Complements or Substitutes?
Immigrant and Native Task Specialization in Spain*

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Abstract

Learning about the impact that immigration has on the labor market of the receiving nation is a topic of major concern, particularly in Spain, where immigration has more than doubled from 4 percent to roughly 10 percent of the population within a decade. Yet, very little is known about the impact that large immigrant inflows have had on the labor market outcomes of Spanish natives. Furthermore, most studies assume that natives and immigrants are perfect substitutes within skill groups—a questionable assumption given recent findings in the literature. In this paper, we first document that foreign-born workers are not perfect substitutes of similarly skilled native Spanish workers, which may help explain why immigration has not significantly lowered natives’ wages. Instead, immigration has affected the occupational distribution of natives. Specifically, owing to the comparative advantage of foreign-born workers in manual as opposed to interactive tasks, natives relocated to occupations with a lower content of manual tasks—an effect reinforced by the significant increase in the share of native female workers over the time span under consideration. Additionally, the increase in the share in foreign-born workers may have raised the manual to interactive task supply of the economy; however, the simultaneous increase in the share of native female workers may have worked in the opposite direction.

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1. Introduction

The impact of immigration on the labor market of the host country is a topic of major concern for many immigrant-receiving nations. Spain is no exception following the rapid increase in immigrant flows experienced over the past decade. In 1991, only 1.2 percent of the Spanish adult population (about 300,000 individuals) was foreign-born. Within a decade, this percentage quadrupled to 4.0 percent (1,370,000 individuals) and, by 2007, it has roughly reached 10 percent (4,500,000 individuals).

While there is a large and growing literature on the consequences of migration on the wages of native workers in the U.S. (see Borjas (1994, 1995, 1999, 2003, 2005), Borjas and Katz (2007), Card (1990, 2001, 2005), Card and Di Nardo (2000), Card and Lewis (2007), Lewis (2003), Ottaviano and Peri (2005, 2006), among others), with a few exceptions, very little is known about the impact of migration on the employment patterns and wages of Spanish natives. Take, for instance, the well-accepted fact that, if workers’ skills are differentiated mainly by their level of educational attainment and workers of different education levels are imperfect substitutes, a large flow of immigrants with limited schooling should (i) increase wages paid to highly-educated natives and (ii) reduce wages paid to less-educated ones. Yet, in general, the effect of immigration on the wages of less-educated natives has been, if any, of very small magnitude in the U.S. as well as in Spain (e.g. Amuedo-Dorantes and De la Rica (2008), González and Ortega (2007), Carrasco et al (2008)). However, as recently noted by Ottaviano and Peri (2006), this is not surprising given that the effect of immigration depends on the degree of substitution between native and immigrant workers within each education group. If native and immigrant workers of similar educational attainment possess productive skills that lead them to specialize in different occupations, it is reasonable to find a small or null impact of immigration on natives’ wages as immigrants and natives are not competing for the same jobs.
Therefore, in order to learn about the impact of immigration on the host country economy, it is first crucial to empirically assess the degree of substitution between native and immigrant workers of comparable educational attainment. Yet, in the Spanish case, it is also crucial to simultaneously account for the significant increase in the native female labor force participation over the period under consideration. Female employment rates in Spain rose from 25 percent in the mid 1980s to about 65 percent by the year 2008—a period of time during which male employment rates remained practically unchanged. Because native female workers may differ from immigrant and native male workers in their comparative advantages, failure to account for their increased presence in the labor market during the period under consideration may bias our findings regarding the impact of immigration on natives’ employment outcomes.

We proceed in two steps. First, we provide evidence of immigrants and natives being imperfect substitutes within skill categories. Subsequently, we proceed to examine some of the reasons as for why that may be the case. In particular, we explore whether, once we take into account the simultaneous increase in native female labor force participation over the time period under analysis, immigration encourages native specialization in occupations that differ from those held by immigrants. The latter would help explain recent native and immigrant employment patterns, as well as the lack of a negative wage impact of immigration on natives’ wages. We find that natives seem to relocate to jobs with a lower content of manual, as opposed to interactive or non-manual tasks\(^1\)—an effect reinforced by the significant increase in the share of native female workers over the time span under consideration. Additionally, the increase in the share in foreign-born workers may have raised the manual to interactive task supply of the economy; however, the simultaneous increase in the share of native female workers may have worked in the opposite direction.

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\(^1\) Throughout the paper, we will be using the terms “interactive” and “non-manual” interchangeably.
The rest of the paper is organized as follows. Section 2 presents the theoretical model upon which we base our empirical analysis. A detailed data description and some motivating descriptive statistics are provided in Section 3 of the manuscript. In Section 4, we discuss our empirical methodology and findings and Section 5 concludes the paper.

2. Theoretical Model

We develop an extension to Peri and Sparber’s (2008) general equilibrium model. In their model, immigrants, compared to natives, have a comparative advantage in performing manual relative to interactive tasks owing to their limited language proficiency and their often missing Spanish-specific human capital skills. Given these comparative advantage differences, Peri and Sparber (2008) solve for the equilibrium provision of relative manual to interactive tasks by natives and in the entire economy and derive some testable hypotheses regarding the impact of low-skill immigration on such provisions.

We extend Peri and Sparber’s (2008) model to allow for gender differences in natives’ comparative advantage in manual as opposed to interactive tasks. As noted in the Introduction, this extension is quite relevant in a country like Spain for a couple of reasons. First, Spain has experienced a significant increase in female labour force participation in recent years. Second, as we shall show later on in the descriptives, women’s task provision is less manual than men’s. This gender difference may have, in turn, significantly impacted the manual to interactive nature of the task provision by native men as well as in the overall economy. Thus, we assume that native women, relative to their male counterparts, have a comparative advantage in performing interactive, as opposed to manual, tasks. Figure 1 shows the evolution of male and female employment rates in Spain between 1976 and the year 2008. Starting in the mid 1980’s, female employment rates started to rise from approximately 25 percent to about 65 percent by the year 2008. In fact, during the period under examination in this study, that is: between 1999 and the year 2007, female employment
rates have risen by approximately 20 percentage points, from 45 percent to about 65 percent. In contrast, over the same time period, male employment rates have stayed fairly stable at around 85 percent.

In what follows, we present a simple theoretical model from which we derive the equilibrium provisions of relative manual tasks by natives and in the economy when there are three heterogeneous agents in the economy, i.e., immigrants, native women and native men. Each of these agents has different comparative advantages in performing manual as opposed to interactive tasks. From the equilibrium provision of relative manual tasks, we then derive testable hypotheses regarding the effect of immigration on the relative tasks supplied by (i) natives and (ii) by the overall economy.

2.1. Aggregate Demand Function

We start with an economy that produces one tradable final consumption good we call \( Y \), which only requires a low skilled intermediate input: \( Y_L \).\(^2\) The production of \( Y_L \) is carried out by less educated workers and requires a technology that combines two different types of tasks: manual (\( M \)) and interactive or interactive (\( I \)) tasks. Manual tasks can be routine or non-routine in nature. Examples of manual tasks include body coordination and physical strength, whereas interactive tasks require interactive skills, such as being able to easily communicate with other people, being capable of performing team work or supervising the work of others. Both tasks are combined to produce \( Y_L \) according to the following CES production function:

\[
Y_L = [\beta_L M^\lambda + (1 - \beta_L)I^\lambda]^{\frac{1}{\lambda}}
\]

where \( \beta_L \) measures the productivity of manual versus interactive tasks in the production of \( Y_L \) and \( \lambda \) captures the elasticity of substitution between manual (\( M \)) and interactive (\( I \)) tasks.

\(^2\) For simplicity, we focus on low skilled goods given that competition among natives and immigrants is more likely to occur in low-skilled jobs. Regarding high-skilled goods, we are implicitly assuming that they are produced by high skilled workers.
Profit maximization in a competitive market then yields the following relative demand function for manual versus interactive tasks:

\[
\frac{M}{I} = m = \left( \frac{\beta_L}{1 - \beta_L} \right)^{\lambda} (w_m)^{-\lambda} \tag{2}
\]

where \( w_m \) is the relative compensation for manual versus interactive tasks, i.e., \( w_m = \frac{w_M}{w_I} \).

### 2.2. Comparative Advantages of Immigrant, Native Female and Native Male Workers

In order to focus on native specialization in occupations that differ from those held by immigrants as a potential explanation for the imperfect substitutability of natives and immigrants within skill cell, we first assume that less educated natives and immigrants differ in their comparative advantage in manual versus interactive tasks. Specifically, we assume that immigrants have, relative to their native counterparts, a comparative advantage in performing manual as opposed to interactive tasks. This is a reasonable assumption given that, unlike manual tasks, interactive tasks require the usage of communication skills that most immigrants may still lack upon arrival owing to their limited language proficiency, lack of Spanish-specific human capital, and overall imperfect transferability of skills. If we denote by \( e_{mi} \) and \( e_{mn} \) as the efficiency in manual relative to interactive tasks of native and immigrant workers, respectively, the stated assumption implies that: \( \bar{e}_{mi} > \bar{e}_{mn} \), where the subscripts \( i \) and \( n \) refer to immigrants and natives, respectively.

Additionally, we assume that, among natives and possibly due to the physical demands of certain jobs, women have a comparative advantage in interactive relative to manual tasks, that is: \( (\bar{e}_m)_{w_m} < (\bar{e}_m)_{wm} \).

Now consider a representative worker \( j \), who dedicates his/her work time (e.g. one unit) to perform manual and interactive tasks. If we denote by \( s_M \) the share of time each
worker dedicates to work on manual tasks, then each worker $j$ will choose how to allocate his
time among manual and interactive tasks so as to maximize his/her labor income ($w_{lj}$):

$$w_{lj} = (s_M)^\alpha t_{mj} w_M + (1 - s_M)^\alpha t_{ij} w_i$$  \hspace{1cm} (3)

where $t_{mj}$ and $t_{ij}$ refer to the work time each worker $j$ dedicates to manual and interactive
tasks, respectively. The superscript $\alpha$ (where: $\alpha < 1$) reflects decreasing returns in performing
either manual or interactive tasks –which guarantees that workers do not completely
specialize in performing one particular type of tasks. Maximization of equation (3) with
respect to $s_M$ yields the optimal relative supply of manual versus interactive tasks, $\eta_{mj}$, which
is directly related to the relative task compensation in manual versus interactive tasks, ($w_m$),
and to the worker relative efficiency in performing manual versus interactive tasks ($e_{mj}$):

$$\eta_m = w_m^{\frac{\alpha}{1-\alpha}} (e_{mj})^{\frac{1}{1-\alpha}}$$  \hspace{1cm} (4)

2.3. The Equilibrium Relative Provision of Manual versus Interactive Tasks

In order to find the equilibrium relative provision of manual to interactive tasks, we
need to aggregate equation (4) across all workers to obtain the market relative supply of
manual relative to interactive or interactive tasks, denoted by $m$:

$$m^* = (w_m)^{\frac{\alpha}{1-\alpha}} (e_m)^{\frac{1}{1-\alpha}}$$  \hspace{1cm} (5)

Using equations (5) and (2), we can solve for the aggregate equilibrium provision of manual
versus interactive tasks as well as for the equilibrium relative compensation:

$$m^* = \left( \frac{\beta_L}{1 - \beta_L} \right)^{\frac{\alpha \lambda}{(1-\alpha)\lambda + \alpha}} \left( \frac{\lambda}{e_m} \right)^{\frac{\lambda}{(1-\alpha)\lambda + \alpha}}$$  \hspace{1cm} (6)

$$w_m^* = \left( \frac{\beta_L}{1 - \beta_L} \right)^{\frac{1-\alpha}{(1-\alpha)\lambda + \alpha}} \left( \frac{-1}{e_m} \right)^{\frac{-1}{(1-\alpha)\lambda + \alpha}}$$  \hspace{1cm} (7)
2.4. Immigrant and Native Task Supplies

We have solved for the equilibrium relative task provision of manual versus interactive tasks of a representative worker assuming that all workers are homogeneous with regards to their efficiency in performing manual and interactive tasks. However, one of the key assumptions of the model is the existence of heterogeneity in the comparative advantage of manual versus interactive tasks across workers. In particular, we assume that (i) immigrants are more efficient in providing manual relative to interactive tasks than natives, and (ii) among natives, women are more efficient in providing interactive relative to manual tasks than their male counterparts. Therefore, we now expand the model to take into account these two assumptions.

We first rewrite the aggregate supply of manual versus interactive tasks in this economy as a weighted average of the relative supply by natives and immigrants of both tasks, where the weight is the share of interactive tasks provided by immigrants (which is a monotonic transformation of the foreign-born share of low-educated workers, \(L_f/(L_N+L_i)\)):

\[
\begin{align*}
ni &= \left( \frac{M}{I} \right) = \left( \frac{M + I_m}{I_i + I_m} \right) = f \left( \frac{M}{I} \right)_i + (1 - f) \left( \frac{M}{I} \right)_n = fm_i + (1 - f)m_n \\
\end{align*}
\]

If we further disaggregate the native provision of relative tasks (i.e. \(m_n\)) by gender, equation (8) can be rewritten as follows:

\[
\begin{align*}
m = fm_i + (1 - f)(gm_{nw} + (1 - g)m_{nm}) \\
\end{align*}
\]

where \(g\) is the share of interactive tasks provided by native women among all native workers, which is a monotonic transformation of the native female share of our sample of native workers. The subscript \(nm\) stands for native men and \(nw\) for native women.

The average relative efficiency of all low educated workers in performing manual versus interactive tasks, \(\bar{e}_{\alpha}\), can also be rewritten as a weighted average of natives and immigrants’ relative efficiency in manual and interactive tasks as follows:
\[ \bar{e}_m = \left[ f\left( \bar{e}_m \right)^{1-\alpha} + (1 - f)\left( \bar{e}_m \right)^{1-\alpha} \right]^{(1-\alpha)} = \left[ f\left( \bar{e}_m \right)^{1-\alpha} + (1 - f)\left( \bar{e}_m \right)^{1-\alpha} \right]^{(1-\alpha)} \]

(10)

The average relative efficiency of the economy increases with the share of foreign born given the assumption that \((\bar{e}_m)_i > (\bar{e}_m)_n\) and with the average relative efficiency of manual tasks of immigrants for a given share of foreign born workers. Once more, if we further assume that the relative efficiency in manual versus interactive tasks of native men and women differs, we have that:

\[ \bar{e}_m = \left[ f\left( \bar{e}_m \right)^{1-\alpha} + (1 - f)\left( \bar{e}_m \right)^{1-\alpha} \right]^{(1-\alpha)} = \left[ f\left( \bar{e}_m \right)^{1-\alpha} + (1 - f)\left( \bar{e}_m \right)^{1-\alpha} \right]^{(1-\alpha)} \]

(11)

Given the assumption that \((\bar{e}_m)_n < (\bar{e}_m)_m\), an increase in the female share among native workers decreases, ceteris paribus, the average efficiency of relative manual tasks of the whole economy. Similarly, an increase in the relative efficiency of manual to non-manual tasks of native women would increase the average relative efficiency of the total workforce.

We need to obtain an expression for the optimal supply of manual to interactive tasks by natives, \((m)_n^*\), and for the equilibrium provision of relative tasks in the economy, \((m)^*\), as a function of the relative efficiency in performing tasks by each group. With that purpose, we make use of equation (5) and obtain the optimal supply of tasks provided by all native workers:
\[ n^*_n = (w^*_m)^{\alpha - \alpha} \left( e_m \right)^{1 - \alpha} = (w^*_m)^{\alpha - \alpha} \left[ g(e_m) \right]^{1 - \alpha} + (1 - g) \left( e_m \right)^{1 - \alpha} = (1 - \alpha)\lambda + \alpha \]

In addition, the equilibrium compensation of relative tasks can be written as:

\[ w^*_m = \left( \frac{\beta_L}{1 - \beta_L} \right)^{(1 - \alpha)\lambda + \alpha} \left( e_m \right)^{\alpha \lambda} + (1 - f) \left( g(e_m) \right)^{\alpha \lambda} + (1 - g) \left( e_m \right)^{\alpha \lambda} = \left( \frac{\beta_L}{1 - \beta_L} \right)^{(1 - \alpha)\lambda + \alpha} \left( e_m \right)^{\alpha \lambda} + (1 - f) \left( g(e_m) \right)^{\alpha \lambda} + (1 - g) \left( e_m \right)^{\alpha \lambda} \]

By substituting equation (13) into equation (12), we can solve for the optimal supply of relative tasks of natives as a function of the relative efficiency of native men, native women, and immigrants in performing manual versus interactive tasks, which is given by:

\[ m^*_n = \left( \frac{\beta_L}{1 - \beta_L} \right)^{(1 - \alpha)\lambda + \alpha} \left( e_m \right)^{\alpha \lambda} + (1 - f) \left( g(e_m) \right)^{\alpha \lambda} + (1 - g) \left( e_m \right)^{\alpha \lambda} = \left( \frac{\beta_L}{1 - \beta_L} \right)^{(1 - \alpha)\lambda + \alpha} \left( e_m \right)^{\alpha \lambda} + (1 - f) \left( g(e_m) \right)^{\alpha \lambda} + (1 - g) \left( e_m \right)^{\alpha \lambda} \]

In order to obtain the expression of the equilibrium provision of relative tasks in the economy, we can substitute equation (10) into equation (6) and rewrite the equilibrium provision of manual to interactive tasks as a function of the relative efficiency of each of the three groups under consideration, i.e., native men, native women and immigrants, in manual relative to interactive tasks:
\[
\begin{align*}
    m^* &= \left( \frac{\beta_L}{1 - \beta_L} \right)^{\alpha \lambda \frac{1}{1 - \lambda + \alpha}} \left[ \frac{1}{f(e_m^m) + (1 - f) \left[ g(e_m^m) \right]^{\frac{1}{1 - \lambda + \alpha}}} \right]^{\lambda \frac{1}{1 - \lambda + \alpha}} \\
    &= \left( \frac{\beta_L}{1 - \beta_L} \right)^{\alpha \lambda \frac{1}{1 - \lambda + \alpha}} \left\{ e_m^m \left( f \left( g(e_n^m) + \frac{1}{f(e_m^m)} \right) + \frac{1}{g(e_n^m)} \right) \right\}^{\lambda \frac{1}{1 - \lambda + \alpha}}
\end{align*}
\]

(15)

2.5. Key Assumptions and Testable Hypotheses

As pointed out earlier, there are two critical assumptions made in the model. The first one is that, relative to natives, immigrants have a comparative advantage in providing manual as opposed to interactive tasks, i.e. \((e_m^m) > (e_m^n)\). This assumption implies that the average supply of manual to interactive tasks by immigrants will be greater than that of natives or: \((\bar{m}_i) > (\bar{m}_n)\). The second assumption is that, among natives, women have a comparative advantage in interactive as opposed to manual tasks, i.e., \((e_n^m) < (e_n^w)\) which implies that: \((\bar{m}_n^w) < (\bar{m}_n^m)\). Using these assumptions, and assuming that the two supply shocks take place simultaneously, we derive two testable hypotheses:

i) **Hypothesis no.1: As native women and immigrants enter the labour force, the provision of manual to interactive tasks by less educated natives decreases.**

According to equation (14), these two supply shocks unambiguously lower the provision of manual to interactive tasks by low-educated native men and women. That is:

\[
d(m)_n^* = \frac{\partial (m)_{n}^*}{\partial f} df + \frac{\partial (m)_{n}^*}{\partial g} dg < 0
\]

given that \(\frac{\partial (m)_{n}^*}{\partial f} < 0\) and \(\frac{\partial (m)_{n}^*}{\partial g} < 0\) (see appendix for proof).

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3 Peri and Sparber (2008) examine the impact of immigration on the relative compensation of manual versus interactive tasks as well. However, owing to the lack of adequate data on wages, we do not test the model predictions regarding the relative manual to interactive compensation.
Hypothesis no. 2: As native women and immigrants enter the Spanish labour force, the provision of manual to non-manual tasks in the overall economy may increase, decrease or remain the same depending on which supply shock dominates.

According to equation (15), due to their opposite signs, these two simultaneous supply shocks have an ambiguous effect on the overall provision of manual to non-manual tasks in the economy depending on whether the immigration or the female supply shock dominates or cancel out. That is:

\[
d(m) = \frac{\partial(m)}{\partial f} df + \frac{\partial(m)}{\partial g} dg \leq 0
\]

given that \(\frac{\partial(m)}{\partial f} > 0\) but \(\frac{\partial(m)}{\partial g} < 0\) (see appendix for the proof).

3. Data and Some Descriptive Evidence

We use the 1999-2007 Spanish Current Population Survey (Encuesta de Población Activa, EPA), which provides the most representative sample of the Spanish workforce. For the descriptive analysis, we also use the wage information contained for Spain in the European Union Standard Living Conditions (EU-SILC) – a micro data panel that currently spans from 2004 to 2006. Because of the limited variables contained in this dataset, as well as the reduced number of years for which these data are available, we are unable to use it in the empirical analysis. We restrict our analysis to recent immigration inflows as recent immigrants (i.e. those with five or fewer years in Spain) are less likely to have yet acquired the language proficiency and Spanish-specific human capital skills than longer-term migrants may enjoy. As a result, they are less likely to display a comparative advantage in interactive tasks relative to long-term migrants who may have already acquired the needed skills to perform well in such tasks. Additionally, since our intent is to explore the implications of low-skilled immigrants’ comparative advantage in performing manual as opposed to
interactive tasks relative to similarly skilled natives, we focus on immigrants and natives with less than a university degree.⁴

Table 1 presents some descriptive statistics of the sample of natives and immigrants taken from the pooled EPA 1999-2007. We define immigrants as holding a foreign nationality (those with a double nationality are excluded – less than 4 percent), and distinguish recent immigrants, i.e. those with 5 or fewer years in Spain, from all immigrants in the sample. About 3 percent of the sample is foreign-born and a total of 2 percent entered the country recently. Immigrants differ from natives in various regards. First, immigrants, in particular recent immigrants, are younger than their native counterparts. For instance, among recent immigrants, sixty-four percent of immigrants are 35 years old or younger relative to 38 percent and 40 percent of native men and women, respectively. In contrast, sixty-two percent of native men and 57 percent of native women are older than forty-five compared to 12 percent of recent immigrants. Second, a higher fraction of immigrant women work relative to native women (i.e. forty-three of all immigrant workers and 46 percent of all recent immigrant workers are women relative to 39 percent for of all native workers). Third, there are also some differences in the educational attainment of immigrants and natives. Native women are the most highly educated, followed by native men and immigrants. Furthermore, although we cannot distinguish recent from non-recent migrants in the EU-SILC data, natives earn, on average, significantly higher wages than foreign-born workers, which would possibly be indicative of the fact that natives perform different tasks than immigrants.

3.1. Substitutability among Native Men, Native Women and Immigrants

The first empirical evidence on the lack of substitutability among native men, native women and immigrants emerges from Figure 3, which displays the relative position of low-educated immigrants and low-educated native women in the wage distribution of low-

⁴ Nonetheless, it is worth noting that our results are robust to the inclusion of all immigrants since the vast majority of them are concentrated in occupations with greater manual task content.
educated native men (pooled 2004-2006 from EU-SILC). We have divided the native male wage distribution in deciles and, for each decile, we have calculated the percentage of immigrants and native women within each native male wage decile. The horizontal line shows that 10 percent of native men fall within each wage decile. However, immigrants and native women are concentrated to a greater extent in the lowest wage deciles of natives, whereas the opposite is true in higher wage deciles. As such, Figure 3 suggests that immigrants and, to a lesser extent, native women basically compete with low-wage native men.

Additional evidence on the lack of substitutability between natives and immigrants emerges from differences in their occupational distribution in Table 2. For the purposes of our analysis, we focus on working-age individuals (i.e. between 16 and 65 years of age) without a university education. The concentration of immigrant workers in a few occupations is remarkable. About 82 percent of immigrants and an astonishing 87 percent of recent immigrants (relative to 60 percent of native women and 54 percent of native men) work in three broad occupational categories: 1) Low skill jobs that only require an elementary education, 2) service and sales occupations, and 3) craft and related trade jobs. Furthermore, two of those three occupations are among the worse paid.

Additionally, the figures in Table 2 indicate that there are also important gender differences among natives. Between 25 and 30 percent of native women are employed in the very low-skilled occupations or as service and sales workers relative to 14 and 11 percent of native men, respectively. Likewise, only 5 percent of native women are craft and related trade workers compared to 30 percent of native men. These gender differences underscore the significance of paying close attention to the separate impact of immigration on native men and women and of distinguishing between the effect of immigrants and native women on the labor supply of native men.
Is the occupational concentration of immigrants and native women, as compared to native men, a by-product of their distinct educational attainment? Table 3 displays the occupational distribution of immigrants and natives with a primary or lower education as well as with a secondary education. It is worth noting that 80 to 85 percent of immigrants with secondary education and 87 to 90 percent of immigrants with a primary or lower education are concentrated in three occupations (i.e. low skill jobs that only require an elementary education, service and sale related occupations, and craft and related trade jobs). The latter figures compare to 53 percent and 57 percent of native men and women with secondary education, respectively, and to 57 percent and 70 percent of native men and women with primary education, correspondingly. Therefore, immigrants, particularly more recent immigrants, are concentrated in poorly paid occupations than native men and, to a lesser extent, than native women, regardless of their educational attainment.

In most studies, the skill level is not measured only in terms of the educational attainment, but rather in terms of education and experience (usually proxied by age), which better reflect the acquired human capital. Table 4 shows the distribution of immigrants, native men and native women across ten skill groups (five age categories and 2 educational groups), along with their average wages. Native men earn consistently more than native women and immigrants within any given skill group and young native women earn less than immigrants. These wage differences within skill groups indicate that native men, native women and immigrants cannot be considered close substitutes within the traditional skill categories either. The observed imperfect substitutability of immigrants, native men and native women of comparable age and educational attainment may be the result of the distinct sorting of each group across occupations. More specifically, as Peri and Sparber (2008) suggest, most immigrants, due to their lack of language proficiency and other necessary production skills (interactive skills), may feel that they have a comparative advantage in
occupations that do not require such abilities and that, instead, require more manual than interactive tasks. In that case, immigrants may choose occupations with a greater manual, as opposed to interactive, task content. In the case of native women, physical demands of the job may induce them to choose occupations characterized by a lower manual to interactive task content than that of occupations chosen by native men and immigrants.

3.2. Measuring Task Specialization

To examine whether, indeed, immigration leads native men and, overall, natives to relocate in jobs demanding greater interactive skills, thus allowing for immigrants to occupy more manual intensive jobs, we rely on information on the job task requirements assembled by Peri and Sparber (2008). In their paper, Peri and Sparber (2008) merged data on job task requirements based on the U.S. Department of Labor’s O*Net abilities survey with Census occupation classifications to examine task specialization patterns of natives and immigrants in the U.S. They transform the O*Net abilities in percentile scores that represent the relative importance of each skill among all U.S. workers in 2000. We merge the O*Net abilities data to the Spanish labor force survey (i.e. Encuesta de Población Activa) by occupation. After properly weighting each occupation’s ability raw scores so as to reflect the importance of that particular ability in the Spanish labor force, we transform the ability scores into percentages to facilitate the interpretation of our findings. This is done by dividing each weighted ability score by the maximum score of the ability in question in other occupations. As such, each final ability score ranges between 0 and 1 and is indicative of the relative importance of that

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5 They use version 11.0 of the survey, available at: http://www.onetcenter.org/
6 The O*NET, initiated in the year 2000, rates the importance of 52 employee abilities –to which we refer to as tasks in this paper– in each occupation in the Standard Occupation Classification (SOC).
7 U.S. 2000 Census codes in the O*Net dataset are first matched to the International Standard Classification of Occupations (ISCO88) using a crosswalk made available by the Centre for Longitudinal Studies in the U.K. at: http://www.cls.ioe.ac.uk/text.asp?section=00010001000500160002. Subsequently, the Spanish occupation codes (CNO94) are matched to ISCO88 codes. Finally, both datasets (the O*Net abilities and the Spanish labor force survey) are then merged using the ISCO88 classification.
particular task in the occupation at hand—as opposed to in other occupations in the Spanish labor force survey.⁸

Using the ability scores in question, we construct two measures of manual and interactive skills. As Peri and Sparber (2008), we have a somehow restrictive definition of manual skills that comprises the following skills: “Limb, Hand, and Finger Dexterity”, “Body Coordination and Flexibility”, and “Strength”, as well as an extended measure of manual skills that adds “Sensory and Perception” abilities to the aforementioned skill categories. Likewise, our restrictive measure of interactive skills includes measures of oral and written expression and comprehension, whereas the extended measure adds “Cognitive and Analytical” and “Vocal” abilities.⁹

Table 5 displays the restrictive manual and interactive task summary measures for each of the 2-digit ISCO88 occupations included in our analysis. As it would be expected, high skill occupations with lower classification codes in Table 5 have a greater content of interactive tasks and a smaller content of manual tasks than low skill occupations with higher codes. In contrast, low skill occupations in Table 5 on average display a greater content of manual, as compared to interactive, tasks than the high skill occupations in Table 5. As such, the relative manual content (i.e. manual/interactive task ratio) of managers and professionals in categories no. 12, 13, 21, 24 and 34 are amongst the lowest. Table 5 also displays the share of foreign-born workers employed in each of the occupations, which is the largest for three occupations with the highest relative manual content, i.e. agricultural, fishery and related laborers, sales and service workers, and laborers in mining, construction, manufacturing and transportation.

We acknowledge the arbitrary choices that one makes when trying to assign the O*NET skill variables into a manual vs. interactive task category; hence, we also carry out the analysis using the more extended measures of manual and interactive skills.⁹
3.3. **Comparative Advantages in the Relative Manual Task Provision by Nativity**

Evidence of our assumption of a greater comparative advantage in the provision of manual as opposed to interactive tasks by immigrants is provided by Figure 4, which plots the relative manual content of the jobs performed by less educated immigrants and natives using the more restrictive measure discussed in Section 3.2.\(^\text{10}\) It is worth noting that immigrants with a secondary education or less take jobs with a greater manual, relative to interactive, component as compared to similarly educated natives. Further support for the higher manual to interactive intensity of job tasks performed by immigrants as compared to natives with a similar educational attainment is provided in Figure 5. Each dot is a (province, year) cell, i.e. our unit of observation in the empirical analysis. Specifically, each dot provides a measure of the relative manual to interactive intensity of tasks carried out by immigrants as compared to natives in those Spanish provinces with more than the average share of less educated immigrant workers in each of the years being plotted, i.e. over 2.5 percent for the entire 1999-2007 period. Overall, most points lie above the 45-degree line, thus indicating that, for high immigrant-receiving regions, the ratio of manual to interactive tasks in jobs performed by the foreign-born exceeds that of jobs performed by similarly educated natives.

3.4. **Comparative Advantages in the Relative Manual Task Provision by Gender**

As noted earlier, the immigration shock in Spain has coincided with a notable growth in native women’s employment rates between 1999 and 2007, even among less educated women. Figure 6 shows the evolution of male and female employment rates among less educated workers in our sample. Over the time period under consideration, employment rates for less educated women rose by an average of 5 percentage points while those of similarly educated men remained practically constant.

\(^{10}\) Figures using the more extended measure are available from the authors upon request. Similar features emerge.
More importantly, women have primarily occupied jobs with lower relative manual task content. Indeed, regardless of the task measure being used, Figure 7 indicate that, during the time period under consideration, native women with a secondary education or less have been taking jobs with a significantly lower manual, relative to interactive component as compared to similarly educated men. Further support for the higher manual to interactive intensity of job tasks performed by native men as compared to native women with a similar educational attainment is provided in Figure 8. As in Figure 5, each dot provides a measure of the relative manual to interactive intensity of tasks carried out by native men as compared to native women in each province with more than the average share of less educated native female workers in each of the years being plotted. Regardless of the measure used for the relative manual content of job tasks, most points lie below the 45-degree line. Hence, for regions with above average shares of native female workers, the ratio of manual to interactive tasks in jobs performed by native men exceeds that of jobs performed by similarly educated native women. Overall, Figure 7 and Figure 8 suggest that, along with the increase in the relative manual task supply provided by foreign-born workers, Spain may have also witnessed a significant reduction in the relative manual task supply provided by native female workers.

4. Methodology and Results

Figures 4, 5, 7 and 8 provide evidence of the greater relative supply of manual tasks by immigrants compared to natives, as well as of the greater relative supply of interactive tasks by native females compared to native males –both central assumptions to the model. We now proceed to testing the hypotheses derived from the model.

4.1. Immigration and the Relative Task Provision by Natives

Hypotheses no. 1 predicts that the equilibrium relative supply of manual tasks by less educated natives decreases as the share of foreign-born rises. To test hypothesis no.1, we
collapse our data into region-time cells using data from 52 Spanish provinces from 9 years, i.e. from 1999-2007, and transform equation (14) into the following regression equation:

\[
\ln \left( \frac{M}{T} \right)_{n,pt} = \alpha_p + \delta_t + \eta_n (\text{Share}_{\text{foreign}})_{pt} + \lambda_n (\text{share}_{\text{nativefem}})_{pt} + \epsilon_{pt}
\]

where \( \alpha_p \) stands for the region (i.e. province) fixed-effects and \( \delta_t \) for the year fixed-effects. Additionally, equation (16) includes information on workers’ personal characteristics (i.e. four age group dummies and a secondary-education dummy) to avoid potential spurious correlations between the two supply shocks and the provision of manual to non-manual tasks by natives.\(^{11}\)

Equation (16) examines the impact of the two supply shocks –the increase in the share of foreign born and the increase in the share of native females– on the provision of relative manual tasks by less educated natives in the economy. If natives specialize in occupations requiring fewer manual, as opposed to interactive, tasks as the share of foreign-born and native women increase, then, the coefficients \( \eta_n \) and \( \lambda_n \) should be negative and statistically different from zero as predicted by hypothesis no.1.

To address any potential endogeneity between the relative supply of manual tasks by less educated natives and the two supply shocks, we re-estimate equation (16) instrumenting the share of low-educated foreign-born and female workers. To instrument the share of low-educated foreign-born workers, we use the share of low-educated long-term immigrants –a group excluded from our sample object of analysis to ensure that immigrants in our sample significantly differ in their Spanish human capital from natives. We base our instrument choice for the share of foreign-born workers on previous studies in the literature that show

\(^{11}\) Results are qualitatively the same to those derived from: (a) regressing each individual’s task supply on a set of age and education dummies to compute the predicted task supply, (b) subtracting the predicted task supply from the individual’s observed task supply to get the “cleaned” residuals, and (c) using the “cleaned” residuals to compute the manual and interactive task supply measures employed in the final regression analysis. We prefer this other method because it relies on the same exact manual and interactive skill measures already displayed in Table 5.
that settlement patterns of previous immigrants are a main determinant of immigrants’ location choices (e.g. Card 2001, Cortes 2006, Lewis 2003, Ottaviano and Peri 2006, Peri 2006, Saiz 2003, and Peri and Sparber 2008, among other ones, for similar strategies). Our instrument is strongly correlated to the share of foreign-born workers. Regardless of the task measure being used as the dependent variable, the first stage regressions from the two-stage instrumental variable estimation procedures yield coefficients that are statistically significant at the 1 percent level.\footnote{First-stage results are available from the authors upon request.}

The share of low-educated female workers is instrumented using information on the fraction of university-educated natives who are female – a group excluded from the analysis. Our choice of instrument is based on the fact that the increase in female labor force participation has occurred simultaneously and has been possibly enhanced by the increased educational attainment of native women. Therefore, using the fraction of university-educated natives who are female proves to be a good instrument owing to its high correlation with the share of female native workers. Indeed, regardless of the task measure being used as the dependent variable, the first stage regressions from the two-stage instrumental variable estimation procedures yield coefficients that are statistically significant at the 1 percent level.

Table 6 displays the results from estimating equation (16) using the two measures of the relative manual content of tasks performed by workers, the more restrictive as well as the extended measure. The figures in the first row of Table 6 help confirm our first hypothesis, that is, the fact that the relative supply of manual versus interactive tasks among natives generally decreases as the shares of foreign-born and native female workers rise.\footnote{The exception is the lost significance of the native female shock when using the first (more restrictive) task measure and the IV methodology.} Of particular interest to us given the purpose of this study is the impact of an increase in the share of foreign-born workers on the native task supply. As predicted by hypothesis 1a) in the appendix, such an increase clearly reduces the manual to interactive task content of jobs
held by both native men and native women regardless of the task measure or estimation method (OLS vs. IV) being used. A 5-percentage point increase in the share of foreign-born workers –similar to the one observed in Figure 2 for the 1999-2007 period and for the sample under consideration– lowers the native supply of manual to interactive tasks by approximately 2.5 percent.\(^\text{14}\) The impact appears to be similar among native men and a bit larger among native women, whose relative manual task supply drops by approximately 3.5 to 4 percent, depending on the task measure being used.

4.2. The Relative Task Provision of Manual Tasks in the Economy following Increases in the Shares of Foreign-Born and Native Female Workers

We now turn to the overall economy and examine the impact of both, an increase in the share of foreign-born and native female workers, on the supply of manual as opposed to interactive tasks. According to hypothesis no.2, the relative provision of manual tasks in the economy could remain unchanged, increase or decrease depending on which of the two supply shocks prevail. To look at it from an empirical perspective, we transform equation (15) to derive the following regression equation:

\[
\ln \left( \frac{M}{T} \right)_{pt} = \alpha_p + \delta_i \eta (Share\_foreign)_{pt} + \lambda (Share\_nativelfem)_{pt} + \varepsilon_{pt} \quad (17)
\]

Note that, in accordance to their comparative advantages and as specified in greater detail in the appendix, an increase in foreign-born workers is expected to increase the manual to interactive task supply in the economy, whereas an increase in the share of native female workers is predicted to do exactly the opposite. Unlike in the case of just natives, where both shocks are expected to lower the manual to interactive task supply of all natives –on the one hand immigrants have a comparative advantage in manual tasks as opposed to natives and, on

\(^\text{14}\) As a reference, it is worth noting that Peri and Sparber find that a 10 percentage-point increase in the share of less-educated foreign-born workers is associated with a 2 percent decline in the relative supply of manual versus interactive tasks among natives. As such, the rapid immigration growth experienced by the Spanish economy within a period of two decades appears to have had a much stronger impact than in the U.S.
the other hand, the entry of native women who tend to occupy jobs less intensive in manual tasks, reduces the overall native supply of manual to interactive tasks—here the two shocks have opposing signs. As a result, it is difficult to assess how the overall supply of manual to interactive tasks in the economy will change following both shocks due to their opposite signs.

The bottom panel of Table 6 displays the results from estimating equation (17) by OLS as well as using IV methods correcting for the endogeneity of our two key regressors as we did in the estimation of equation (16). In general, we find no clear evidence of significant impacts of increases in neither the share of foreign-born nor the share of native female workers on the relative task supply of the overall economy. Yet, it is possible that, due to their simultaneous nature, both shocks cancel each other out, forbidding us to see the individual impact of each shock on the manual to interactive task supply in the economy.

To partially address this problem, we try to control for the size of the increase in any given share when looking at the impact of the other one by interacting both supply shocks. Results are displayed in Table 7. Regardless of the task measure or methodology being used, the interaction term is negative, thus reflecting the different impact that each shock has on the relative manual to interactive supply of tasks in the overall economy. What is, however, the impact of an increase in the share of foreign-born workers on the economy’s relative manual to interactive task supply? Using the IV results from the more restrictive task measure, a 5-percentage point increase in the share of foreign-born workers raises the relative manual to interactive task supply in the economy by 0.85 percent ((1.58 – 3.97*0.355)*5).15 Likewise, using the broader task measure, the IV estimates indicate that a 10 percentage point increase

15 Note that, because of the interaction term, we cannot simply look at the coefficient for the share of foreign-born and conclude that, because it is not significantly different from zero, an increase in the share of foreign-born workers has no impact on the relative manual to interactive task supply of the economy. Instead, and because the coefficient on the share of foreign-born and the interaction term are jointly different from zero, we need to take into account what the impact of an increase in the share of foreign-born workers would be at the mean of the share of native female workers as indicated above.
in the share of foreign-born workers raises the manual to interactive task supply in the
economy by 0.7 percent \((1.37 -3.48*0.355)*5\). Hence, as predicted by hypothesis 2a in the
appendix, an increase in the share of foreign-born workers raises the manual to interactive
task supply of the Spanish economy.

What about an increase in the share of native female workers? Do native women
lower the manual to interactive task supply of the economy due to their comparative
advantage in non-manual tasks? The answer is yes. As predicted by hypothesis 2b) in the
appendix, a 5 percentage-point increase in the share of native female workers –similar to the
one experienced between 1999 and 2007– lowers the manual to interactive task supply in the
economy anywhere between 0.2 percent and 1.5 percent.

5. Conclusions

Learning about the impact that immigration has on the labor market of the receiving
nation is a topic of major concern to economists given the ever growing percentage of the
world population living in a country other than her own. Spain is no exception following the
rapid increase in immigrant flows experienced over the past decade. While there is a large
and growing literature on the consequences of migration on the wages of native workers in
the U.S., very little is known about the impact of migration on the employment patterns and
wages of Spanish natives. Furthermore, the literature has generally failed to document a
significant effect of immigration on the wages of less-educated natives, both in the U.S. as
well as in Spain. As recently noted by Ottaviano and Peri (2006), this is not surprising given
that the effect of immigration depends on the degree of substitution between native and
immigrant workers within each education group. If native and immigrant workers of similar
educational attainment posses productive skills that lead them to specialize in different
occupations, it is reasonable to find a small or null impact of immigration on natives’ wages
as immigrants and natives are not competing for the same jobs. As such, the assumption of
perfect substitutability between native and immigrant labor may not be a reasonable one to make. In this vein, some studies (e.g. Dustmann, Frattini and Preston (2008)) have shown that natives and immigrants in the U.K. of comparable skills do not compete for the same jobs, which can help explain the lack of a significant impact of immigration on native wages.  

With the purpose of gaining a better understanding of the impact of recent immigration inflows on the Spanish economy, we first empirically assess the degree of substitution between native and immigrant workers of comparable educational attainment. Subsequently, we proceed to examining the implication that the increase in the share of foreign-born may have had on the manual to interactive task supply of (a) Spanish natives and of (b) the Spanish economy. This type of analysis has previously been performed by Peri and Sparber (2008) for the U.S. In addition to our focus on Spain, our study differs from theirs in that we also take into account the simultaneous increase in the share of native female workers experienced by the Spanish economy during the time period under consideration. This twist is crucial, not just because of the magnitude of the increase in the native female labor supply itself, but because native women display different comparative advantages with regards to manual as opposed to interactive tasks than native men and immigrants. Therefore, failure to account for their massive entry into the labor market could significantly bias our findings.  

Using data from the 1999 through 2007 Encuesta de Población Activa (EPA), we find evidence of immigrant and native workers of similar skill levels being employed in different occupations, hinting on the fact that native and foreign-born workers may not compete for the same jobs. Thus, using a variant of the model proposed by Peri and Sparber (2008) in their analysis of the impact of immigration on the U.S. labor market, we look for an explanation of the impact that recent immigration inflows have had on the Spanish labor market. We find that the increase in the share of foreign-born workers experienced by the Spanish economy
may have resulted in the relocation of natives to jobs with a lower intensity of manual (as opposed to interactive) tasks. Indeed, the 5 percentage-point increase in the share of foreign-born workers over the 1999-2007 period appears to have lowered the native relative manual task supply by approximately 2.5 percent. This relocation may have been intensified by the massive entry of native women, who display a clear comparative advantage in interactive, as opposed to manual, tasks.

How have the increase in the share of foreign-born and native female workers impacted the manual to interactive task supply in the overall economy? We find that this is a harder question to answer due to the predicted opposite effects of these two supply shocks on the manual to interactive task supply of the economy. In particular, the increase of 5 percentage-points in the share in foreign-born workers over the time period under consideration may have raised the manual to interactive task supply of the economy anywhere between 0.7 (using the broader task measure) and 0.85 percent (using the more restrictive task measure). In contrast, the 5 percentage-points increase in the share of native female workers may have helped lowered it between 0.2 (using the more restrictive task measure) and 1.5 percent (using the broader task measure).
Appendix – Proofs of Hypotheses 1 and 2

1. Hypothesis no.1: \( d(m)^* = \frac{\partial (m)^*}{\partial f} df + \frac{\partial (m)^*}{\partial g} dg < 0 \)

1.a. \( \frac{\partial (m)^*}{\partial f} < 0 \)

Consider the equilibrium provision of relative tasks supplies offered by natives – eq. (14):

\[
m^*_n = \left( \beta_l \right) \frac{e_m \left( f, g, \alpha \left( \beta_l \right) \right)}{1 - \beta_l} \left[ e_m \left( \gamma, \lambda, \alpha \left( \beta_l \right) \right) \right]
\]

If we take the partial derivative with respect to \( f \):

\[
\frac{\partial (m)^*}{\partial f} = B E_2 \rho E_1 \rho^{-1} \frac{\partial E_1}{\partial g} = \left( \frac{\beta_l}{1 - \beta_l} \right) \left( \frac{-\alpha}{(1 - \alpha) + \alpha} \right) e_m \left( \gamma, \lambda, \alpha \left( \beta_l \right) \right) \frac{1}{\gamma} < 0
\]

1.b. \( \frac{\partial (m)^*}{\partial g} < 0 \)

\[
\frac{\partial (m)^*}{\partial g} = B \left[ E_2 \rho E_1 \rho^{-1} \frac{\partial E_1}{\partial g} + E_1 \rho E_2 \rho^{-1} \frac{\partial E_2}{\partial g} \right]
\]

Given that \( \rho < 0 \), and \( \frac{\partial E_1}{\partial g} < 0 \), \( \frac{\partial E_2}{\partial g} < 0 \), the partial derivative is negative if:

\[
E_1 \rho E_2 \rho^{-1} \frac{\partial E_2}{\partial g} > E_2 \rho E_1 \rho^{-1} \frac{\partial E_1}{\partial g}
\]

or:

\[
E_1 \rho E_2 \rho^{-1} \frac{\partial E_2}{\partial g} > 1 \quad \frac{\partial E_2}{\partial g} \frac{\partial E_1}{\partial g}
\]

However, it is immediate to see that the above inequality is satisfied if we take into account that: \( E_1 > E_2 \), \( |\ell| > |\rho| \) and \( \left| \frac{\partial E_2}{\partial g} \right| > \left| \frac{\partial E_1}{\partial g} \right| \).
2. **Hypothesis no. 2:**

\[ d(m) = \frac{\partial (m)^*}{\partial f} df + \frac{\partial (m)^*}{\partial g} dg \leq \text{or} \geq 0 \]

Consider equation (15), i.e.:

\[
m^* = \beta_l \frac{\alpha_l}{1 - \beta_l} \frac{(1 - \alpha) \lambda + \alpha}{B} \left[ \begin{array}{c}
\frac{\lambda (1 - \alpha)^2}{(1 - \alpha) \lambda + \alpha} E_3 \frac{\lambda (1 - \alpha)^2}{(1 - \alpha) \lambda + \alpha} \left( \frac{\partial E_3}{\partial f} \right)_+ \\

\end{array} \right]
\]

2a. \( \frac{\partial (m)^*}{\partial f} > 0 \)

\[
\frac{\partial (m)^*}{\partial f} = B \frac{\lambda (1 - \alpha)^2}{(1 - \alpha) \lambda + \alpha} \left( E_3 \frac{\lambda (1 - \alpha)^2}{(1 - \alpha) \lambda + \alpha} \left( \frac{\partial E_3}{\partial f} \right)_+ > 0 \right)
\]

2b. \( \frac{\partial (m)^*}{\partial g} < 0 \)

\[
\frac{\partial (m)^*}{\partial g} = B \frac{\lambda (1 - \alpha)^2}{(1 - \alpha) \lambda + \alpha} \left( E_3 \frac{\lambda (1 - \alpha)^2}{(1 - \alpha) \lambda + \alpha} \left( \frac{\partial E_3}{\partial g} \right)_- < 0 \right)
\]
References


## Table 1
Descriptive Statistics - Natives and Immigrants (1999-2007)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Native Men</th>
<th>Native Women</th>
<th>Recent Immigrants</th>
<th>All Immigrants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Age</td>
<td>40.23</td>
<td>38.6</td>
<td>33.1</td>
<td>35.3</td>
</tr>
<tr>
<td>Distribution by age categories (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;30 years</td>
<td>25.3</td>
<td>25.9</td>
<td>44.1</td>
<td>36.08</td>
</tr>
<tr>
<td>31-35 years</td>
<td>12.5</td>
<td>13.7</td>
<td>19.4</td>
<td>19.2</td>
</tr>
<tr>
<td>36-40 years</td>
<td>13.3</td>
<td>14.4</td>
<td>14.7</td>
<td>16.6</td>
</tr>
<tr>
<td>41-45 years</td>
<td>13.6</td>
<td>14.1</td>
<td>10.2</td>
<td>11.8</td>
</tr>
<tr>
<td>&gt;45 years</td>
<td>35.2</td>
<td>28.8</td>
<td>11.6</td>
<td>16.3</td>
</tr>
<tr>
<td>Percentage Female (%)</td>
<td>38.8</td>
<td>45.5</td>
<td>42.9</td>
<td></td>
</tr>
<tr>
<td>Education (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary or Less</td>
<td>24.8</td>
<td>18.0</td>
<td>23.09</td>
<td>25.9</td>
</tr>
<tr>
<td>Secondary</td>
<td>51.0</td>
<td>46.8</td>
<td>55.04</td>
<td>52.05</td>
</tr>
<tr>
<td>University</td>
<td>24.1</td>
<td>35.2</td>
<td>21.04</td>
<td>21.9</td>
</tr>
<tr>
<td>Average Hourly Log Wage</td>
<td>7.13</td>
<td>6.30</td>
<td>(*)</td>
<td>4.83</td>
</tr>
<tr>
<td></td>
<td>(4.20)</td>
<td>(3.97)</td>
<td></td>
<td>(2.96)</td>
</tr>
<tr>
<td>Observations (in Spanish CPS)</td>
<td>353,797</td>
<td>223,675</td>
<td>12,324</td>
<td>19,167</td>
</tr>
</tbody>
</table>

Note: Working individuals between 16 and 65 years of age. The sample of recent immigrants contains immigrants whose length of stay in Spain is at most 5 years. All features are taken from the Spanish Current Population Sample, except for Average Wages, which are taken from a pooled sample of 2004-2006 European Survey of Living Conditions for Spain. (*) We cannot report average wages of recent immigrants because the EU-SILC does not contain information on the length of stay of immigrants in Spain.
Table 2
Occupational Distribution (%) – Non-University Natives and Immigrants (1999-2007)

<table>
<thead>
<tr>
<th>Occupations</th>
<th>Native Men</th>
<th>Native Women</th>
<th>Recent Immigrants</th>
<th>All Immigrants</th>
<th>Average Hourly Log Wage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managers</td>
<td>8.32</td>
<td>8.01</td>
<td>1.4</td>
<td>3.5</td>
<td>8.41</td>
</tr>
<tr>
<td>Professionals</td>
<td>0.53</td>
<td>0.65</td>
<td>0.3</td>
<td>0.5</td>
<td>9.97</td>
</tr>
<tr>
<td>Technicians and Assoc. professionals</td>
<td>7.18</td>
<td>8.10</td>
<td>1.8</td>
<td>2.6</td>
<td>7.41</td>
</tr>
<tr>
<td>Clerical support workers</td>
<td>5.18</td>
<td>13.69</td>
<td>2.1</td>
<td>2.7</td>
<td>6.70</td>
</tr>
<tr>
<td>Service and sales workers</td>
<td>10.61</td>
<td>30.39</td>
<td>19.3</td>
<td>19.4</td>
<td>5.08</td>
</tr>
<tr>
<td>Skilled agricultural/fishery workers</td>
<td>7.04</td>
<td>3.97</td>
<td>2.2</td>
<td>2.2</td>
<td>4.62</td>
</tr>
<tr>
<td>Craft and related trade workers</td>
<td>30.34</td>
<td>4.62</td>
<td>19.6</td>
<td>20.2</td>
<td>5.57</td>
</tr>
<tr>
<td>Plant/machine operators and assemblers</td>
<td>17.24</td>
<td>5.22</td>
<td>5.5</td>
<td>6.6</td>
<td>6.21</td>
</tr>
<tr>
<td>Elementary Occupations</td>
<td>13.55</td>
<td>25.36</td>
<td>47.7</td>
<td>42.4</td>
<td>4.74</td>
</tr>
<tr>
<td>N. observations</td>
<td>268,410</td>
<td>144,905</td>
<td>9683</td>
<td>14800</td>
<td></td>
</tr>
</tbody>
</table>

Note: The Occupational Distribution is taken from a Pooled sample of 1999-2007 Current Population Survey. Data on average Hourly wage are taken from the 2004-2006 EU-SILC survey for Spain. Natives are of all working-age individuals with less than a university education. Recent Immigrants include only those with at most 5 years of stay in Spain.
Table 3
Occupational Distribution (%) of Natives and Immigrants by Educational Level

<table>
<thead>
<tr>
<th></th>
<th>Secondary</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Primary or less</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Native Men</td>
<td>Native Women</td>
<td>Recent Immigrant</td>
<td>All Immigrants</td>
<td>Native Men</td>
<td>Native Women</td>
<td>Recent Immigrant</td>
<td>All Immigrants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managers</td>
<td>8.41</td>
<td>6.78</td>
<td>1.6</td>
<td>3.8</td>
<td>8.15</td>
<td>11.19</td>
<td>1.1</td>
<td>2.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professionals</td>
<td>0.73</td>
<td>0.84</td>
<td>0.4</td>
<td>0.7</td>
<td>0.13</td>
<td>0.16</td>
<td>0.0</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technicians and professionals</td>
<td>9.45</td>
<td>10.49</td>
<td>2.3</td>
<td>3.6</td>
<td>2.53</td>
<td>1.88</td>
<td>0.5</td>
<td>0.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clerical support workers</td>
<td>6.59</td>
<td>17.48</td>
<td>2.5</td>
<td>3.4</td>
<td>2.29</td>
<td>3.82</td>
<td>1.06</td>
<td>1.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service and sales workers</td>
<td>12.08</td>
<td>33.61</td>
<td>22.2</td>
<td>22.6</td>
<td>7.61</td>
<td>22.00</td>
<td>12.3</td>
<td>12.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skilled agricultural/fishery workers</td>
<td>4.73</td>
<td>1.99</td>
<td>2.05</td>
<td>1.8</td>
<td>11.79</td>
<td>9.13</td>
<td>2.7</td>
<td>3.02</td>
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<td></td>
</tr>
<tr>
<td>Craft and related trade workers</td>
<td>28.96</td>
<td>4.26</td>
<td>19.6</td>
<td>19.5</td>
<td>33.17</td>
<td>5.53</td>
<td>19.5</td>
<td>21.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant/machine operators and assemblers</td>
<td>16.94</td>
<td>5.39</td>
<td>6.03</td>
<td>6.7</td>
<td>17.86</td>
<td>4.78</td>
<td>4.12</td>
<td>5.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary Occupations</td>
<td>12.12</td>
<td>19.15</td>
<td>43.2</td>
<td>37.7</td>
<td>16.47</td>
<td>41.51</td>
<td>58.5</td>
<td>52.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The Occupational Distribution is taken from a Pooled sample of 1999-2007 Current Population Survey. Data on average Hourly wage are taken from the 2004-2006 EU-SILC survey for Spain. Natives are of all working-age individuals with less than a university education. Recent Immigrants include only those with at most 5 years of stay in Spain.
<table>
<thead>
<tr>
<th>Skills</th>
<th>Native Men</th>
<th>Native Women</th>
<th>All Immigrants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Log</td>
<td>Distribution</td>
<td>Mean Log</td>
</tr>
<tr>
<td></td>
<td>Wage (%)</td>
<td>across Skills</td>
<td>Wage (%)</td>
</tr>
<tr>
<td>&lt;30, Primary or less</td>
<td>1.41 (.57)</td>
<td>4.14</td>
<td>1.07 (.84)</td>
</tr>
<tr>
<td>&lt;30, Secondary</td>
<td>1.46 (.58)</td>
<td>23.11</td>
<td>1.26 (.61)</td>
</tr>
<tr>
<td>31-35, Primary or less</td>
<td>1.60 (.44)</td>
<td>2.33</td>
<td>1.31 (.65)</td>
</tr>
<tr>
<td>31-35, Secondary</td>
<td>1.74 (.42)</td>
<td>9.62</td>
<td>1.48 (.55)</td>
</tr>
<tr>
<td>36-40, Primary or less</td>
<td>1.66 (.46)</td>
<td>2.81</td>
<td>1.30 (.67)</td>
</tr>
<tr>
<td>36-40, Secondary</td>
<td>1.78 (.50)</td>
<td>11.51</td>
<td>1.53 (.60)</td>
</tr>
<tr>
<td>41-45, Primary or less</td>
<td>1.60 (.50)</td>
<td>3.81</td>
<td>1.40 (.56)</td>
</tr>
<tr>
<td>41-45, Secondary</td>
<td>1.87 (.47)</td>
<td>11.01</td>
<td>1.56 (.62)</td>
</tr>
<tr>
<td>&gt;45, Primary or less</td>
<td>1.73 (.48)</td>
<td>13.87</td>
<td>1.40 (.59)</td>
</tr>
<tr>
<td>&gt;45, Secondary</td>
<td>1.94 (.50)</td>
<td>17.80</td>
<td>1.68 (.54)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Occupations (ISCO88 code)</th>
<th>Manual</th>
<th>Interactive</th>
<th>Ratio Manual/Interactive</th>
<th>No. of Workers</th>
<th>Share of Foreign-born (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. Corporate Managers</td>
<td>0.49</td>
<td>0.99</td>
<td>0.49</td>
<td>9912</td>
<td>0.2</td>
</tr>
<tr>
<td>13. Managers of Small Enterprises</td>
<td>0.49</td>
<td>0.94</td>
<td>0.52</td>
<td>24168</td>
<td>0.4</td>
</tr>
<tr>
<td>21. Physics, Mathematics and Engineering Science Professionals</td>
<td>0.47</td>
<td>0.93</td>
<td>0.50</td>
<td>309</td>
<td>0.3</td>
</tr>
<tr>
<td>22. Life Science and Health Professional</td>
<td>0.57</td>
<td>0.96</td>
<td>0.59</td>
<td>71</td>
<td>1.4</td>
</tr>
<tr>
<td>23. Teaching Professionals</td>
<td>0.54</td>
<td>0.94</td>
<td>0.57</td>
<td>1145</td>
<td>1.4</td>
</tr>
<tr>
<td>24. Other Professionals</td>
<td>0.47</td>
<td>0.98</td>
<td>0.48</td>
<td>887</td>
<td>1.3</td>
</tr>
<tr>
<td>31. Physical and Engineering Science Associated Professionals</td>
<td>0.67</td>
<td>0.87</td>
<td>0.77</td>
<td>4382</td>
<td>0.6</td>
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<tr>
<td>32. Life Science and Health Professionals</td>
<td>0.67</td>
<td>0.91</td>
<td>0.73</td>
<td>1467</td>
<td>0.5</td>
</tr>
<tr>
<td>33. Teaching Associated Professionals</td>
<td>0.48</td>
<td>0.85</td>
<td>0.56</td>
<td>574</td>
<td>0.5</td>
</tr>
<tr>
<td>34. Other Associated Professionals</td>
<td>0.48</td>
<td>0.94</td>
<td>0.51</td>
<td>24756</td>
<td>0.5</td>
</tr>
<tr>
<td>41. Office Clerks</td>
<td>0.53</td>
<td>0.87</td>
<td>0.60</td>
<td>16598</td>
<td>0.3</td>
</tr>
<tr>
<td>42. Customer Services Clerks</td>
<td>0.53</td>
<td>0.89</td>
<td>0.59</td>
<td>17344</td>
<td>0.8</td>
</tr>
<tr>
<td>51. Personal and Protect. Service Workers</td>
<td>0.71</td>
<td>0.84</td>
<td>0.84</td>
<td>48376</td>
<td>3.2</td>
</tr>
<tr>
<td>52. Models, Salespersons and Demonstrators</td>
<td>0.66</td>
<td>0.78</td>
<td>0.84</td>
<td>26012</td>
<td>1.1</td>
</tr>
<tr>
<td>61. Skilled Agriculture and Fishery Workers</td>
<td>0.86</td>
<td>0.72</td>
<td>1.18</td>
<td>24878</td>
<td>0.8</td>
</tr>
<tr>
<td>71. Extraction and Building Trades Workers</td>
<td>0.87</td>
<td>0.66</td>
<td>1.32</td>
<td>47508</td>
<td>2.6</td>
</tr>
<tr>
<td>72. Metal, Machinery and Related Trade Workers</td>
<td>0.86</td>
<td>0.269</td>
<td>1.24</td>
<td>998</td>
<td>0.4</td>
</tr>
<tr>
<td>73. Precision, Handicraft, Craft Printing and Related Trade</td>
<td>0.80</td>
<td>0.62</td>
<td>1.30</td>
<td>33933</td>
<td>1.4</td>
</tr>
<tr>
<td>74. Other Craft and Related Trade Workers</td>
<td>0.80</td>
<td>0.59</td>
<td>1.35</td>
<td>7577</td>
<td>1.9</td>
</tr>
<tr>
<td>81. Stationary Plant and Related Operators</td>
<td>0.85</td>
<td>0.68</td>
<td>1.25</td>
<td>5170</td>
<td>1.9</td>
</tr>
<tr>
<td>82. Machine Operators and Assemblers</td>
<td>0.81</td>
<td>0.65</td>
<td>1.25</td>
<td>19976</td>
<td>1.0</td>
</tr>
<tr>
<td>83. Drivers and Mobile Plant Operations</td>
<td>0.86</td>
<td>0.72</td>
<td>1.18</td>
<td>29224</td>
<td>0.9</td>
</tr>
<tr>
<td>91. Sales and Services Elementary Operations</td>
<td>0.70</td>
<td>0.73</td>
<td>0.95</td>
<td>41916</td>
<td>5.8</td>
</tr>
<tr>
<td>92. Agricultural, Fishery and Related Labourers</td>
<td>0.92</td>
<td>0.58</td>
<td>1.56</td>
<td>9185</td>
<td>9.4</td>
</tr>
<tr>
<td>93. Labourers in Mining, Construction, Manufacturing and Transportation</td>
<td>0.86</td>
<td>0.82</td>
<td>1.49</td>
<td>26634</td>
<td>4.9</td>
</tr>
</tbody>
</table>
### Table 6
Impact of the Share of Foreign Born and of the Share of Native Women on the Supply of Tasks

| Dependent Variable (in Logs) | Task Measure 1 | | Task Measure 2 | | |
|-----------------------------|---------------|-----------------|-----------------|-----------------|
|                             | OLS IV        | OLS IV          | OLS IV          | OLS IV          | OLS IV          |
|                             | Share of Foreign-born | Share of Native Female Workers | Share of Foreign-born | Share of Native Female Workers | Share of Foreign-born | Share of Native Female Workers |
| All Natives                 | -0.33**       | -0.17**         | -0.22           | -0.29**         | -0.16**         | -0.48**         | -0.21* |
|                             | (0.09)        | (0.06)          | (0.18)          | (0.17)          | (0.09)          | (0.05)          | (0.16) |
| All Native Men              | -0.34**       | -0.07           | -0.20           | -0.30**         | -0.01           | -0.41**         | -0.18  |
|                             | (0.11)        | (0.06)          | (0.15)          | (0.19)          | (0.10)          | (0.05)          | (0.26) |
| All Native Women            | -0.44**       | -0.81**         | -0.40**         | -0.01           | -0.72**         | -         |        |
|                             | (0.15)        | (0.28)          | (0.14)          | (0.26)          |                  |            |        |

**Hypothesis 1:**

- **All Natives:** -0.33** (-0.09)  
- **All Native Men:** -0.34** (0.11)  
- **All Native Women:** -0.44** (0.15)  

**Hypothesis 2:**

- **All the Economy:** 0.05 (0.07)  
- **All Males:** 0.07 (0.10)  
- **All Women:** -0.06 (0.13)  

N. observations 468

**Notes:** *** indicates significant at the 1% level, ** indicates significant at the 5% level and * indicates significant at the 10% level. Each reported coefficient is the impact of the share of foreign-born or of the share of Native Female Workers on each of the dependent variables stated in the left column. For each Task Measure, the coefficients reported in each row are the result of different regressions. All regressions include a full set of region dummies (50) plus controls for time (7 dummies), average age and the proportion of workers with secondary education at cell level. All regressions are weighted by the cell (province, year) size and standard errors are corrected for clustering at cell level. The Instrument for the share of foreign-born in the IV regressions is the share of non-recent immigrants with more than five years of residence. The instrument for the share of native females is the share of native females among workers with university education excluded from our sample of study.
<table>
<thead>
<tr>
<th>Dependent Variable (in Logs)</th>
<th>OLS</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of Foreign-born</td>
<td>Share of Native Female Workers</td>
<td>Share of Foreign-born*Share Native Women</td>
</tr>
<tr>
<td>Task Measure 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Economy</td>
<td>1.73**</td>
<td>-0.10**</td>
</tr>
<tr>
<td></td>
<td>(0.51)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Task Measure 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Economy</td>
<td>1.54</td>
<td>-0.11**</td>
</tr>
<tr>
<td></td>
<td>(0.47)</td>
<td>(0.10)</td>
</tr>
<tr>
<td>N. observations</td>
<td>468</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** *** indicates significant at the 1% level, ** indicates significant at the 5% level and * indicates significant at the 10% level. Each reported coefficient is the impact of the share of foreign-born or of the share of Native Female Workers on each of the dependent variables stated in the left column. For each Task Measure, the coefficients reported in each row are the result of different regressions. All regressions include a full set of region dummies (50) plus controls for time (7 dummies), average age and the proportion of workers with secondary education at cell level. All regressions are weighted by the cell (province, year) size and standard errors are corrected for clustering at cell level. The Instrument for the share of foreign-born in the IV regressions is the share of non-recent immigrants with more than five years of residence. The instrument for the share of native females is the share of native females among workers with university education excluded from our sample of study.
Figure 1
Evolution of Employment Rate by Gender

Source: EPA – All individuals between 16-65 years. Employment rate is the ratio between the total employed and the total number of working age individuals.
Figure 2
Employment Rate of Low Educated Native Women and of Foreign-Born (%)

Source: EPA 1999-2007 – 2nd terms. The calculations are based on working individuals aged 16-65 with less than university education.
Figure 3
Distribution of Less Educated Immigrants and Native Women along
the Male Native Wage Distribution

Figure 4
Relative Manual to Interactive Task Supply by Native and Foreign-Born Workers

Figure 5
Relative Manual to Interactive Intensity of Native versus Immigrant Tasks

Note: Each dot represents a (province, year) cell for those Spanish provinces with at least 2.5 percent of foreign-born workers over the entire period.
Figure 6
Employment Rate of Low Educated Natives over the Sample Period

Source: EPA 1999-2007 – 2nd terms. The calculations are based on native individuals aged 16-65 with less than university education.
Figure 7
Relative Manual to Interactive Task Supply by Native Men and Women

Figure 8
Relative Manual to Interactive Intensity of Native Male and Female Tasks

Note: Each dot represents a (province, year) cell for those Spanish provinces with at least 2.5 percent of foreign-born workers over the entire period.