The Joint Impact of Offshoring and Immigration on Wages: Matched Employer-Employee Evidence from Norway

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Abstract

Using matched employer-employee data with detailed import and export information on the firm level, together with information on the inflow of immigrant workers at the local region level, we analyse effects of both offshoring and immigration on hourly wages. In contrast to many other studies, we find positive within-job wage effects of offshoring, for both high and low skilled workers. Hence, we cannot conclude that offshoring increases the skill-premium within firms. The positive effect of offshoring on wages is sustained after controlling for the impact of immigration. The impact of immigration on wages is negative in the fixed effect estimations. However, once controlling for endogeneity, using an IV-FE estimation, the negative effect is reduced and is no longer significant. Using O*NET data which provides information on the knowledge, skills, and abilities of a particular occupation we find that workers enjoy larger wage gains in response to both offshoring and immigration for occupations that require higher levels of social skills and non-routineness.

Index-terms: F14, F16, J24, J31.

Keywords: Offshoring, immigration, tasks, wages.

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1. Introduction

A characteristic feature of globalisation in the last decades is the increase in both offshoring and migration (see for example Feenstra and Hanson 2003, Hummel et al. 2016, Freeman 2006 2006). In our data, the sum of imports in manufacturing firms has tripled during the period of analyses (1999-2008), while during the same period the number of workers in manufacturing has gone down by more than 10 per cent. These parallel trends, also found in most other industrialised countries, have led many to speculate that offshoring of manufacturing jobs has resulted in domestic job loss and declining wages (for an overview, see Hummels et al. 2016). Still, how offshoring should affect workers is theoretically unclear. On the one hand outsourcing tasks that can be done domestically to other countries, can lead to reduced wages and/or loss of jobs in offshoring firms (Feenstra and Hanson 1999). On the other hand, offshoring may lead to reduced costs and higher productivity, which may increase wages and increase employment (Grossman and Rossi-Hansberg 2008).

Increasing flows of people across borders is another characteristic feature of globalisation in the last decades (see e.g., Freeman, 2006). Parallel to this trend we have experienced a large and growing empirical literature analysing the impact of immigration on domestic labour markets, focussing on outcomes like wages and employment (Card 2001, Borjas 2003, Ottaviano and Peri 2013, Dustmann et al. 2013, 2016). There is far from any consensus on the size and direction of the impact of immigration on domestic labour markets, but both the theoretical and empirical literature seems to agree that workers that compete most closely with the immigrants suffer most, with respect to wages and employment (Dustmann et al. 2016). One recent and relevant paper is from Foged and Peri (2015) who use Danish longitudinal data during the period 1991–2008. They analyse the labour market outcomes of low-skilled natives in response to an exogenous inflow of low-skilled immigrants. They find that an increase in the supply of refugee-country immigrants pushed less educated natives to

undertake less manual-intensive occupations. As a result, immigration had positive effects on native wages.

Since offshoring is outsourcing of domestic jobs to foreign workers, and immigration is the relocation of foreign workers to domestic jobs, offshoring and immigration appear to be substitutes in the firm's production process. If the firm is located in a region with a large influx of foreign workers, this may reduce the need for offshoring domestic jobs. This highlights the need for including immigration and offshoring together when analysing their impact on wages.

In this paper, we analyse effects of both offshoring and immigration on wages. We use high quality Norwegian matched employer-employee register data with a panel dimension, enabling us to follow individuals over time. This data is linked to firm level information on imports and exports. The trade data includes information on the value of each firm's imports and exports, broken down by HS-6 digit product codes and source countries. The starting point is all individuals employed in a manufacturing firm in the period 1999-2008. For these individuals we have information from a wide set of registers, enabling us to follow individuals both within and between firms. To reach causal statements we employ an instrumental variable strategy; we use world import and world export as instruments for the firm's offshoring and export, and the familiar Bartik-type instrument for local immigrant inflows.

There is a growing empirical literature analysing the impact of trade and offshoring on domestic labour markets. Especially, we relate to the literature focusing on individual impacts on offshoring (Baumgarten et al. 2013, Hummel et al. 2014, Hakkala and Huttunen 2016; Ebenstein et al. 2014, 2015).[1] Still, few studies have exploited matched employer-employee data with linked firm-level information on import and export. Hummels et al. (2014) and Hakkala and Huttunen (2016) are two exceptions. Hummels et al. (2014) use Danish data to estimate the wage effects of firm-level offshoring on workers, for firms that both import and

[1] There is also a large literature focusing on the impact pf import competition, especially stemming from the increased volume of trade from China (see for example Autor et al. (2013, 2014, 2015), Balsvik et al. (2015),

export. In this way, they focus on the effects of within firm changes in the intensity of trade. They find that offshoring, tends to increase the wages of high-skilled employees and decrease the wages of low-skilled employees within a job spell. Hakkala and Huttunen (2016) use Finnish data to analyse the combined effects of offshoring and import competition on different outcomes. They focus on Chinese imports. They find that both types of importing increase the risk of job loss for all workers and, in particular, for workers in production occupations. Furthermore, they find that an increase in import competition has larger negative effects than an increase in offshoring. Production workers suffer the largest earnings losses, while for high-skilled workers the wage-effect is positive.

The literature that has looked at the joint effect of offshoring and immigration is more scant. Ottaviano et al. (2013) analyse the impact of offshoring and immigration on employment shares, employment level, and task specialization in US manufacturing 2000-2007, using data on industry level over time. In the model, they assume that immigrants specialize in tasks with low complexity, offshore workers perform intermediate tasks, and natives specialize in the most complex tasks. The empirical results show that offshoring leads to a reduction in immigrant and native employment shares, but does not affect wages. Immigration decreases offshoring employment shares, but does not affect native employment share or wages. Olney (2009) uses Canadian industry-state-year data to estimate the impact of both immigration and offshoring. The theoretical model predicts that the productivity effect causes offshoring to have a more positive impact on low-skilled wages than immigration, but the gap decreases with the workers' skill level. The empirical results confirm these predictions. Finally, a recent study is Firsin (2018). He jointly analyses the effects of low-skilled immigration and offshoring on wages of American Workers. He shows that wages of low-skilled natives increase in response to offshoring, decrease in response to low-skilled immigration, and that the wage effect of immigration becomes more negative with more offshoring.

This paper expands the scant literature that has studied the joint effects of offshoring and immigration on wages. We contribute to the literature by analysing the combined effect of offshoring and immigration using detailed employer-employee data with a panel dimension, enabling us to control for a series of fixed effects. To our knowledge, this type of data has not been used to analyse the combined effects of immigration and offshoring. In addition, we expand the literature by using a wide battery of O*NET characteristics, combined with both offshoring and immigration.

The paper proceeds as follows: Section 2 presents institution information on the Norwegian labour market and trade and offshoring exposure. Section 3 provides a theoretical framework for the analysis. Section 4 presents the data, the sample, and the variables. Section 5 presents the empirical specification, section 6 presents the results, and section 6 concludes.

2. Institutional context

In an international context, the Norwegian labour market is characterized by having a compressed wage structure (OECD, 2017), and it is especially compressed at the bottom of the wage distribution. The system of wage determination is typically characterised by a two tier system, centralised and local wage agreements. In the manufacturing industry, the wage settlement agreements differ between groups of workers; white-collar workers and blue-collar workers have separate wage agreements. White-collar workers typically have individual wage agreements, while blue-collar workers have a two-tier system; a central wage agreement followed by local wage agreements. The share of unionised workers, is relatively high in Norway, 52.5 per cent in 2014 (OECD, 2016), although the share is somewhat lower compared to the other Scandinavian countries such as Denmark and Sweden. As in many countries, union membership rates in Norway are decreasing, down from 54 per cent in 2000.

Permanent contracts are the standard in Norway, constituting approximately 90-92 per cent of all contracts. In OECD's indicators on EPL for 2013, Norway is a country with medium strictness for permanent workers. Norway is among the countries with the strictest regulation on temporary employment. This may be moderated to some extent after the deregulation of temporary employment in Norway in 2015. The rules for dismissal and redundancy are laid down in The Working Environment Act (WEA). In general, there are strict rules for dismissals in Norway. The general rule is that it must be factual based. When it comes to dismissals with respect to large downsizing and mass layoffs, the employer must follow strict rules, and inform and consult with trade unions/employee representatives. The notification procedures in the case of individual dismissal of a worker with a regular contract are that it requires a written notice to the employee, with statement of reasons upon request. Before making a decision regarding dismissal with notice, the employer is obliged (to the extent that it is practically possible) to discuss the matter with the employee and the employees' elected representatives unless the employee himself does not want this. The length of notice period depends on among other things the length of tenure. Tenure periods shorter than six months requires 14 days' notice, up until 5 years' tenure requires 1 month, up till 10 years is two months, and more than 10 years requires three months.

3. Theoretical framework

In this section, we present some theoretical motivation for the later empirical analyses. From the firm's perspective, offshoring, or reallocating jobs abroad, is often motivated by cost reduction. At the same time, a large local inflow of immigrant workers may also lower the cost of labour and therefore reduce the motivation to offshore jobs abroad. The firm is then faced with the choice between hiring workers abroad through offshoring or employing migrant workers locally. In this sense, offshoring and hiring immigrant workers are substitutes in

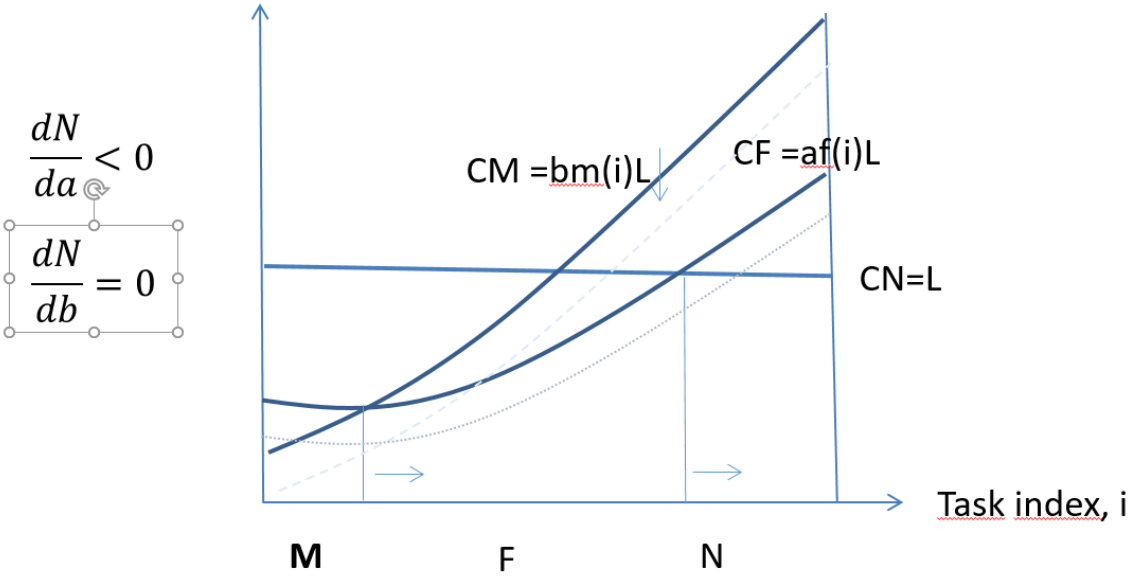
production. If offshoring and low-skilled workers are substitutes in production, an increase in offshoring will lead to a reduction in demand for domestic low skilled workers, and therefore reduce their wages. However, if offshoring increases firm productivity, wages may increase for all employees, including low-skilled workers.

Assume that some type of organisational improvements or institutional change may induce a negative shock in the cost of offshoring and/or immigration. Foreign (offshore) workers (F) are included in the firms production function together with immigrant workers (M) and native workers (N). The F, M and N workers perform different tasks. Economic theory suggests that the firm's labour demand is affected by two mechanisms. *Displacement (substitution):* For a given level of output the firm demands more of the production factors that have become cheaper; F and/or M, and less of the production factors that are relatively more expensive. *Productivity (scale):* Due to lower costs/ higher productivity the profit maximizing firm wants to increase the level of output and, thus, wants to hire more of all types of workers.

The net effect of the negative shocks – on the demand for native workers - depend on their substitutability with F and M workers, and the size of the productivity effect. We follow Ottaviano et al (2013) (who modify Grossman and Rossi-Hansberg 2008), and assume that tasks may be characterized according to an index; ***i,*** e.g., from more routine to less routine, or from less to more communication based solutions. The cost functions of workers are defined along this index: F workers: $CF(i) = af(i)L$, $f'>0$, M workers: $CM(i)=bm(i)L$, $m'>0$, and N workers: $CN=L$. L is one unit of labour performed by a N worker.

The allocation of tasks between the three groups are illustrated in Figure 1, where the task index is along the horizontal axis and the costs along the vertical axis.

Figure 1. Distribution of tasks and the substitution effect of a negative shift in the cost of offshoring (da<0) and immigration (db<0) on the demand for native workers

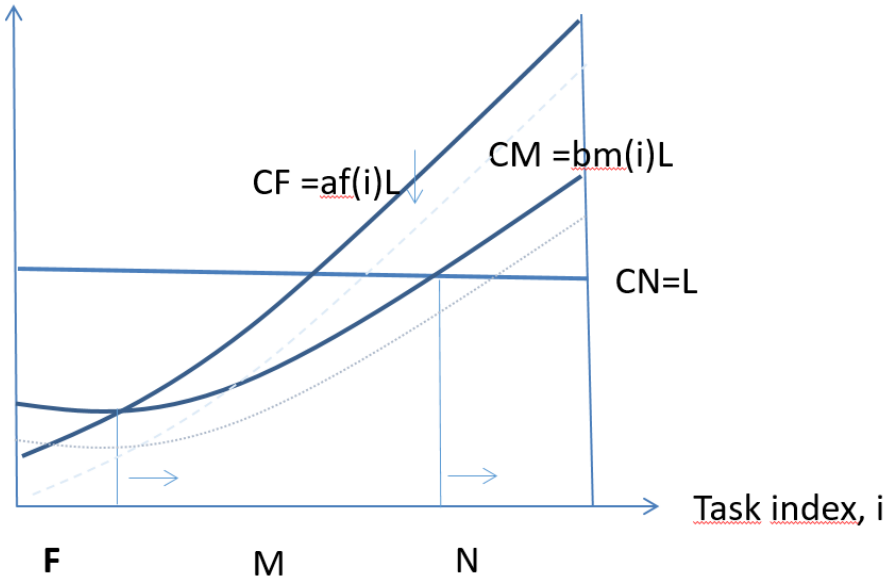


The costs curves for offshore workers and immigrants are upward sloping. The cost curve for native workers the the horizontal curve. With the way we have ranked the three groups with respect to task complexity (N>F>M), it is easy to see that a negative shock in offshoring costs will lead to negative demand for native workers (dN/dα<0); and that a negative shock in immigration costs will have no effect on the demand for native workers (dN/db=0). This is similar to the predictions in Ottaviano et al. (2013). Still, one could set up different predictions, with different assumptions on distribution of tasks and the position of cost function. Figure 2 presents alternative scenarios:

Figure 2. Distribution of tasks and the substitution effect of a negative shift in the cost of offshoring (da<0) and immigration (db<0) on the demand for native workers

$$\frac{dN}{da} = 0$$

$$\frac{dN}{db} < 0$$



The way that the three groups are ranking in Figure 2 (N>M>F), it is clear that a negative shock in immigration costs will lead to negative demand for native workers (dN/db<0), and that a negative shock in offshoring costs will have no effect on the demand for native workers (dN/dα=0). This theoretical exercise does not leave us with any clear predictions with respect to the impact of immigration, offshoring on wages, but we will return to the predictions when interpreting the empirical results.

4. Data, sample, and variables

We exploit rich individual register data, collected and organised by Statistics Norway. The sample consists of all male native individuals employed in the manufacturing industry in the period 1999-2008. The key registers for individual information contains information on wages,

working hours, employment spells, age, marital status, number of children, educational attainment, union membership, regional place of work, and occupation.

The key explanatory variables are firm level measure of offshoring and immigrant shares in the local labour market region. Offshoring is estimated using information on the firm's import of intermediate goods.[2] Trade data comes from the Norwegian Trade Statistics Register. For each year, we have the value of imports disaggregated by origin country, and products. Yearly information from the Trade Statistics Database is merged with all of the firms in the sample. The data therefore allows us to link individuals with their place of work, and more specifically observe individual level wages and firm level characteristics such as offshoring and exports. Trade flows are reported according to the 8-digit combined nomenclature. These are aggregated up to the six-digit Harmonised system (HS) to be compatible with the COMTRADE data, which is the United Nations International Trade Statistics Database providing annual trade data for over 170 countries covering our period of interest. We use this detailed data to construct variables capturing the yearly changes in world export supply and world import demand at the import country- product level, which are then used to instrument offshoring and exports in our wage regressions. The value of imports is reported in Norwegian kroner (NOK). In the empirical analyses, we focus on imports of intermediate goods.[3] To analyse the net effect of trade, we also include a firm-level measure of exports, consisting of the total sum of the firm's export each year. This implies that we include firms in the sample only in the years in which they both import and export. This restriction is necessary in order to implement our IV-strategy.

[2] Intermediate goods is defined from BEC-codes (Broad Economic categories). The following codes are included: 111, 121, 21, 22, 31, 322, 41, 42, 521, and 53.
[3] We allocate each six-digit HS code to intermediate input using the Broad Economic Categories (BEC) codes from Eurostat (http://ec.europa.eu/eurostat/ramon/)

A concern for our identification is that firms may be importing inputs that are not substitutes for what labour within the firm could have produced. We follow Feenstra and Hanson (1999) and define "narrow offshoring" as purchases of inputs belonging to the same industry as that of producing firms. The idea is that the closer the imported inputs are to the final outputs, the more likely it is that labour within the firm could have produced those inputs. Concretely, we limit import within the same two-digit industry as the firm's output.

The immigrant share in the local labour market is constructed from individual register-information on all resident immigrants in the local labour market region at time t. We limit the study to immigrants from outside Western Europe and the new EU-countries from the east. Concretely, we leave out immigrants from EU-, and OECD-countries. This leaves us with a set of immigrants where location is not mainly driven by local labour demand. The tendency of typical labour immigrants to settle in regions with growing labour demand would usually lead to an upward bias in the OLS estimation of the effect of immigration on native wages.

We use local labour market regions as defined by Statistics Norway (Bhuller, 2009). There are 46 regions and they are constructed from information on commuting patterns. The benefit of using this measure is that it is designed to capture local labour markets, rather than administrative units.

The dependent variable is log hourly wage. Hourly wage is constructed from information on the total wage sum in the job in a given period, the length of the period (number of working days), and weekly working hours.[4]

We use O*NET data to create indicators for the extent to which each occupation contains tasks that can be categorized as routine, non-routine, or social skills. We use crosswalks from the National Crosswalk Service Centre to ensure that the occupational

[4] Agreed working hour per week is measured by three categories: short part-time (4-15 weeks per week), long part-time (16-29 hours per week), and full-time (30 hours or more). In the construction of hourly wage, we give them weights: Short part time: 1/3, long part-time: 2/3, and full-time: 1.

categories used in the O*NET database are compatible with Norwegian STYRK occupation codes (which are closely related to the International Labour Organization's International Standard Classification of Occupations (ISCO)).[5] We follow Hummels et al. (2014) to identify components that typify routine and non-routine tasks. The non-routine task variable is constructed form the O*NET topics of thinking creatively, mathematics, mathematical reasoning, response orientation, gross body coordination, and organising, planning and prioritizing work. The routine task variable is composed of data from the components of manual dexterity, finger dexterity, multi-limb coordination, processing information, and evaluating information to determine compliance with standards. In creating the three variables we take the mean of the relevant O*NET scores for the topics outlined above for each occupational category. Compared to Hummel et al. (2014), we add social skills to the set of tasks. Deming (2017) finds that over the last three decades the labour market increasingly rewards social skills. He finds that between 1980 and 2012, jobs requiring high levels of social interaction grew by nearly 12 percentage points as a share of the U.S. labour force. His results also show that the labour market return to social skills was much greater in the 2000s than in the mid-1980s and 1990s.

We follow Denning (2017) in creating a social skill intensity variable for all of the occupation categories in our data. We define an occupation's social skill level by using O'NET categories that cover different aspects of social skills and their requirement in a given occupation. More specifically we use the average of the four items in the O*NET module on "social skills" - 1) coordination; 2) negotiation; 3) persuasion; and 4) social perceptiveness. "Coordination" describes the extent to which an occupation requires adjusting actions in relation to others' actions. "Negotiation" captures to the importance of bringing others together and trying to reconcile differences. "Persuasion" captures the importance of being able to

[5] http://www.xwalkcenter.org/index.php/downloads

persuade others to change their minds or behaviour. Finally, "social perceptiveness" covers the extent to which being aware of others' reactions is necessary for a given occupation. In order to make results easier to interpret we standardise the scores to have a mean of 0 and standard deviation of 1.

As individual control variables, we include information on age (and age squared), educational attainment (compulsory school, secondary school, university or college degree lower level, college or university degree higher level), union membership, marital status, and number of children 0-17 years old. Firm level controls include information on number of employees, output, capital, whether the firm is single or multilevel plant firm, county (19 counties), and industry (two-digit).

The sample consists of male workers in the manufacturing industry, in the period 1999-2008. They are not registered with an ongoing education, and they work in firms with 5 employees or more. In the empirical analysis, we present results for all workers, as well as for high and low skill workers separately. We define high skill workers as those with a university or college degree, and low skilled as those with less than university or college degree.

Table 1 presents descriptive statistics for the main variables for the included sample, defined by worker-firm-year. We present descriptive statistics for the whole sample, and separately for the high and low education categories. Approximately 50 per cent of all workers are married, a large share of the workers have either secondary school (51 per cent) or primary school (27 per cent) as their highest educational attainment. Only one out of five workers has higher education (college or university degree at lower or higher level). The statistics on union memberships show that a large majority of the workers are members of a trade union. When looking at the summary statistics separately for each education category, we see, as expected, that high skilled workers have higher wages. Furthermore, they are in occupations with higher social skill requirements, higher requirements for non-routine tasks, and in jobs with fewer

routine and repetitive tasks. The union membership rate is higher among low skilled than high skilled workers.

Table 1. Descriptive statistics for included variables

	All		Low skill		High skill	
	Mean	SD	Mean	SD	Mean	SD
Individual level variables:						
Log hourly wage	5.379	0.465	5.293	0.435	5.695	0.437
Married	0.513	0.499	0.491	0.499	0.600	0.489
Number of children	0.827	1.059	0.775	1.036	1.019	1.121
Primary school	0.268	0.443	0.341	0.474		
Secondary school	0.518	0.499	0.658	0.474		
Higher education I	0.161	0.368			0.757	0.429
Higher education II	0.052	0.222			0.242	0.429
Age	42.506	11.303	42.481	11.594	42.597	10.161
Union	0.695	0.460	0.733	0.442	0.559	0.497
Routine	0.364	0.815	0.469	0.729	-0.017	0.979
Non-routine	-0.073	0.830	-0.254	0.770	0.576	0.710
Social skills	-0.391	1.041	-0.593	0.945	0.340	1.049
Firm level variables:						
Log employment	5.736	1.584	5.692	1.586	5.898	1.567
Log Output	13.145	1.884	13.068	1.892	13.425	1.841
One plant-firm	0.461	0.498	0.469	0.499	0.428	0.495
Log Capital	11.181	2.356	11.192	2.362	11.152	2.333
Log narrow offshoring	16.111	3.054	16.004	3.093	16.508	2.873
Log export	17.641	3.312	17.431	3.368	18.415	2.972
Labour market region variables:						
Share immigrants	0.055	0.032	0.053	0.032	0.059	0.034
N	768874		604190		164681	

Note: Number of children is number of children aged 0-17 years. Educational attainment is measured at the first period of observation. Output is measured total sales, capital as the sum of assets in buildings and constructions and other variable assets.

The firm-level variables are all measured in logs (except the indicator for whether the firm is a one-plant firm). Almost half of the workers are employed in one-plant firms.

5. Empirical specifications

The sample for all of the following estimations includes all workers employed in a manufacturing firm in the period 1999-2008. We estimate variants of individual level equations of type (1):

$$(1) \quad y_{ijmt} = \boldsymbol{X}_{it}\alpha_1 + \boldsymbol{Z}_{jt}\alpha_2 + \alpha_3 OFF_{jt} + \alpha_4 EXP_{jt} + \alpha_5 IMM_{mt} + \alpha_{ij} + \theta_t + \varepsilon_{ijmt}$$

for individual *i*, at firm *j*, in region *m*, at time *t*. The dependent variable *y* is log hourly wages. **X** is a vector with individual characteristics, and **Z** is a vector of firm level characteristics. The key explanatory variables are *OFF*, measuring the log of offshoring at firm *j* at time *t*, and *IMM*, measuring the immigrant share in region *m*, at time *t*. *EXP* is the corresponding measure of the firm's export. In all models, we control for worker-firm level fixed effects, and year fixed effects, in addition to year by industry effects, and year by county effects.

Identification of causal relationships

To ensure that our empirical specification captures the causal relationship between offshoring, export, immigration, and individual outcomes we include instrumental variables in our analysis. With respect to offshoring our main concern is that productivity and demand shocks that affect companies in Norway can also affect firm level decisions regarding how much of total production should be offshored and the wage setting. In order to capture the causal relationship between changes in offshoring, export and individual level labour market outcomes we follow Hummels et al (2014) and construct two instruments that are correlated with the price of imports and exports but exogenous to wage setting and productivity of individual firms. The instruments we utilise to isolate the causal effect of offshoring on wage setting and labour participation is the variation in world export supply and world export demand.

The price that a Norwegian company has to pay for an imported good depends partly on the World export supply of that good. At the same time, changes in a Norwegian firm's productivity and wage structure do not influence the world export supply of a given good from a specific country. In our World export supply instrument, we want to capture how changes in global market forces affect specific firms in Norway based on the goods they import. To do this

we identify the goods a firm imports in 1999 and then look at how World export demand of those goods changes over our sample years 1999 to 2013. We use COMTRADE data, which contains information on bilateral trade between all countries for our sample period.

Following Hummels et al (2014), we construct a World export supply variable:

$$WES = \sum_{c,k} M_{jck} WES_{ckt}$$

Where WES_{ckt} denotes the total supply of product *k* from country *c* to the world market (minus supply to Norway) in year *t*, and M_{jck} denotes total offshored imports of product *k* from country *c* as a share of total offshored imports in base year 1999. In our instrument *WES*, M_{jck} represents the relative importance of a given import *ck* to a Norwegian firm, and WES_{ckt} captures changes in the desirability of good *ck* over time. We construct the instrument at HS 6-digit level, as both Norwegian trade data and UN COMTRADE data uses the HS nomenclature. Firms that did not offshore in 1999 have the first year they did offshore as the base year instead.[6]

Using a similar approach, we instrument for Norwegian exports by constructing a World import demand variable. In our analysis, World import demand is:

$$WID = \sum_{c,k} X_{jck} WID_{ckt}$$

where WID_{ckt} denotes country *c*'s total purchases of good *k* in year *t*, minus purchases from Norway, and X_{jck} is total exports of product *k* from country *c* as a share of total exports in base year 1999, or the first year a firm was observed exporting something[7] . As above, we construct the instrument using Norwegian trade and COMTRADE data, which combined, provide information at HS-6 digit level.

[6] For 61% of firms in our sample the first instance of offshoring was in 1999. These 61% of companies therefore have 1999 as their base year. The other 39% of companies started offshoring later and have the first year they offshored as their base year instead.
[7] 68% of companies first exported in 1999.

The main threat to identification of the instrument for offshoring is that the WES instrument do not only pick changes in world supply, but also world demand. An increase in the supply of one component in production may be correlated with increased demand for output of the product that uses that component. This is a threat to identification. We approach this problem by including industry by year fixed effects, and also by including the firm's own export to the world market. The WID instrument faces the same threats to identification, and the remedies are the same. A favourable aspect of using Norwegian data is that Norway is a small country, with only 5 million inhabitants. It is unreasonable to assume that shocks originated in Norwegian firms could affect product prices of foreign suppliers or customers.

Regarding the share of immigrants in the region, we face the usual problem that their location may not be exogenous to the local labour market situation. Typically, the research literature has found that immigrants move in direction of areas with favourable labour market conditions (Borjas, 2001, Røed and Schøne, 2012). We have reduced the problem by leaving out immigrants from EU- and OECD-countries, which constitute a large portion of the labour migrants. Still, to further address this endogeneity, the local labour supply from immigrants is instrumented by a variant of the familiar Bartik – also referred to as a shift share - instrument (Bartik 1991, Card 2001). We proceed as follows.

First, the immigrants are divided into four categories, according to their country of birth: i) Eastern Europe (except EU-member countries), ii) African countries, iii) Asian countries, iv) Latin America. Then, based on the Population survey from 1990 we calculate, separately for these four groups of immigrants, the shares living in each of the 46 Norwegian economic regions. Next, by using the register data we calculate the total numbers of adult immigrants, from each country of birth region, who are recorded as living in Norway in 1999 to 2008. Finally, this yearly stocks of immigrants are divided between the economic regions, by the origin specific location shares from 1990, and summarized.

In a more formal manner, this instrument of immigrant labour supply may be expressed:

$$IMMIV_{gmt} = \sum_{g} \tau 90_{gm} M_{gt}$$

Where M_{gt} is the stock of immigrants from origin group g (1-4), living in Norway in year t. $\tau 90_{gm}$ is the share of immigrants from country group g that resided in local region m in 1990.

6. Results

Our main goal is to estimate the combined causal relationship between offshoring, immigration and wages, controlling for the firm's export, job-spell effects and time varying individual characteristics. In addition, we control for firm level variables, thereby controlling for potential labour demand effects stemming from productivity effects.

Table 2 presents regression results of impacts of offshore, export, and immigration on log hourly wages, for all workers. All estimations are within-job spell wage regressions in which we include all workers. We present fixed effects (FE) and fixed effects instrumental variable results (FE-IV). The FE-estimations exploit only within-job variation, but ignores the simultaneity problem where unobserved firm productivities may drive both wages and offshoring. This problem is addressed in the FE-IV models.

For both the FE and FE-IV models, we present estimations for offshore and export alone, immigration alone, and offshoring, export and immigration together. In all estimations we include the full set of controls, i.e., also the firm level variables (see also note to the table). In Appendix, Table A1, we present FE-IV results for the full set of controls. Throughout the paper we control for job-fixed effect, i.e., the variation we exploit is within job. However, as a comparison we include an estimation were we control for person-fixed effects; in column 6B in Table 2. This model is similar to the model in column 6, except for the person fixed effects.

Comparing the estimates from these two specifications allows us to see whether the impact of firm-specific offshoring is stronger for those who stay in their job.

Table 2. Regression results. FE and FE-IV results Effects of offshoring and immigration on wages. Dependent variable: Log hourly wages. 1999-2008.All workers

	FE			FE-IV			
	(1)	(2)	(3)	(4)	(5)	(6)	(6B)
Log offshoring	0.000466		0.000490	0.0127**		0.0127**	0.0120**
	(0.00110)		(0.00110)	(0.00623)		(0.00623)	(0.0062)
Log export	0.000364		0.000346	0.00281		0.00276	0.0058
	(0.00100)		(0.00100)	(0.00781)		(0.00783)	(0.0081)
Share immigrants		-0.532*	-0.533*		-0.229	-0.322	-0.287
		(0.281)	(0.280)		(0.364)	(0.371)	(0.264)
F-stat instr Off				24.9		17.6	17.6
F-stat instr Exp				13.6		13.3	13.3
F-stat instr Imm					116.4	39.9	115.4
Observations	768874	768874	768874	768874	768874	768874	768874
R^2	0.774	0.774	0.774	0.774	0.774	0.774	0.752

Note: Additional controls include: (individual level) Marital status, number of children 0-17 years of age, educational attainment, age (age squared), and union member, (firm level) log employment, log output, and log capital. All specifications include job-spell, industry-year, and regional-year fixed effects. Standard errors are clustered at the firmXyear level. Level of significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Results in Table 2 reveal very small and not significant relationships between offshoring, exports and wages, using the FE-estimations. For immigration, we find a negative and significant effect on wages. The negative impact of immigration is unaltered when including offshoring and export in column 3.

However, when handling the simultaneity problem, by instrumenting the offshoring, export, and immigration variables, the effects of offshoring are increased considerably. The wage elasticity coefficient suggests that increasing offshoring by 1 per cent increases wages by 0.012 per cent, for all workers. We find no effects of export on log hourly wages.[8] For the immigration variable, the coefficient is reduced, and it is no longer significant. When including

[8] The impact of firm export is always insignificant in the estimations. Estimations excluding the export variable (not presented) shows that this does not affect the estimates for offshoring and immigration.

all three variables in the same estimation, the positive offshoring effect is sustained, and the immigration effect is still not significant. The F-stat tests for the instruments reveal strong instruments for all endogenous variables. [9]

Comparing the FE- and FE-IV estimates for immigration, we see that the FE-IV estimates are somewhat smaller. A tendency of immigrants to seek areas with high and growing labour demand would imply an upward bias in the FE estimate of the impact of immigration on domestic wages. We see the opposite. However, we consider a group of immigrants for which the settlement is not determined by local labour market conditions. Hence, it is not obvious that in this case that the OLS estimate is upward biased.

Regarding the impact of offshoring; if firms with high unobserved productivity (that affect both offshoring and wages) offshore more, this would imply an upward bias in the offshoring FE-estimates. This is not what we see in Table 2. This may be because firms that offshore more are not those that are characterised by high unobserved productivities. Note also that we in all estimations include a wide set of firm-level controls that may be correlated with firm productivity. From the theoretical section, the predictions varied depending on the ranking of the three groups and the positioning of the cost curves. Irrespective of assumptions, we do not get any support for a negative impact of offshoring on the demand for native workers. Regarding immigration, the estimate is negative; giving suggestive support to the predictions in Figure 2, but the impact is not significant and should be interpreted with caution. Comparing the immigration results with the results in Foged and Peri (2015), the results differ. They find positive and significant effects of immigration on native wages. This difference may be due to differences in samples, they include the whole labour market, we limit the analyses to the manufacturing industry.

[9] We have also estimated a model using a gross offshoring measure, i.e., not limiting the offshoring measure to be within the same 2-digit industry. This estimation do also produce positive and significant effects of offshoring, but the F-statistic for the included instrument reveals that the instrument is not as strong compared to net measure.

In our main specification we include firm-individual (job) spell fixed effects. This implies that we cannot capture potential effects of offshoring/export for people who change firm. In Model 6B, we relax the specification including a specification with firm and individual effects separately. If the impact is larger, that means that the effects of globalization manifest themselves mainly through people changing jobs and getting higher wages. The results do not support that hypothesis. The impact of offshoring is reduced somewhat (but is still significant), suggesting that the impact of globalization (measured by offshoring) manifests itself within job, or in other words; the positive impact of offshoring is stronger among those workers that stay in the same job (the same worker-firm match). In the rest of the analyses we present analyses controlling for job-fixed effects.

Results for the control variables, presented in table A1, show that wages increase with age, at a diminishing rate, that there is martial wage premium, and a sizeable wage premium for union membership (in the range of 10 per cent for all workers). For the firm-level variable, we find that larger firms (measured by output and number of employees) pay higher wages, and firms with more capital pay higher wages.

Heterogeneous results

The impact of both offshoring and immigration may vary between workers at different skill levels. If low-skilled workers and imported inputs are substitutes, an increase in imported inputs lowers unskilled labour demand. This may put downward pressure on the wages' of low skilled workers. Correspondingly, if low-skilled workers dominate the inflow of immigrants, the competition for natives will be hardest among those with the lowest skills; which will put downward pressure on their wages. Table 3 presents results separately for low skilled (upper half) and high skilled workers (lower half).

Table 3. Effects of offshoring and immigration on wages. Low-skilled and high skilled workers

	Low skilled workers					
	FE			FE-IV		
	(1)	(2)	(3)	(4)	(5)	(6)
Log offshoring	0.000748		0.000758	0.0102*		0.0101*
	(0.00111)		(0.00111)	(0.00601)		(0.00601)
Log export	0.0000576		0.0000482	0.00187		0.00185
	(0.00104)		(0.00104)	(0.00830)		(0.00831)
Share immigrants		-0.510	-0.511		-0.133	-0.191
		(0.311)	(0.311)		(0.416)	(0.419)
Observations	604190	604190	604190	604190	604190	604190
R^2	0.715	0.715	0.715	0.714	0.715	0.714
	High skilled workers					
	FE			FE-IV		
	(1)	(2)	(3)	(4)	(5)	(6)
Log offshoring	0.000568		0.000549	0.0218**		0.0218**
	(0.00178)		(0.00178)	(0.0104)		(0.0104)
Log export	0.00142		0.00143	0.0136		0.0137
	(0.00154)		(0.00154)	(0.0108)		(0.0108)
Share immigrants		0.148	0.150		0.470	0.278
		(0.270)	(0.272)		(0.312)	(0.352)
Observations	164681	164681	164681	164681	164681	164681
R2	0.828	0.828	0.828	0.826	0.828	0.826

Note: Additional controls include: (individual level) Marital status, number of children 0-17 years of age, educational attainment, age (age squared), and union member, (firm level) log employment, log output, and log capital. All specifications include job-spell, industry-year, and regional-year fixed effects. Standard errors are clustered at the firmXyear level. Level of significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The FE-estimates reveal very small and non-significant relationships for offshoring and export, for both low- and high-skilled workers. The negative immigration relationship found in Table 2 is explained by a negative relationship for low skilled workers. For high-skilled workers we find no significant relationships between immigration and wages. Again, controlling for endogeneity, leads to positive offshoring effect on wages. The positive effect is somewhat higher for high skilled workers than for low-skilled workers, but the difference is not statistically significant. Thus, we find no support for offshoring increasing the skill premium within firms. The positive wage effects for high skilled workers are in line with Hummels et al.

(2014), reporting wage elasticities for high skilled about +0.03.[10] However, they report negative wage elasticities for low skilled about -0.02, thus, suggesting that offshoring tends to increase the within-firm skill premium. The export effect is small and not significant, irrespective of skill level.

The significant and negative relationship between immigration and wages disappears, after controlling for endogeneity. Focussing on the sign of the coefficient, and focusing on the last model, there is a negative effect for low skilled workers and a small positive effect for high-skilled workers. This is in line with the hypothesis that it is the low skilled workers that compete most strongly with the immigrants. Finally, the F-tests for the included instruments in Table 3 suggest that the instruments have sufficient power.

The importance of tasks

In our data we have detailed information on the occupation of each worker, this allows us to analyse whether occupations that have particular task characteristics are especially affected by offshoring and immigration. Instead of grouping workers by educational attainment, we now group them by the characteristics of the particular tasks they do. As many others we use the U.S. O*NET database, which provides information on the knowledge, skills, and abilities of a particular occupation (see section 4 for explanation of the tasks included).

For all workers we include an interaction term between the task of the occupation and our two key variables of interest, to see whether offshoring and immigration effects on wages are different across task characteristics. We use three types of tasks: *Routine, Non-routine, and social skills* (see e.g. Autor et al. 2003, Ebenstein et al. 2014 for the use of the routine and non-routine approach, and Deming 2017, for social skills).

[10] In their estimations, they use an interaction term between offshoring and a dummy for whether the worker is high skilled or not.

We use fixed effects-IV approach in the estimation, similar to Table 2. Also like in the above estimation, we instrument for the additional interaction between tasks and offshoring, as well as tasks and immigration.[11] To get a cleaner identification, we drop the workers who switch occupations during job spells.[12] We report the results in Table 4. For each of the three tasks we present three models, where the models vary based on how we include the explanatory variables: i) Offshoring only, ii) Immigration only, and iii) Offshoring and immigration together. The results in column 1-3 are for routine (R1-R3) column 4-6 for non-routine (NR4-NR6), and 7-9 for social skills (SS7-SS9). F-statistics for the included instruments are presented in Appendix, Table A2.

[11] The interaction instrument is an interaction between the task variables (routine, non-routine, social skills) and the instrument for offshoring and immigration (Wooldridge, 2002).

[12] Since information on occupation is only available from 2003, the period of analyses in Table 4 is limited to 2003-2008.

Table 4. Effects of offshoring and immigration on wages. Routine, non-routine and social skills

	(1) R1	(2) R2	(3) R3	(4) NR1	(5) NR2	(6) NR3	(7) SS1	(8) SS2	(9) SS3
Log offshoring	0.00581		0.00567	0.00582		0.00577	0.00638		0.00574
	(0.00532)		(0.00531)	(0.00532)		(0.00532)	(0.00531)		(0.00532)
Log export	0.00695		0.00690	0.00705		0.00722	0.00689		0.00693
	(0.00592)		(0.00591)	(0.00593)		(0.00593)	(0.00592)		(0.00590)
Share immigrants		-0.0974	-0.122		-0.181	-0.258		-0.145	-0.183
		(0.545)	(0.558)		(0.543)	(0.557)		(0.549)	(0.564)
RoutineXOffshoring	-0.00039***		0.000083						
	(0.000124)		(0.00025)						
RoutineXImmigration		-0.121***	-0.131**						
		(0.0301)	(0.0578)						
Non-routineXOffshoring				0.000466***		-0.000574**			
				(0.000119)		(0.000246)			
Non-routineXImmigration					0.222***	0.346***			
					(0.0353)	(0.0674)			
Soc skillsXOffshoring							0.000819***		-0.000446*
							(0.000115)		(0.000228)
Social skillsXimmigration								0.291***	0.368***
								(0.0288)	(0.0553)
Observations	410783	410681	410681	410783	410681	410681	410783	410681	410681
R^2	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816	0.816

Note: Additional controls include: (individual level) Marital status, number of children 0-17 years of age, educational attainment, age (age squared), and union member, (firm level) log employment, log output, and log capital. All specifications include job-spell, industry-year, and regional-year fixed effects. Standard errors are clustered at the firm level. Level of significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The first column shows that employees working in occupations with requirements for average routineness in tasks are not significantly affected by offshoring, measured by the log of offshoring variable, but the interaction term suggests that workers with above average routineness are negatively affected. These results suggest that offshoring has a negative effect on the wages of workers whose occupations include a high proportion of routine tasks. Conversely, offshoring has a positive wage effect on workers in occupations where non-routine tasks dominate. These results are in line with results in Hummels et al. 2014, and Ebenstein et al. 2014). In column 2 we report that workers in occupations with above average routineness are negatively affected by immigration. Controlling for both offshoring and immigration in column 3, we still find that that workers in occupations with above average routines are negatively affected by immigration. The coefficient is not altered much from column 2. The negative interaction effect between offshoring and routines disappear when controlling for immigration.

The results for non-routines are presented in column 4-6. To a large extent, the results mirror the results for routineness. The interaction term suggests that workers with above average non-routines are positively affected by offshoring and immigration, and only the results for immigration survive, once controlling for both. The interaction term between non-routines and offshoring - once controlling for immigration - is actually negative, suggesting that workers with above average non-routines are negatively affected by offshoring. Note that this effect is only present after controlling for immigration, and the interaction between immigration and non-routines, and the size of the effect is very small.

Finally, the results for social skills are presented in columns 7-9. As for non-routineness, the interaction term is positive, suggesting that workers with above average social skills are positively affect, by both offshoring and immigration, when analysed separately. When analysing the combined effects only the immigration effect is still positive and significant.

Again, when controlling for local immigration, the interaction term between social skills and offshoring switches sign. In general, for all three tasks, it is the immigration effect that stands out in combination with the three tasks, when controlling for both immigration and offshoring. For all tasks, the interacted effect for immigration is strengthened when we include both offshoring and immigration in the estimation.

6. Conclusions

A characteristic feature of globalisation in the last decades is the increase in both offshoring (Feenstra and Hanson 2003, Hummel et al. 2016) and immigration (Freeman, 2006). However, it is theoretically unclear how increased offshoring should affect workers. On the one hand, one might expect that outsourcing tasks abroad that the firm could have done itself, would lead to reduced wages and/or loss of jobs (Feenstra and Hanson 1999). On the other hand, offshoring may lead to reduced costs and increased productivity, which may increase wages and employment (Grossman and Rossi-Hansberg 2008). The impact of immigration on domestic workers is still an unresolved empirical question, but there is a consensus that domestic workers that compete most directly with the immigrants, are affected the most, with respect to falling wages and employment opportunities.

In this paper, we use high quality longitudinal Norwegian matched employer-employee register data, to analyse the combined effect of offshoring and immigration on wages of domestic workers. To our knowledge, this type of data has not been used to analyse combined effects of immigration and offshoring. The data is linked to firm level information on imports and exports. The trade information is based on detailed data which includes the value of each firm's yearly imports and exports, disaggregated by HS-6 digit product codes and by source country. Information on immigration is based on the share of immigrants in the local labour market region.

The starting point is all individuals employed in a manufacturing firm in the period 1999-2008. The 2SLS results show positive and significant effects of offshoring on wages; for all workers, and for both skill groups (high and low skilled). The positive effect is larger for high skilled workers than for low-skilled workers, but the difference is not statistically significant. Thus, we cannot conclude that offshoring increases the skill-premium within firms. The wage elasticity coefficient for all workers suggests that increasing offshoring by 1 per cent increases wages by 0.0120 per cent, for all workers.

Compared to the results in Hummel et al. (2014), which find negative offshoring effects for low skilled workers and positive effects for high skilled, we do not find negative effects for low skilled. In our data we find positive impacts for both groups. Considering the familiarities of the two neighbouring Scandinavian countries, this is somewhat surprising, and warrants further investigation, for example looking at differences in wage setting systems between the two countries in the manufacturing industry. In the Norwegian manufacturing industry, a large part of the blue-collar workers, get their wages set by a combination of central and local wage agreements (see section 2 for more information).

The results for the impact of immigration reveal, after controlling for endogeneity, that immigration has a negative, but not significant impact on wages of domestic workers. Focussing on the size of the coefficients, the negative impact is limited to low skilled workers.

Using O*NET data which provides information on the knowledge, skills, and abilities of a particular occupation we find that workers enjoy smaller wage gains in response to immigration if their occupation is characterized by a high level of routine tasks . Conversely, we find that workers enjoy larger wage gains in response to immigration if their occupation is characterized by having a high requirements for non-routine tasks and in occupations where social skills are important. With respect to offshoring, we find, after controlling for immigration, no significant interaction effects between routines, social skills and wages.

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Appendix

Table A1. Regression results. FE-IV estimates

	(1) All	(2) Low skilled	(3) High skilled
Log offshoring	0.0127**	0.0101	0.0218**
	(0.00641)	(0.00620)	(0.00964)
Log export	0.00276	0.00185	0.0137
	(0.00856)	(0.00930)	(0.0112)
Share immigrants	-0.322	-0.191	0.278
	(0.540)	(0.550)	(0.477)
Married	0.00553***	0.00387*	0.00404
	(0.00197)	(0.00221)	(0.00428)
Number of children under 18	-0.0116***	-0.0146***	-0.00722***
	(0.00131)	(0.00141)	(0.00243)
Secondary school	0.0480***	0.0567***	-0.0646
	(0.00528)	(0.00524)	(0.0604)
Higher education - short	0.146***	0.180***	-0.0343
	(0.0312)	(0.0380)	(0.0239)
Higher education - long	0.203***	0.199	0
	(0.0406)	(0.156)	(.)
age	-6.870	-0.152	-0.388
	(9539.2)	(1712.2)	(5779.6)
age2	-0.000522***	-0.000500***	-0.000645***
	(0.0000168)	(0.0000185)	(0.0000259)
union	0.0925***	0.116***	0.0141**
	(0.00834)	(0.0104)	(0.00717)
Log employment	0.0216**	0.0272***	-0.0134
	(0.00898)	(0.00951)	(0.0106)
Log output	0.0434***	0.0475***	0.0198
	(0.00953)	(0.00975)	(0.0133)
Single firm	0.0227***	0.0235***	0.0142
	(0.00750)	(0.00666)	(0.0142)
Log capital	0.00467**	0.00312	0.00915***
	(0.00208)	(0.00218)	(0.00268)
Observations	768874	604190	164681
R^2	0.774	0.714	0.826

Standard errors in parentheses
Robust standard errors adjusted for clustering on the firm level
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A2. F-statistics for included instruments

	(1) R1	(2) R2	(3) R3	(4) NR1	(5) NR2	(6) NR3	(7) SS1	(8) SS2	(9) SS3
Log offshoring	21.3		15.2	18.9		13.0	19.2		14.1
Log export	6.3		4.8	6.7		5.3	6.3		4.9
Share immigrants		139.1	57.2		138.4	57.6		136.3	56.8
RoutineXOffshoring	1124.9		1030.2						
RoutineX Immigration		6855.9	2862.6						
N-routineXOffshoring				452.9		553.5			
N-routineX Immigration					3163.5	1435.5			
Soc skillsXOffshoring							1268.1		1046.0
SockillsXImmigration								7863.2	3108.1