questions referring to firms' preferences towards domestic workers' skills profiles.

Analysis of firms, split by 'multinational'⁸ and 'other' reveals that the overall majority of firms value foreign language skills, but that the importance of these skills in domestic workers is highest in firms employing foreign highly skilled workers. A similar pattern is found with regard to the importance of foreign work experience for domestic workers. Firms hiring foreign workers are

⁸ We define multinationals as those firms indicating that they are part of a multinational firm, or that report that their firm is owned by a foreign company.

more likely to send their domestic employees abroad for foreign work experience and are more likely to do this as standard policy.

From evidence on the field specialisation and job function of workers it therefore appears that firms, within the four countries and five sectors selected, recruit for jobs with a certain subject and function profile and that these jobs are as likely to be filled by foreigners as domestic workers. Where foreign workers are employed however, comparable skills such as foreign languages and work experience are also sought of domestic workers. No strong evidence seems to support the particular employment of one group over another because of specific human capital.

5. More on costs of recruitment

We have argued that generally the cost to firms of recruiting foreign workers will be higher than recruiting domestic workers, key determinants of these higher costs including cultural differences, language skills, the interpretation of foreign qualifications and possibly, visa and work-permit requirements. The dataset contains subjective information on the extent of such costs. Firms were asked to indicate which factors within a suggested list were potentially problematic when recruiting foreign skilled workers. Table 8 presents the percentage of firms responding that a factor was potentially problematic.

Table 8 about here

Firms actively recruiting foreign staff are the most likely to be aware of the potential problems involved - those firms currently employing foreign workers were more likely to voice potential problems with their recruitment. This holds breaking down results by country and sector and is consistent across the range of factors questioned. For both firms recruiting (66%) and not recruiting (57%) foreign highly skilled workers, obtaining a work permit for non-EU foreign workers presents the largest potential problem, significantly more so for firms mainly recruiting non-EU foreign workers. While few firms employing only domestic workers envisage other problems with the employment of foreign staff, for firms employing foreign workers, language problems and socio-cultural differences are far more frequently cited - by around 50% of firms. Problems related to the evaluation of foreign human capital are also important for firms, particularly so for those employing mainly non-EU workers. Just under 10% of firms consider high recruitment costs to present difficulties in the hiring of foreign labour.

Yet the empirical evidence presented has outlined that firms *are* prepared to pay the higher costs associated with the hire of foreign workers out of their profits – given that 30% of firms already employ them. Furthermore information available in the survey reveals that a considerable proportion of these firms are also willing to pay foreign workers for moving costs and language lessons. 22% (39%) of firms with foreign workers always (at least sometimes) pay for the moving costs and 30% (40%) always (at least sometimes) pay for language costs. We are interested in why domestic employers employ foreign workers, even though they are indifferent between the domestic and the foreign highly skilled. Moreover, why firms willing to pay a higher cost for the foreign workers than the

local workers. In order to understand these phenomena we turn to a theoretical efficiency wage model to give us some insights into these questions.

6. A theoretical framework

6.1 An overview

The presence of unemployed immigrants in the welfare state is a key issue in the paper by Epstein and Hillman (2002). Epstein and Hillman (2002) show, using an efficiency wage model, that it may be Pareto optimal for countries to enable migrants to enter their borders, knowing that they will be unemployed, even when the unemployed migrants receive unemployment benefits that are financed by the local working population. The main issue driving this result is the efficiency wage phenomena. The idea behind this is simple: under the efficiency wage framework (Shapiro and Stiglitz, 1984), in order for workers to be willing to exert effort, there must be unemployment. If there is no unemployment then a worker caught shirking would be fired and would find a job the next day, since in equilibrium wage is set such that demand is equal to supply with full employment. Employers wanting their workers to exert effort must pay a wage higher than the equilibrium wage. In this case there is unemployment and thus a worker caught shirking may not find a job “the next day”. This encourages workers to exert effort at the work place. If someone has to be unemployed, why not let it be the immigrants and not the local population? Thus in their paper, Epstein and Hillman (2002) show that it may well be optimal, from the government’s perspective, to allow immigrants to enter a country with the intention of them being unemployed in order to force the local workers to exert effort. Moreover, the authors show that this may even be Pareto optimal.

In this paper we take an approach similar to that of Epstein and Hillman (2002) but with a couple of important differences. Allowing immigrants to enter a country and become unemployed, receiving welfare benefits, seems to be a situation that is credible for low skill workers. In our framework, we address a situation in which employers are willing to employ foreign immigrants in highly skilled jobs at the local competitive equilibrium wage, and even pay the cost of transportation and immigration fees for these immigrants. Why? The answer is as follows: in order for the domestic workers to be willing to exert effort there must be unemployment. For this to occur, the employers must pay the local population a wage higher than the competitive wage. However, in the market for highly skilled workers it is not immediately obvious that an equilibrium where wages are high and there is persistent unemployment can be sustained. In this paper we present the case where firms pay the competitive equilibrium wage and workers are willing to exert effort. For this to happen, the employed workers must know that if they are fired it will be hard for them to find another job. If the employers can convey to the employed workers that they can be replaced, the employed workers will be willing to exert effort at the work place while been paid the competitive equilibrium wage. The idea in this paper is that the employers show the employed domestic workers that they can be replaced through hiring foreign workers with the same skills. Hence the foreign highly skilled workers in their home country represent a ‘reserve army’, playing the role of the unemployed in the standard efficiency wage scenario. The threat of replacement seeks to boost the effort exerted by domestic workers.

This scenario prompts the question ‘why don’t the employers just employ the foreign workers, fire the domestic workers and use them as the “reserve army”? That way they might also be able to pay a lower wage to the foreign

workers than the domestic workers?'. The answer to the question might be presented by the additional cost of bringing in all the migrants. Firm profits will be higher employing the domestic population with the foreign workers acting as the reserved army than vice versa. Other reasons might be the preferences of the employers regarding the employment of the local and the foreign population, the loyalty of the local workers to the firm, which might be an important long-term consideration, or political pressure set by authorities seeking full employment of the local highly skilled workers.

6.2 The Model

Competitive wage equilibrium

Assume that the labor market sets its wages via a competitive market equilibrium under which the wage set, w_c , is such that the demand for workers $D(w)$, equals supply $S(w)$:

$$w_c \text{ is such that } D(w_c) = S(w_c) \quad (1)$$

Denote by N the employed work force and by L the total labor supply, then by definition,

$$N(w_c) = L(w_c) \quad (2)$$

Thus the level of unemployment will be zero: Unemployment = $L(w_c) - N(w_c) = 0$.

An Efficiency Wage Equilibrium

We follow the framework set out by Shapiro and Stiglitz (1984) and Epstein and Hillman (2002). A population consists of people who are either owners of capital or workers, the latter made up of L nationals who are risk neutral and averse to effort. Workers have utility that is separable and linear in private consumption provided by the wage w and in the level of effort e ,

$$U(w, e) = w - e. \quad (3)$$

Effort is dichotomous at zero or positive. An unemployed worker receives benefits of w_o from the state and has no need to exert effort, so $e = 0$. The level of effort, e , is assumed, at this stage, to be fixed when exerting effort. Later on we look at the choice of the optimal level of e .

A worker has a probability of p of becoming unemployed for exogenous reasons that do not depend on the employer. All workers maximize present discounted utility, with a rate of time preference $r > 0$. The model is set in continuous time. The only choice that a worker makes is selection of effort e . A worker who does not shirk performs at a customary level of effort for the job, receives the wage w , and retains his or her job until he or she exogenously becomes unemployed. Employers imperfectly monitor effort. Workers who shirk are detected and fired with probability per unit of time q .

$V_e(s)$ and $V_e(n)$ are expected lifetime utilities of an employed worker when shirking (s) and when not (n). V_u is the expected lifetime utility of an unemployed person. For a shirker,

$$rV_e(s) = w - (p + q)(V_e(s) - V_u) \quad (4)$$

and for a non-shirker,

$$rV_e(n) = w - e - p(V_e(n) - V_u) \quad (5)$$

From (4) and (5), we have:

$$V_e(s) = \frac{w + (p + q)V_u}{r + p + q} \quad (6)$$

and

$$V_e(n) = \frac{(w - e) + p V_u}{r + p}. \quad (7)$$

No shirking takes place *if and only if* $V_e(s) \leq V_e(n)$ i.e.,

$$w \geq rV_u + \frac{(r + p + q)}{q}e \quad (8)$$

Production functions for firms are $\tilde{f}(\bar{K}, L, e)$ where \bar{K} is available capital, N is the number of employed workers, and e is the level of effort the workers exert. Owners of capital (or employers) benefit whenever more workers are

employed⁹. Demand for workers is given by their value of marginal product, and is a decreasing function of the wage w . An equilibrium is defined as an outcome where owners of capital, taking as given wages and employment levels at the other firms, find it optimal to offer the going wage rather than a different wage. That is, there is a Nash equilibrium in wages paid by employers. The sole variable determining employers' decisions is the disciplining of employed workers through V_u , the expected utility of an unemployed worker.

All unemployed workers receive the same welfare benefits w_0 , V_u is common to all employees, hence

$$rV_u = w_0 + k(V_e - V_u) \quad (9)$$

where k is the rate at which workers who are unemployed find jobs and V_e is the expected utility of an employed worker of type j , which in equilibrium equals $V_e(n)$. Substituting (9) into (6) and (7), we obtain

$$rV_e = \frac{(w - e)(k + r) + w_0 p_j}{k + p + r} \quad (10)$$

and

$$rV_u = \frac{(w - e)k + w_0(r + p)}{k + p + r} \quad (11)$$

⁹ Because of diminishing marginal product of labor.

Then, substituting (10) and (11) into (8), we determine that a worker will not shirk if

$$w \geq w_o + e + \frac{e}{q}(k + p + r). \quad (12)$$

The *efficiency wage* is defined as the lowest wage that satisfies (11).

Denote by N total employment of individuals. In a steady state,

$$k = p \frac{N}{L - N} \quad (13)$$

We assume that the probability of job loss independent of the employer's decision quit rate, p , is an increasing function of the rate of employment:

$$p = p\left(\frac{N}{L}\right) \quad \text{such that} \quad \frac{\partial p\left(\frac{N}{L}\right)}{\partial \left(\frac{N}{L}\right)} > 0 \quad (14)$$

From (14), (13), and (12), the condition that a worker of type j will not shirk is

$$w \geq w_o + e + \frac{e}{q} \left(p \left(\frac{N}{L} \right) \frac{L}{L-N} + r \right) . \quad (15)$$

and the equilibrium efficiency wage is where (15) holds with equality.

The question is now what happens to the efficiency wage when we increase the size of the labor market without increasing employment:

$$\frac{\partial w}{\partial L} \geq - \frac{e}{q} \frac{1}{L-N} p \left(\frac{N}{L} \right) \left(\eta + \frac{N}{L-N} \right) < 0 \quad (16)$$

where η is the elasticity of the probability of being unemployed with regard to

the rate of employment $\left(\eta = \frac{\partial p \left(\frac{N}{L} \right) \frac{N}{L}}{\partial \left(\frac{N}{L} \right) p \left(\frac{N}{L} \right)} > 0 \right)$. Thus,

As the size of the labor market increases without increasing the level of employment the efficiency way will decrease.

The level of effort as a decision variable

In a more general setting, where the level of effort is endogenous and not a binary decision as presented above, we might consider the amount of effort to be a decision variable of the workers. Although in this case the analysis would change, the main idea behind (15) still holds. Thus the optimal level of effort invested by the worker will be a function of the different variables presented in

(15). Specifically it will be a function of the wage level, w , and the unemployment level. Denoting the optimal level of effort invested by the workers as e^* .¹⁰ e^* would satisfy:

$$\frac{\partial e^*}{\partial w} > 0 \text{ and given } N, \frac{\partial e^*}{\partial L} > 0 \quad (17)$$

Therefore,

If the size of the unemployed population increases, without changing the employed population, N , and without changing the wage level, w , then the effort extracted from the workers and the firms profits will increase.

If the employers pay the local highly skilled workers w_c (the competitive equilibrium wage) as defined in (1), then the actual local employment level will be zero (see(2)). However, if the employers import foreign workers, the actual unemployment level will be greater than zero and thus the workers will exert more effort as the actual unemployment level increases.

From a political perspective, the government may not want local unemployment to increase, especially for the highly skilled - that may have opportunities in other countries. At the same time the capital owners benefit from the increase in effort exerted by the workers. Thus, the government may be willing to help the capital owners, while at the same time not changing the level of unemployment of the highly skilled workers. The government can do this by allowing employers to import a limited amount of foreign highly skilled labour.

¹⁰ The optimal level of effort is calculated in equilibrium taking into account the effect it has on

These highly skilled workers will be perfect substitutes to the local workers. Thus the local workers observe the foreign workers and know that if they are caught shirking, they will be fired and replaced by a foreign highly skilled worker. *The stock of high skilled workers living in a different country can therefore be seen, in the eyes of the locally employed population, as the pool of highly skilled unemployed workers - the reserve army of the employers.* In this way, the government, together with the employers, has increased the *perceived* number of unemployed highly skilled workers without having actual unemployment in the host country.

If employers can import a sufficient amount of foreign highly skilled labour in order to signal to the local highly skilled labour that they have substitutes, then willingness of the local population to exert effort and the profits of the firm will increase without increasing the local unemployment or wage level.

There are two more issues that we should briefly acknowledge:

- a. How to determine the optimal number of foreign workers that are sufficient to convey to the local population that the employers can really implement a strategy of local worker replacement if they wish to. Here we assume that the employers know how to estimate the number of workers that constitute a sufficient signal to the local population.
- b. The maximum number of foreign workers that the employers will be willing to import. Remember that the employers are paying both the local and foreign workers the same wage, but

that the employer must also pay the cost of importing workers which makes the foreign workers more expensive.

Regarding b: denote the production functions for the firms as $\tilde{f}(\bar{K}, L, e)$ where \bar{K} is available capital, N is the number of employed workers, and e is the level of effort the workers exert. Notice that the level of exerted effort is a function of the potential number of foreign workers the firm can employ. We will denote this level by U_f (unemployment of foreign workers – these workers are perceived to be unemployed in the host country, even though they are in their own home country). The price set – the equilibrium price, is therefore also a function of the level of exerted effort of the workers: $P(e)$. Thus the optimal number of workers that the firms will import, U_f , is a function of the effect it has on the level of exerted effort by workers and the profits of the firm. The local workers know this information and thus will also know the optimal number of foreign workers that the employers could import (in a Nash equilibrium) – this number is seen as the “reserve army” of the employers. Thus, the level of unemployment in the efficiency model: $L - N = U_f$ will be equal to the number of foreign workers that the employers would be willing to import under the constraint of the demand for and supply of their products.

7. Conclusion

The aim of this paper has been to investigate the demand side of worker immigration, with a focus on highly skilled workers. The first part of the paper presents empirical evidence on the international recruitment experiences of firms from the new IZA International Employer Survey 2000. We find that about one

third of firms hire foreign highly skilled workers, but that the fraction recruited by firms is generally low – on average just under 4%. Surprisingly, foreign workers appear very similar in their skills profiles to domestic workers in the same firms. Evidence available on subject specialisation, function performed and a selection of specific skills suggests that jobs could as easily be filled by foreigners as domestic workers. Only a small proportion of firms suggest that they recruit workers because the skills that are required for the job are not produced by the domestic education system. Instead, just over half of firms mention the lack of good domestic candidates as a reason for recruiting foreign workers. Information available in the survey reveals that a considerable proportion of these firms are not only willing to pay the higher costs of hiring foreign highly skilled workers, but also pay for their moving costs and language lessons.

We are interested in why domestic employers employ foreign workers, even though they are indifferent between the domestic and the foreign highly skilled. Moreover, why are firms willing to face a higher cost for the recruitment of foreign workers. In order to understand these phenomena we suggest a theoretical efficiency wage model to offer insights into these questions. In our framework, employers are willing to employ a limited number of foreign immigrants within highly skilled positions at the local competitive equilibrium wage and even pay the cost of transportation and immigration fees for these workers. Firms do so in order to signal to domestic workers that they are replaceable. Hence the foreign highly skilled workers in their home country represent a ‘reserve army’, playing the role of the unemployed in the standard efficiency wage scenario. The threat of replacement seeks to boost the effort exerted by domestic workers.

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9. Appendix

IZA International Employer Survey 2000

For the empirical part of the paper we utilize the IZA International Employer Survey 2000. This is a survey of 850 firms in four European countries - Germany, The Netherlands, France and Great Britain, within five industrial sectors – chemical, manufacturing, IT, research and development and finance. Data was collected through the use of a pre-tested questionnaire, applied through computer assisted telephone interviews¹¹, and conducted with the personnel manager responsible for recruiting university graduates in a firm. For the purpose of the survey, firm, highly qualified workers and foreign highly qualified workers were defined as follows: The company or firm is defined as the unit the interviewed person is responsible for, as far as recruitment is concerned. Furthermore, where the respondent was in charge of recruitment for more than one country, he/she was asked to restrict answers to refer to the home country firm only in order to exclude foreign based units of multinationals. Highly qualified are defined as holding a university degree and foreign highly qualified are defined as workers with a university degree, who obtained their qualifications abroad and who are foreign citizens. Those workers that are not foreign workers using our definition are labelled domestic¹².

The survey includes a host of questions, approximately 70, on firm characteristics, the employment of foreign highly skilled workers and firms' recruitment. For the purpose of this paper we utilise information on sector, country, firm size, the

¹¹ More details on the methods and the questionnaire can be found in Kunze and Ward (2001), Infratest Burke Sozialforschung (2001). See also Winkelmann, et al. (2001). Data is available for scientific use.

recruitment and percentage recruitment of foreign workers, the origin of foreign workers, education and function, reasons for and problems associated with the recruitment of foreign workers, together with relatively rare information concerning contractual arrangements and components of compensation packages. Ideally we would also like to have information on harder economic measures such as turnover, profitability and wage sum. The latter was left out the survey, however, due to the problems of collecting this type of information, while ensuring a reasonable response. This is a caveat to the analysis that follows.

Assuming that large firms, i.e. larger than 100 employees, are more likely to employ highly skilled workers sampling was stratified by firm size and on the sectors that are likely to employ foreign highly skilled workers (sectors were identified through the pre-test). For the final sample, firms were randomly drawn from a representative sample of firms¹³. In order to ensure a sufficiently large number of observations for each country, cell sizes were fixed. Hence, draws were conducted with the pre-defined probabilities, until the pre-defined number of observations were reached¹⁴. As a result the sample is not representative for each country, only within sector by country¹⁵.

¹² Hence, those with domestic citizenship and higher education from abroad, or foreign citizenship and domestic higher education are included in the group of domestic highly qualified workers.

¹³ For Germany, the Markus CD (MARKetingUnterSuchungen), i.e. is a file of firm addresses, was used. For the Netherlands, the UK and France the Dun and Bradstreet database was used that contains overall approximately 49 million firms covering 200 countries. Unfortunately, we have no access to these data files.

¹⁴ No. of observations were 340 for Germany, 170 for France, 170 for Netherlands, 170 for the UK (Total 850).

¹⁵ Reweighting the sample to population averages as suggested by methods applying to other stratified data sets (See e.g. Imbens and Lancaster 1996) is theoretically possible. However, it is quite hard or impossible to obtain the appropriate weights from external data sources, for each country, and within the defined NACE Code sectors. Hence, in the following analysis we refrain from doing so. We only weight regression results for the fact that in our sample Germany is over-represented.

For our analysis, we assume that missing values are randomly distributed across firms and questions. In the following, we define sub-samples containing the group of firms we want to analyse and a set of variables of interest. Accordingly, we drop all firm spells that contain missing values for any of these variables in order to have a well-defined sample for analysis. For the purpose of our analysis, we drop firms for which information on sector or firm size is missing and firms that are smaller than 100 employees. Furthermore, we delete 10 firms from the German sample that reported a firm size of over 26,000¹⁶. The final sample contains 770 firms: those firms employing both domestic and foreign highly qualified workers (527 firm spells), and those firms employing only domestic highly skilled workers (175 firm spells).

¹⁶ It appeared obvious that in these cases the request to exclude foreign units in response was misunderstood.

Table 1: Background Information for the four EU countries

Country		Germany	France	United Kingdom	Netherlands
<i>Panel A:</i>					
GDP per capita (using PPP)		22049	21293	20483	22142
Total Population		82016	58608	58105	15277
Total Employment		35351	22033	26564	7206
Foreign or foreign born population		7320	3597	2207	662
%		8.9	6.3	3.8	4.4
Employment by sector					
Agriculture	Foreigners	1.4	3.2	0.7	2.1
	Nationals	3.1	4.8	1.9	3.8
Industry	Foreigners	46.3	38.2	20.2	28.3
	Nationals	34.1	26.0	27.4	22.9
Services	Foreigners	52.3	58.7	79.1	69.7
	Nationals	62.8	69.3	70.7	73.4
<i>Panel B:</i>					
Education (% of age 15+)					
Primary or less		13.2	34.5	13.5	32.6
Secondary		49.6	43.4	45.7	43.3
Tertiary		18.7	22.1	22.8	23.9
Missing		18.7	0	18	0.2

Note: OECD Employment Outlook, OECD Economic Outlook 2000. Source for figures on educational levels refer to 1996, except for Germany where it is 1995: See ILO (1999), Key indicators of the labour market 1999, Geneva.

Table 2: Incentives to immigrants

	Unemployment Rate (Tertiary Level)		GNP per capita		Average wage			Average wage				
					per hour		per month	per hour				
					Industry	Manufacturing		Total industry and services	Total industry	Manufa cturing	Total services	Financial intermediation
	1999	1997	1999 (Euro)	1998 (\$)	1998 (Euro)	1998 (Euro)	1998 (Euro)	1995 (ECU)	1995 (ECU)	1995 (ECU)	1995 (ECU)	1995 (ECU)
Europe												
<i>West Germany</i>	5.0	13.6	22 712	31 290	13.66	13.69	-	15.4	15.9	16.1	14.1	16.9
<i>France</i>	6.2	-	20 861	28 130	9.93	8.45	-	10.2	10.5	10.6	9.9	12.6
<i>Great Britain</i>	2.7	10.3	21 598	20 630	10.7	14.56	-	8.7	9.2	9.0	8.3	11.7
<i>Netherlands</i>	1.7	-	23 838	29 280	14.43	14.53	-	11.0	11.6	11.5	10.7	12.9
<i>Austria</i>	1.9	5.0	23 484	30 960	18.71	-	2067	10.6	11.1	10.8	10.0	12.5
<i>Switzerland</i>	1.8	-	27 196	44 757	18.3	-	-	-	-	-	-	-
<i>Ireland</i>	3.5	10.8	24 133	22 980	9.34	9.12	-	-	-	9.12	-	-
<i>Hungary</i>	1.2	2.8	4 300	4 920	1.85	-	270.12	-	-	-	-	-
<i>Poland</i>	-	4.6	3 900	3871	2.28	-	313.66	-	-	-	-	-
America												
<i>United States</i>	-	39.2	32 867	28 926	12.79	14.98	-	-	-	-	-	-
<i>Argentina</i>	-	4.8	-	8476	-	4.58	-	-	-	-	-	-
<i>Brasil</i>	-	-	-	4623	-	-	248 (1997)	-	-	-	-	-
Africa												
<i>Uganda</i>	-	1.2	-	330	-	-	-	-	-	-	-	-
<i>Algeria</i>	-	4.6	-	1527	-	-	191	-	-	-	-	-
Asia												
<i>China</i>	-	24.2	-	717	-	-	81	-	-	-	-	-
<i>Japan</i>	-	23.7	-	42 055	-	-	2644	-	-	-	-	-
<i>Korea</i>	-	23.4	-	11 123	-	-	1360	-	-	-	-	-
<i>Pakistan</i>	-	29.7	-	-	-	-	57 (1997)	-	-	-	-	-
Australia	-	11.3	-	21 881	-	9.85	-	-	-	-	-	-
Source:	Eurostat Yearbook 2001	Key indicators of the Labour Market, International Labour Office, 1999	Eurostat Yearbook 2001	Statistical s Yearbook for Abroad 2000, p. 341	Eurostat Yearbook 2001	Yearbook of Labour Statistics, International Labour Organisation, Exchange rates from 12.10.2001	Eurostat Yearbook 2000					

Table 3: Summary Statistics, by Country

Country	Germany	France	United Kingdom	Netherlands	Total
All firms					
Number of firms	234 (44.44%)	99 (18.78)	76 (14.42)	118 (22.39)	527 (100.0)
Number of firms with foreign workers (%)	85 (36.32%)	33 (33.33%)	26 (34.42%)	31 (26.27%)	175 (33.21%)
Mean size	902	528	831	745	786
(Highly Qualified/Employment)*100	23.59 (1.53)	37.79 (2.87)	29.36 (2.97)	17.78 (1.91)	25.79 (1.09)
(Foreign Highly Qualified /Employment)*100	0.010 (0.0018)	0.015 (0.0053)	0.006 (0.002)	0.011 (0.011)	0.011 (0.001)
(Foreign Highly Qualified / Highly Qualified) *100	3.33 (0.56)	3.35 (0.82)	3.68 (1.35)	4.58 (1.28)	3.67 (0.454)
Firms with foreign workers					
(Highly Qualified /Employment)*100	33.84 (2.87)	44.81 (5.35)	33.84 (5.86)	31.3 (3.44)	35.4 (2.03)
(Foreign Highly Qualified / Highly Qualified)*100	9.16 (1.32)	10.0 (2.03)	10.7 (3.62)	17.4 (4.14)	11.0 (1.18)
Firms without foreign workers					
(Highly Qualified /Employment)*100	17.7 (1.59)	34.2 (3.32)	27.0 (3.31)	12.9 (2.06)	20.9 (1.21)

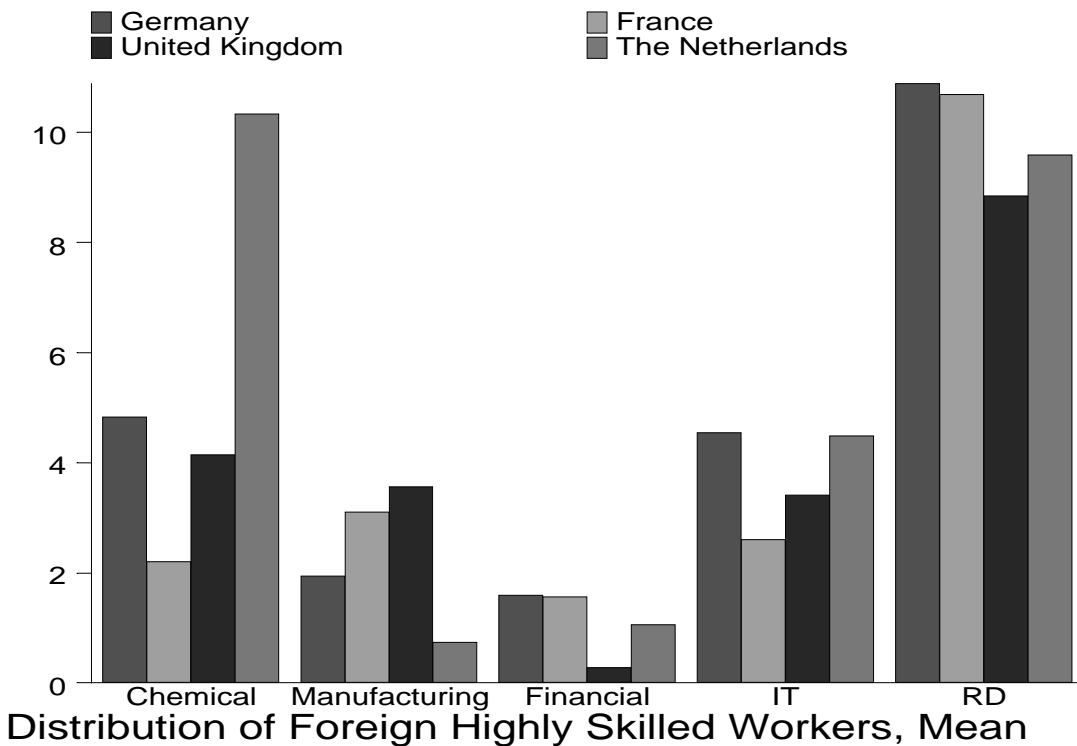
Note: Own calculations from IZA-IES. Standard errors are in brackets.

Table 4: Summary Statistics, by Sector

Sector	Chemical	Manufacturing	Financial	IT	R&D	Total
All firms						
Number of firms	103 (19.54%)	186 (35.29%)	109 (20.68%)	79 (14.99%)	50 (9.48%)	527 (100.0%)
Number of firms with foreign workers (%)	43 (41.75%)	51 (27.42%)	24 (22.02%)	30 (37.97%)	27 (54%)	175 (33.21%)
Mean Size	767	631	1210	870	345	786
(Highly Qualified/Employment) *100	16.89 (1.78)	15.24 (1.14)	27.3 (2.42)	48.5 (3.26)	44.10 (3.73)	25.79 (1.09)
(Foreign Highly Qualified / Employment) *100	0.007 (0.0018)	0.004 (0.001)	0.006 (0.0021)	0.0209 (0.0057)	0.037 (0.0103)	0.011 (0.001)
(Foreign Highly Qualified / Highly Qualified) *100	5.56 ^{M, F} (1.44)	2.21 ^{F10, IT, RD} (0.40)	1.24 ^{IT, RD} (0.34)	3.99 RD (0.89)	9.97 (2.83)	3.67 (0.454)
Firms with foreign workers						
(Highly Qualified /Employment) *100	20.19 (2.80)	23.2 (2.89)	45.3 (5.44)	55.4 (4.45)	52.05 (4.82)	35.4 (2.03)
(Foreign Highly Qualified / Highly Qualified) *100	13.32 (3.12)	8.06 (1.14)	5.65 (1.22)	10.5 (1.82)	18.4 (4.69)	11.0 (1.18)
Firms without foreign workers						
(Highly Qualified/Employment) *100	14.5 (2.29)	12.2 (0.98)	22.2 (2.44)	44.33 (4.42)	34.76 (5.28)	20.9 (1.21)

Note: Own calculations from IZA-IES. Superscripts for sector indicate significant difference from group at 5% level. C: chemical; M: manufacturing; F: financial. F10=at 10%. Standard errors are reported in parentheses.

Figure 1: Percentage of Foreign Highly Skilled Workers



Own calculations from IZA-IES. *Chemical*: Pharmaceutical products, chemical fibres; *Manufacturing*: Electrical engineering, metal industry; *Finance*: Insurance, banking, consulting, *IT*: Software development, computing; *Research and Development*: Biotechnology, government research

Table 5: Country of Origin and Country of Destination, matrix

PANEL A: Inter-country migration					
<i>Destination</i>	<i>Country of Origin</i>				
	<i>Germany</i>	<i>France</i>	<i>United Kingdom</i>	<i>Netherlands</i>	
Germany	-	42.59	40.74	22.22	
France	47.06		62.75	23.53	
United Kingdom	44.64	53.57		23.21	
Netherlands	44.44	40	64.44		
Total # obs	69	94	105	49	
Total %	45.39	44.98	51.47	22.79	
PANEL B: Other European countries					
<i>Destination</i>	<i>Country of Origin</i>				
	<i>Austria</i>	<i>Switzerland</i>	<i>Ireland</i>	<i>Other EU</i>	<i>Easter Europe</i>
Germany	30.56	17.59	n.a.	54.63	40.74
France	n.a.	15.69	n.a.	60.78	17.65
United Kingdom	n.a.	n.a.	25	42.86	14.29
Netherlands	n.a.	n.a.	n.a.	48.89	37.78
Total # obs	33	27	14	136	78
Total %	30.56	16.98	25	52.31	30
PANEL C : Non European countries					
<i>Destination</i>	<i>Country of Origin</i>				
	<i>US</i>	<i>India, Pakistan</i>	<i>Other Asia</i>	<i>North Africa</i>	<i>Others</i>
Germany	37.96	n.a	30.56	16.67	18.52
France	33.33	n.a.	15.69	25.49	9.8
United Kingdom	23.21	14.29	26.79	7.14	30.36
Netherlands	37.78	n.a.	26.67	n.a	31.11
Total # obs	88	8	68	35	56
Total %	33.85	14.29	26.15	16.28	21.54

Note: Own calculations from IZA-IES. For calculations responses to the question “Where do the foreign employees with a university degree come from?” were used. Here firms could give multiple responses.

Table 6: Most comment field of Study of Foreign Highly Qualified Workers (% within group)

By Country	All		Germany		France		United Kingdom		Netherlands	
	Domestic %	Foreign	Domestic %	Foreign	Domestic %	Foreign	Domestic %	Foreign	Domestic %	Foreign
Engineering	33.73	33.61	38.32	38.68	28.57	27.91	52	52	6.98	6.67
Maths and natural science	15.66	16.8	12.15	15.09	12.24	9.3	26	16	16.28	28.89
IT	14.46	19.26	14.95	23.58	14.29	11.63	8	12	20.93	24.44
Law	1.2	0.41	1.87	0	0	0	2	0	0	2.22
Economics	14.06	10.66	21.5	13.21	4.08	6.98	0	4	23.26	15.56
Medicine	3.61	2.87	2.8	2.83	6.12	6.98	2	2	4.65	0
Other	17.27	16.39	8.41	6.6	34.69	37.21	10	14	27.91	22.22
%	100	100	100	100	100	100	100	100	100	100

Note: Own calculations from IZA-IES.

Table 7: Firms' Preferences: Qualification Profiles of domestic workers

	All firms			Multinationals			Other firms		
	All	With foreign workers	With No foreign workers	All	With foreign workers	With No foreign workers	All	With foreign workers	With no foreign workers
<i>=1 if it is ... that domestic applicants have a very good knowledge of at least one foreign language</i>									
Important	70.97	78.29	67.33	79.56	80.36	79.01	67.95	77.31	63.84
Less important	17.46	12.57	19.89	10.95	10.71	11.11	19.74	13.45	22.51
Unimportant	11.57	9.14	12.78	9.49	8.93	9.88	12.31	9.24	13.65
<i>=1 if it is ... that domestic applicants have gathered study or work experience abroad</i>									
Important	28.84	33.14	26.7	35.04	37.5	33.33	26.67	31.09	24.72
Less important	49.72	49.14	50.0	44.53	42.86	45.68	51.54	52.1	51.29
Unimportant	21.44	17.71	23.3	20.44	19.64	20.99	21.79	16.81	23.99
Firm's mean responses									
<i>=1 if firms send domestic employees for work experience abroad</i>									
				62.77	67.86	59.26	49.23	69.75	40.22
<i>=1 if firms send domestic employees abroad as a:</i>									
Standard policy	7.4	14.29	3.98	12.41	17.86	8.64	5.64	12.61	2.58
Frequently	11.01	16.57	8.24	10.95	12.5	9.88	11.03	18.49	7.75
Occasionally	23.91	29.71	21.02	28.47	25	30.86	22.31	31.93	18.08
Seldom	10.44	8.57	11.36	10.95	12.5	9.88	10.26	6.72	11.81
No response	47.25	30.86	55.40	37.23	32.14	40.74	50.77	30.25	59.78

Note: Own calculations from IZA-IES.

Table 8: Problems with Recruiting Foreign Workers, Percentages

Factor	Firms with domestic workers only	Firms with foreign workers with foreign degree
Language problems	10.17 (30.27)	47.45 (50.41)
Socio cultural differences e.g different mentality of habits	5.96 (23.70)	53.57 (50.41)
Acceptance by superiors	0.25 (4.98)	3.45 (18.40)
Acceptance by subordinates	1.74 (13.08)	12.76 (32.86)
Acceptance by customers	3.97 (19.55)	11.22 (32.86)
Difficulties in evaluating foreign worker experience	4.96 (21.74)	17.24 (38.10)
Lack of awareness of foreign education systems, grades and qualifications	5.71(23.23)	29.31 (45.92)
High recruitment costs	5.71 (23.23)	10.34 (30.72)
Is it difficult to obtain a work permit non EU workers	60.53 (48.95)	56.71 (49.92)
No applicants	38.71 (48.77)	-
No need – vacancies filled with domestic workers	22.08 (41.53)	-

Note: Own calculations from IZA-IES. Fractions reported refer to the proportion of firms responding that a factor was potentially problematic when recruiting foreign employees with a university degree. Standard deviations are reported in parentheses.