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Native Task Specialization in Spain**

by

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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 quadrupled 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 non-manual tasks, natives relocated to occupations with a lower content of manual tasks –such as technical and alike professional occupations, clerical support jobs, and sales and service occupations. Yet, possibly owing to the significant and simultaneous reduction in the manual to non-manual task supply resulting from the increase in the share of native female workers, the increase in the relative supply of manual to non-manual tasks from foreign-born workers does not appear to have significantly changed the overall manual to non-manual task supply in the Spanish economy.

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)). 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. We do so. First, we provide evidence of immigrants and natives being imperfect substitutes *within* skill categories. Subsequently, we proceed to examining some of the reasons as for why that may be the case. In particular, we explore whether immigration encourages native specialization in occupations that differ from those held by immigrants, thus explaining 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 did seem to relocate to jobs with a lower content of manual, as opposed to non-manual, tasks. Therefore, to conclude, we look more closely at the impact that immigration inflows may have had on the occupational distribution of natives in Spain. We find that, indeed, natives fled occupations with a higher content of manual as opposed to non-manual tasks –such as crafts and related trades, machine operations and assembly, or other low skilled jobs, as domestic help– for jobs with a lower content of manual tasks –such as technical and alike professional occupations, clerical support jobs, and sales and service occupations.

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 2 of the manuscript. In Section 4, we discuss our empirical methodology and preliminary findings and Section 5 concludes the paper.

2. Theoretical Model

We follow Peri and Sparber's (2008) general equilibrium model, according to which immigrants, compared to natives, have a comparative advantage in performing manual relative to non-manual tasks owing to their limited language proficiency and their often missing Spanish-specific human capital skills. Using that framework, we derive some

comparative statistics regarding the impact of immigration on native and immigrant occupational specialization.

2.1. The Demand Function

We start with an economy that produces, among other goods, one tradable good that we call Y , which only requires a low skilled intermediate input: Y_L .¹ 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 non-manual (NM) tasks. Manual tasks can be routine or non-routine in nature. Examples of manual tasks include body coordination and physical strength, whereas non-manual 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:

$$Y_L = [\beta_L M^{\frac{\lambda-1}{\lambda}} + (1-\beta_L) NM^{\frac{\lambda-1}{\lambda}}]^{\frac{\lambda}{\lambda-1}} \quad (2)$$

where β_L measures the productivity of manual versus non-manual tasks in the production of Y_L and λ captures the elasticity of substitution between manual and non-manual tasks. Profit maximization in a competitive market then yields the following relative demand function for manual versus non-manual tasks:

$$\frac{M}{NM} = \left(\frac{\beta_L}{1-\beta_L} \right)^{\lambda} \left(\frac{w_M}{w_{NM}} \right)^{-\lambda} \quad (3)$$

where w_M and w_{NM} are the compensations paid for each unit of manual and non-manual task, respectively.

2.2. Immigrant and Native Task Supplies

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

¹ For simplicity, we focus on low skilled goods given that competition among natives and immigrants is more likely to occur in low-skilled jobs. Therefore, we are implicitly assuming that high-skilled goods are produced by high skilled natives.

immigrants within skill cell, we assume that less educated natives and immigrants differ in their comparative advantage in manual versus non-manual tasks. Specifically, immigrants have, relative to natives, a comparative advantage in performing manual (whether they are routine or non-routine), as opposed to non-manual or interactive, tasks. This is a reasonable assumption given that, unlike manual tasks, non-manual tasks require the usage of interactive skills that 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 e_M and e_{NM} as the efficiency in manual and non-manual tasks of native and immigrant

workers, the stated assumption implies that: $\left(\frac{e_M}{e_{NM}}\right)_i > \left(\frac{e_M}{e_{NM}}\right)_N$, where the subscripts i and n refer to immigrants and natives, respectively.

Now consider a representative worker j , who dedicates his/her work time (e.g. one unit) to perform manual and non-manual 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 non-manual tasks so as to maximize his/her labor income (W_{Lj}):

$$W_{Lj} = (s_M)^\alpha m_j w_M + (1 - s_M)^\alpha nm_j w_{NM} \quad (4)$$

where m_j and nm_j refer to the work time each worker dedicates to manual and non-manual tasks, respectively. The superscript α (where: $\alpha < 1$) reflects decreasing returns from performing either manual or non-manual tasks –which guarantees that workers do not completely specialize in performing one particular type of tasks. Maximization of equation (4) with respect to s_M yields the equilibrium relative supply of manual versus non-manual tasks, which is directly related to the relative task compensation and to the worker relative efficiency in performing manual versus non-manual tasks (e_{mj}/e_{nmj}):

$$\frac{\eta_{mj}}{\eta_{nmj}} = \left(\frac{w_m}{w_{nm}}\right)^{\frac{\alpha}{1-\alpha}} \left(\frac{e_{mj}}{e_{nmj}}\right)^{\frac{1}{1-\alpha}} \quad (5)$$

2.3. The Equilibrium Relative Provision of Manual versus Non-manual Tasks

In order to find the equilibrium relative provision of manual and non-manual tasks, we need to aggregate equation (5) across all workers to obtain the market relative supply of manual versus non-manual tasks:

$$\frac{M}{NM} = \left(\frac{w_m}{w_{nm}} \right)^{\frac{\alpha}{1-\alpha}} \left(\frac{e_{mj}}{e_{nmj}} \right)^{\frac{1}{1-\alpha}} \quad (6)$$

Using equations (6) and (3), we can solve for the equilibrium provision of manual versus non-manual tasks and for the equilibrium relative task compensation:

$$\frac{M^*}{NM^*} = \left(\frac{\beta_L}{1-\beta_L} \right)^{\frac{\alpha\lambda}{(1-\alpha)\lambda+\alpha}} \left(\frac{e_M}{e_{NM}} \right)^{\frac{\lambda}{(1-\alpha)\lambda+\alpha}} \quad (7)$$

$$\frac{w_m^*}{w_{nm}^*} = \left(\frac{\beta_L}{1-\beta_L} \right)^{\frac{(1-\alpha)\lambda}{(1-\alpha)\lambda+\alpha}} \left(\frac{e_M}{e_{NM}} \right)^{\frac{-1}{(1-\alpha)\lambda+\alpha}} \quad (8)$$

2.4. The Impact of Immigration on Relative Task Supplies

We have, so far, solved for the equilibrium relative task provision of manual versus non-manual tasks assuming all workers are homogeneous with regards to their effectiveness in performing manual and non-manual tasks. We now expand the model to allow for differences in the relative efficiency of immigrants and natives in performing manual and non-manual tasks, which result in distinct native and immigrant relative task supplies. Overall, the aggregate supply of manual versus non-manual tasks in this economy is a weighted average of each group's supply, where the weight is the share of non-manual tasks provided by immigrants (which is a monotonic transformation of the foreign-born share of low-educated workers, $L_i/(L_N+L_i)$):

$$\left(\frac{M}{NM} \right) = \left(\frac{M_I + M_N}{NM_I + NM_N} \right) = f \frac{M_I}{NM_I} + (1-f) \frac{M_N}{NM_N} \quad (9)$$

In turn, the relative efficiency of immigrants and natives in performing manual versus non-manual tasks is given by:

$$\overline{\left(\frac{e_M}{e_{NM}}\right)} = \left[f \overline{\left(\frac{e_{mi}}{e_{nmi}}\right)}^{\frac{1}{1-\alpha}} + (1-f) \overline{\left(\frac{e_{mn}}{e_{nmn}}\right)}^{\frac{1}{1-\alpha}} \right]^{(1-\alpha)} \quad (10)$$

We can then substitute equation (10) into equations (7) and (8) and rewrite the equilibrium provision of manual to non-manual tasks and their relative compensation as a function of the relative efficiency of natives and immigrants in manual and non-manual tasks as follows:

$$\frac{M^*}{NM^*} = \left(\frac{\beta_L}{1-\beta_L} \right)^{\frac{\alpha\lambda}{(1-\alpha)\lambda+\alpha}} \left[f \overline{\left(\frac{e_{mi}}{e_{nmi}}\right)}^{\frac{1}{1-\alpha}} + (1-f) \overline{\left(\frac{e_{mn}}{e_{nmn}}\right)}^{\frac{1}{1-\alpha}} \right]^{\frac{\lambda(1-\alpha)}{(1-\alpha)\lambda+\alpha}} \quad (11)$$

$$\frac{w_m^*}{w_{nm}^*} = \left(\frac{\beta_L}{1-\beta_L} \right)^{\frac{(1-\alpha)\lambda}{(1-\alpha)\lambda+\alpha}} \left[f \overline{\left(\frac{e_{mi}}{e_{nmi}}\right)}^{\frac{1}{1-\alpha}} + (1-f) \overline{\left(\frac{e_{mn}}{e_{nmn}}\right)}^{\frac{1}{1-\alpha}} \right]^{\frac{-(1-\alpha)}{(1-\alpha)\lambda+\alpha}} \quad (12)$$

Then, substituting the equilibrium compensation (i.e. equation (12)) into the equilibrium aggregate supply of manual to non-manual tasks (i.e. equation (6)) for natives, we can solve for the equilibrium supply of relative manual versus non-manual tasks for native workers, which is given by the following equation:

$$\frac{M_N^*}{NM_N^*} = \left(\frac{\beta_L}{1-\beta_L} \right)^{\frac{\alpha\lambda}{(1-\alpha)\lambda+\alpha}} \left[f \overline{\left(\frac{e_{mi}}{e_{nmi}}\right)}^{\frac{1}{1-\alpha}} + (1-f) \overline{\left(\frac{e_{mn}}{e_{nmn}}\right)}^{\frac{1}{1-\alpha}} \right]^{\frac{-\alpha}{(1-\alpha)\lambda+\alpha}} \overline{\left(\frac{e_{mn}}{e_{nmn}}\right)}^{\frac{1}{1-\alpha}} \quad (13)$$

Overall, equations (11), (13) and (12) describe the equilibrium supply of manual versus non-manual skills in this economy as well as for natives, and the relative compensation of manual versus non-manual skills, respectively.

2.5. Key Assumptions and Testable Hypotheses

As pointed out in the theoretical model, a critical assumption is the fact that, relative to natives, immigrants have a comparative advantage in manual as opposed to non-manual

tasks, i.e. $\left(\frac{e_M}{e_{NM}}\right)_i > \left(\frac{e_M}{e_{NM}}\right)_N$. This assumption implies that the relative supply of manual

versus non-manual tasks of immigrants will be greater than that of natives or:

$\left(\frac{M_i}{NM_i}\right) > \left(\frac{M_N}{NM_N}\right)$. We first examine whether the data generally support this assumption.

Then, using comparative statistical analysis, we derive two testable hypotheses². First, according to equation (13), as the share of immigrant low-educated workers increases, the relative supply of manual versus non-manual tasks of natives will decrease. That is:

$$\text{Hypothesis no.1: } \frac{\partial(M^*_N / NM^*_N)}{\partial f} < 0$$

Second, from equation (11), it is easy to show that, as the share of immigrant low-educated workers increases, the total relative supply of manual versus non-manual tasks in the economy will increase, i.e.

$$\text{Hypothesis no.2: } \frac{\partial(M^* / NM^*)}{\partial f} > 0$$

Figure A in the appendix illustrates how the labor market equilibrium changes in an economy that receives an inflow of immigrant workers with a comparative advantage in manual tasks. The relative supply of immigrants is to the right of the relative supply from natives and, as a result, the overall relative supply—a weighted average of the native and immigrant supplies—shifts to the right. At the new lower equilibrium relative compensation,

² Peri and Sparber (2008) examine the impact of immigration on the relative compensation of manual versus non-manual 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 non-manual compensation.

the relative supply from natives is reduced (as predicted by hypothesis no.1), while the overall relative supply in the economy is augmented (as predicted by hypothesis no.2).

3. Data and Some Descriptive Evidence

We make use of 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 make use of the wage information contained for Spain in the European Union Standard Living Conditions (EU-SILK) – a micro data panel that at present 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 such, they are less likely to display a comparative advantage in non-manual tasks as opposed to long-term migrants, who may have already acquired the needed skills to perform well in non-manual tasks. Additionally, since our intent is to explore the implications of low-skilled immigrants' comparative advantage in performing manual as opposed to non-manual tasks compared to similarly skilled natives, our sample consists of immigrants and natives with less than a university education.

Table 1 presents some descriptive statistics of the sample of natives and immigrants taken from the pooled EPA 1999-2007. Our sample consists of working individuals between 16 and 65 years of age. 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 are recent immigrants. 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 40 percent of natives. In contrast, thirty-two percent of natives are older than forty-five as compared to 12 percent of recent immigrants. Secondly, 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 38 percent for of all native workers). Third, there are also some differences in the educational attainment of immigrants and natives. While the percentage of low educated workers in both groups is rather similar (i.e. 3 to 5 percentage points difference –see Amuedo-Dorantes and De la Rica (2008) for a lengthier discussion), the fraction of workers with secondary schooling is 4 to 7 percentage points higher for immigrants, whereas that of workers with a university degree is 7 percentage points higher among natives. Furthermore, although we cannot distinguish recent from non-recent migrants in the EU-SILK 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. Therefore, the small differences in educational attainment or other observable skills, such as age (or experience), do not necessarily mean that immigrants and natives are substitutes in the labor market.

3.1. Immigrants and Natives as Close Substitutes

The first empirical evidence on the substitutability between immigrants and natives emerges from Figure 1, which displays the relative position of immigrants in the native wage distribution (pooled 2004-2006 from EU-SILK). We have divided the native wage distribution in deciles and, for each decile, we have calculated the percentage of immigrants within each native wage decile. The horizontal line shows that 10 percent of natives fall within each wage decile. However, immigrants 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 1 suggests that immigrants may only compete with low-paid natives.

Additional evidence on the lack of substitutability between natives and immigrants emerges from differences in their occupational distribution. According to the figures in Table 2, the concentration of immigrant workers in a few occupations is quite remarkable. In particular, about 74 percent of immigrants and an astonishing 81 percent of recent immigrants (relative to 45 percent of natives) 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.

Are the differences in occupations held by immigrants and natives due to their different educational attainment? Table 3 displays the occupational distribution of immigrants (recent and all) and natives according to their educational attainment, i.e. primary or less, secondary and university. It is worth noting that 50 percent of highly educated immigrants (up to 60 percent among recent immigrants), as compared to 22 percent of similarly educated natives, are concentrated in: low skill jobs that only require an elementary education, service and sale related occupations, and craft and related trade jobs. Likewise, 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 these three occupations relative to 55 percent and 61 percent of similarly educated natives, respectively. Therefore, immigrants, particularly more recent immigrants, are concentrated in poorly paid occupations to a greater extent than natives 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 reflects the acquired workers' human capital. Most of the literature has traditionally

assumed that immigrants and natives within skill groups are close substitutes. This implies that immigrants and natives within a skill group would compete for similar jobs and, therefore, display similar occupational and wage distributions. However, one would expect immigrants' acquired human capital to differ to a great extent from that of natives with similar observable skills (measured by age and education). In the first place, most immigrants acquire their education elsewhere and their human capital is not fully transferable. Additionally, most immigrants face language barriers and lack country-specific human capital, such as useful work contacts or awareness of social norms, innate to natives. As such, immigrants and natives are unlikely to be close substitutes to natives even within observed skill levels. We, nonetheless, check whether that is the case in Table 4, which shows the distribution of immigrants and natives across fifteen skill groups (five age categories and three educational groups), along with their average wages and their corresponding wage gaps. With the exception of immigrants and natives in the lowest skill category (i.e. younger than 30 and with a primary education or less), natives earn consistently more than immigrants within any given skill group. The wage gap rises from 0.05 for workers below age 30 and with secondary schooling to 3.49 for workers between 41 and 45 years of age with a university degree (practically half of the average hourly wage of foreign-born workers in that category). These large wage gaps indicate that immigrants and natives cannot be considered close substitutes within the traditional skill categories. Therefore, observed skills, measured in terms of age and education, cannot be used as a good measure of acquired human capital when we try to compare immigrants and natives.

This observed imperfect substitutability of immigrants and natives of comparable age and educational attainment may be a result of a different sorting of immigrants and natives 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 non-manual tasks. In this context, immigrants would sort into occupations requiring more manual tasks, whereas natives would specialize in jobs demanding other non-manual tasks.

3.2. Immigration and Native Task Specialization

To examine whether, indeed, immigration leads natives to relocate in jobs demanding greater non-manual skills allowing for immigrants to occupy more manual intensive jobs, we rely on information on the job task requirements assembled by Autor, Levy and Murnane (2003).³ In their paper, Autor et al. (2003) merged data on job task requirements based on the U.S. Department of Labor's *Dictionary of Occupational Titles* (DOT) with Census occupation classifications to examine how computerization altered job skill demands. We merge the job task requirement information gathered by Autor et al. (2003) to the Current Population Survey data from Spain, i.e. the Encuesta de Población Activa (EPA).⁴

We focus our attention on two of the job task requirements recorded by Autor et al. (2003), i.e. the “eye-hand-foot coordination” or EHF and the “direction-control-planning” or DCP measures. The first measure refers to manual tasks. In particular, EHF describes the “ability to move the hand and foot coordinately with each other in accordance with visual stimuli”. The second measure, DCP, is defined as the “adaptability to accepting responsibility for the direction, control or planning of people and activities” and captures the interactive content of job tasks.⁵ All variables take values that range from zero to ten.

³ The authors are grateful to David Autor for kindly providing the data.

⁴ Census Occupation Codes (COC) from 1980 are matched to the International Standard Classification of Occupations (ISCO88) –from which the Clasificación Nacional de Ocupaciones (CNO94) used in the Spanish-SILK data are derived– using a crosswalk from the U.S. COC-1980 to the ISCO88 based on the translation provided by Harry Ganzeboom at: <http://home.scw.vu.nl/~ganzeboom/occisco/index.htm>

⁵ We also experimented with other measures of the manual content of job tasks, such as the finger dexterity (FINGER). However, because finger dexterity can take relatively high values in jobs typically considered as having a high non-manual content, as is the case of administrative personnel, we chose to exclude it from the analysis discussed herein. Yet, as we note in what follows, results using finger dexterity along with the EHF and DCP measures follow closely those using the EHF and DCP measures and are available from the authors

Table 5 displays information on the manual and non-manual tasks involved in various occupations. As it would be expected, high skill occupations with lower CNO-94 classification codes in the top panel of Table 5 have a greater content of non-manual tasks and a smaller content of manual tasks. In contrast, low skill occupations in the bottom panel of Table 5 on average display a greater content of manual, as compared to non-manual, tasks. These results are evident from the values of the DCP and from the EHF measures which, generally, are higher for the first measure and lower for the second measure in the occupations in the top panel of Table 5 and vice versa for the occupations in the bottom panel of Table 5. To keep things simpler, we use the EHF and DCP measures to create a summary measure of the relative manual to non-manual task content of each occupation, i.e. $[EHF/(EHF+DCP)]$. To facilitate the interpretation of our findings, this measure takes values between 0 and 1. Additionally, since these job task requirement measures are based on specific U.S. Department of Labor's *DOT* definitions and we are using Spanish data, we also make use of a more traditional and possibly better understood classification of jobs as is the case with the blue-collar versus white-collar classification. The rationale behind this measure is that blue-collar jobs have by definition a greater content of manual tasks compared to white collar jobs, which are intrinsically non-manual jobs. Specifically, for the purpose of the analysis, we classify as blue collar jobs the occupations with the following 2-digit ISCO88 codes: 51 (personal and protective service workers), 61 (Skilled agricultural and fishery workers), 71-74 (Craft and related trade workers), 81-84 (Plant/machine operators and assemblers) and 91-94 (Elementary Occupations). The remaining occupations are grouped into the so-called white collar job group. When carrying out the regression analysis, as we

upon request. Additionally, we do not use two other task measures from the *DOT*, i.e. GED Math and STS, because they are both more closely related to the educational attainment of the worker than to her/his comparative advantage in manual versus non-manual tasks owing to country-specific or language skills. In particular, GED Math is defined as "General educational development, mathematics" and is considered a measure of analytical tasks, whereas STS is defined as "the adaptability to situations requiring the precise attainment of set limits, tolerances or standards" and is primarily a measure of cognitive skills.

group the data into (province, year) cells, we re-define this measure as the *relative intensity of blue collar jobs in each cell*, i.e. $[BC/(BC+WC)]$ –a variable that, as the two measures from above, takes values between 0 and 1.

Preliminary evidence of our assumption of a greater supply of relatively manual relative to non-manual tasks by immigrants as opposed to natives is provided by Figures 2a and 2b, which plot the relative manual content of the jobs performed by less educated immigrants and natives using the two measures discussed in the previous paragraph. It is worth noting that immigrants with a secondary education or less take jobs with a greater manual, relative to non-manual, component as compared to similarly educated natives. In fact, the gap in the manual to non-manual component of the tasks performed by immigrants and natives has widened in the midst of heightened immigration. In Figures 2a and 2b the gap has widened by an additional 5 percent during the time period under consideration. It is also important to mention that much of the widening gap is explained by the increased concentration of immigrants in jobs that require relatively more manual tasks. Indeed, native concentration in jobs with a greater manual relative to non-manual component has remained practically unchanged over the course of the entire period. This suggests that technological change is not likely to be the factor driving the higher concentration of immigrants, relative to natives, in jobs with a greater manual, as compared to non-manual, component.

Further support for the higher manual to non-manual intensity of job tasks performed by immigrants as compared to natives with a similar educational attainment as immigration rises is provided in Figures 3a and 3b. 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 non-manual 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, regardless of the measure used for the relative manual content of job tasks, most points lie above the 45-degree line, thus indicating that for high immigrant-receiving regions, the ratio of manual to non-manual tasks in jobs performed by the foreign-born exceeds that of jobs performed by similarly educated natives as assumed by the model.

4. Regression Results

Figures 2a through 3b provided evidence of the greater relative supply of manual versus non-manual tasks of immigrants compared to natives –an assumption central to the model. We now move on to testing each of the two hypotheses derived from the model via regression analysis.

4.1. Immigration and the Relative Supplies of Manual to Non-manual Tasks

Hypotheses no. 1 and no. 2 predicted that: (1) the equilibrium supply of manual versus non-manual tasks of the economy will increase with the share of foreign born, and that (2) the equilibrium supply of manual versus non-manual tasks of low skilled natives will decrease as the share of foreign-born increases, respectively. To test these hypotheses, we collapse our data into region-time cells across 52 Spanish provinces and over 9 years, i.e. from 1999-2007.

First, we transform equation (13) into the following regression equation in order to test hypothesis no. 1:

$$\ln\left(\frac{M}{M + NM}\right)_n = \alpha_p + \delta_t + \eta_n(Share_foreign)_{pt} + \varepsilon_{pt} \quad (14)$$

Equation (14) examines whether natives' relative supply of manual to non-manual tasks decreases with the share of foreign-born as natives specialize in occupations requiring fewer manual, as opposed to non-manual, tasks. In that event, the coefficient η_n should be negative and statistically different from zero.

Various specifications are estimated to assess the robustness of our estimate as well as to address a variety of econometric issues that may arise in the estimation. First, to assess if natives' occupational patterns are the mere by-product of technological shocks, we re-estimate equation (14) replacing the dependent variable with: $\ln\left(\frac{M}{M + NM}\right)_i$. If, indeed, the relationship meaning from equation (14) is the result of a technological shock, we should get a similar finding from examining the responsiveness of the relative manual to non-manual task supply of immigrants. In addition, to address any potential endogeneity between the share of foreign-born and natives' relative supply of manual to non-manual tasks, we re-estimate our specifications using the share of long-term immigrants –excluded from the analysis (i.e. those with more than five years of residence in Spain)– as an instrument for the current share of recent immigrants. We base our instrument choice on previous studies in the literature that use instrumental variables that rely on the fact that new immigrants tend to move to the same areas in which they have country networks (e.g. Card 2001, Cortes 2006, Lewis 2003, Ottaviano and Peri 2006, Peri 2006, Saiz 2003, and Peri and Sparber 2008).

Subsequently, we test hypothesis no.2 by transforming equation (11) into the following regression equation:

$$\ln\left(\frac{M}{M + NM}\right) = \alpha_p + \delta_t + \eta(\text{Share_foreign})_{pt} + \varepsilon_{pt} \quad (15)$$

Equation (15) allows for the testing of whether the relative manual to non-manual provision of tasks in the economy increases with the share of foreign-born. Based on the model predictions, η should be positive and statistically different from zero. To address any potential endogeneity between the share of foreign-born and the overall relative supply of manual to non-manual tasks in the economy, we re-estimate all models using the share of long-term immigrants as an instrument for the current share of recent immigrants.

Table 6 displays some preliminary results using the two measures of the relative manual content of tasks performed by workers. The first rows of results for each of the two task measures displayed in Table 6 help confirm our first hypothesis, that is, the fact that the relative supply of manual versus non-manual tasks among natives decreases with the share of foreign-born. In particular, regardless of whether we instrument the share of foreign-born or not, the estimated coefficients turn out to be always negative. A 10 percent increase in the share of foreign-born workers –similar to the one experienced by the Spanish economy over the course of the past decades– would lower the native supply of manual to non-manual tasks anywhere between 5 percent and 9 percent when we do not instrument. Once we instrument for the endogeneity of the share of foreign-born workers, these estimates fluctuate around -12 percent, depending on the manual to non-manual task content measure being used. Therefore, as depicted in Figure A in the appendix, as the share of foreign-born increases, the relative supply of the entire economy shifts to the right, the equilibrium relative compensation drops and the relative supply from natives shifts to the left as natives relocate.

Could this effect be the result of a simultaneous technological shock steering natives towards occupations with a lower content of manual tasks? The results from the second rows for each of the two task measures displayed in Table 6 do not support that idea as such a broad technological shock would have the same impact on immigrants as on natives. Yet, there is no evidence of a statistically different from zero impact of an increase in the share of foreign-born on the relative supply of manual versus non-manual tasks among immigrants.

Has the relative supply of manual tasks in the economy risen following the increase in foreign-born workers? The last rows of results displayed for each of the two measures in Table 6 address this question following the estimation of equation (15). In this case, we are unable to confirm the second hypothesis from the model. The estimates using the two task measures are either equal to zero or negative. In both instances, these results suggest that an

increase in the share of foreign-born does not increase the overall share of manual versus non-manual tasks in the economy but, rather, leaves it unchanged or even reduces it. Indeed, using the first task measure, we find that a 10 percent increase in the share of less educated and recent immigrant workers is associated with a -4 percent to a -8 percent decline in the relative supply of manual versus non-manual tasks in the economy depending on whether we instrument for the share of foreign-born workers or not. What could be an explanation for this finding?

One potential justification for the observed reduction in the relative supply of manual tasks in the economy could be found in the important boost in native female labor force participation (FLFP) during the period under consideration. Indeed, the immigration shock coincided with a notable growth in FLFP between 1999 and 2007 of almost 10 percentage points (from 39.6 percent to 48.7 percent). More importantly, these women occupied jobs with lower relative manual task content. Indeed, regardless of the task measure being used, Figures 4a and 4b 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 non-manual, component as compared to similarly educated men. Further support for the higher manual to non-manual intensity of job tasks performed by native men as compared to native women with a similar educational attainment is provided in Figures 5a and 5b. As in Figures 3a and 3b, each dot provides a measure of the relative manual to non-manual 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 above the 45-degree line, thus indicating that, for regions with above average shares of native female workers, the ratio of manual to non-manual tasks in jobs performed by native men exceeds that of jobs performed by similarly educated native

women. Overall, Figures 4a through 5b 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.

We incorporate this possibility in the theoretical model and allow for differences in the comparative advantage to perform manual versus non-manual tasks among men and women, in addition to the already acknowledged comparative advantage of immigrants as opposed to natives in performing manual relative to non-manual tasks. Appendix no.2 describes the equilibrium provisions of manual versus non-manual tasks for the overall economy once we expand the initial model to allow for gender differences in the comparative advantage to perform manual versus non-manual tasks among native workers. According to this extension of the theoretical model, and as depicted in Figure B in Appendix no.1, an increase in the labor supply due to the entrance of female native workers in the labor market would shift, *ceteris paribus*, the overall relative supply of manual versus non-manual tasks to the left owing to the comparative advantage of native women in the provision of non-manual as opposed to manual tasks relative to native men. However, given that the native female shock is simultaneous to the immigrant shock, the rightward shift in the relative supply of foreign-born workers and the leftward shift in the relative supply of native female workers may result in a positive, negative or non-statistically significant reduction in the relative supply of manual to non-manual tasks in the overall economy – depending of the size of the female shock compared with the immigrant shock. Nonetheless, we can derive a new testable hypothesis from the expanded model as shown in Appendix no.2, i.e., hypothesis no.3, which is the equivalent to hypothesis no.2 from the previous model. According to the new hypothesis:

$$\text{Hypothesis no.3: } \frac{\partial(M^* / NM^*)}{\partial g} < 0$$

We can subsequently test hypothesis no.3 by estimating equation (15) augmented with an additional regressor, i.e. the share of native female (non-university) workers in the economy:

$$\ln\left(\frac{M}{M + NM}\right) = \alpha_p + \delta_t + \eta(\text{Share_foreign})_{pt} + \gamma(\text{NativeFemale_share})_{pt} + \varepsilon_{pt} \quad (16)$$

Equation (16) allows for the testing of whether the relative manual to non-manual provision of tasks in the economy significantly shifted with the share of foreign-born and the share of native female workers. Based on the model predictions described in Appendix no. 2, the estimated coefficient for η should be positive and the estimated coefficient for γ (i.e. hypothesis no.3) should be negative. To address any potential endogeneity between the share of foreign-born or the share of native female workers and the overall relative supply of manual to non-manual tasks in the economy, we re-estimate all models using: (a) the share of long-term immigrants as the instrument for the current share of recent immigrants, and (b) fertility rate as the instrument for the share of native female workers. While the share of long-term immigrants does appear to be highly correlated to the current share of recent immigrants, the correlation between fertility rates and the share of native female workers is relatively weak.⁶ As a result, our instrumental variable results need to be improved upon and we are currently experimenting with various measures.

Table 7 displays our preliminary results from estimating equation (16) using the two different measures of the relative manual intensity of the tasks being performed by workers. A couple of findings are worth discussing. First, the estimated coefficient for the share of foreign-born workers continues to display a negative and statistically significant sign despite accounting for the share of native women working when we use the first task measure –just as we found in Table 6. Nonetheless, the overall provision of manual to non-manual tasks

⁶ We have also tried other variables, such as university attainment among Spanish females, average age at maternity and average number of children per women as possible instruments for the share of females but all seem to be very weakly correlated with the latter.

seems to remain unchanged following changes in the shares of foreign-born or native female workers as we instrument for the endogeneity of our regressors. Secondly, using the blue-collar versus white-collar task measure more specific to our set of Spanish occupations, we continue to find that a change in the share of foreign-born workers does not significantly impact the relative supply of manual to non-manual tasks in the economy. However, the share of native female workers turns out negative when we do not instrument, with a 10 percent increase in the share of native female workers being accompanied by an overall 6 percent reduction in the manual to non-manual task provision in the economy. The latter effect, once again, vanishes as we correct for the endogeneity of our regressors. In part, the loss of statistical significance may be due to the weakness of our instruments. Therefore, we are still polishing these estimates. Hence, summarizing, the figures in Table 7 seem to overall suggest that the provision of manual to non-manual tasks in the economy does not significantly change following a simultaneous change in the relative supply of manual to non-manual tasks by foreign-born and native female workers.

Overall, as depicted in Figure B, we are able to confirm hypothesis no.1, with natives relocating to less manual jobs as the share of foreign-born increases. However, contrary to Peri and Sparber (2008) for the U.S., we are unable to confirm hypothesis no.2 for the Spanish economy. Instead, we find it possible for the change in the relative share of foreign-born workers to have been accompanied by a simultaneous change in the relative share of native female workers in the opposite direction. The latter may have contributed to leaving the relative supply of manual to non-manual tasks in the economy unchanged.

5. Native Occupational Mobility Following an Immigrant Shock

According to the confirmed hypothesis no.1, natives relocate to less manual jobs as the share of foreign-born workers in the economy rises. In this last section of the paper, we examine in greater detail the occupational mobility of natives following an immigrant shock.

That is, which are the specific occupations natives leave and which do they go to as the share of foreign-born workers increases?

To answer this question, we make use of the one-digit level occupational disaggregation publicly available in the data being used herein, i.e. the EPA, and estimate a system of equations where the dependent variables reflect changes in the distribution of natives across the various occupation by province and year. The regressors are the same in all the equations. Of particular interest to us is the share of foreign-born workers in each cell, i.e. each province and year. While these equations appear independent from each other on the surface, they have the same regressors, use the same data and, as such, have correlated error terms. Thus, we estimate our system of regressions using a seemingly unrelated regression (SUR) model first developed by Zellner (1962). The SUR model is an extension of the linear regression model which allows for correlated errors between equations. The OLS estimates are still BLUE (i.e. will yield the Best Linear Unbiased Estimator) and, by estimating the equations jointly, the efficiency is improved upon. The results from this exercise are displayed in the first column of Table 8, whereas in the second column we show the results as we instrument for the share of foreign-born workers using the share of long-term foreign-born workers as in the previous sections.

A couple of findings are worth discussing from Table 8. First, the estimated coefficients are generally quite robust to the instrumentation of the share of foreign-born workers, with the exception of highly skilled occupations with lower relative manual to non-manual tasks, as is the case with managers and professionals. Therefore, we focus our attention on the IV estimates. Secondly, focusing on the IV estimates, it is worth noticing that a 10 percent increase in the share of foreign-born workers raises the growth rate of native workers in occupations characterized by a lower intensity of manual tasks, i.e. technicians and alike professionals, clerical support workers, and service and sales workers, anywhere

between 8 percent to 17 percent. The largest growth rate in the fraction of natives employed takes place in technical jobs, followed by jobs in services/sales and clerical jobs. In contrast, a 10 percent increase in the share of foreign-born workers lowers the growth rate of native workers in occupations with a higher intensity of manual tasks, as is the case with: crafts and related trade workers, machine operators and assemblers, or workers in other low skilled occupations, between 9 percent and 14 percent. Specifically, the largest reduction in the fraction of native workers occupied in those jobs takes place for both low skilled occupations, such as domestic help, as well as in crafts and related trades. The next largest decline is in machine operators and assemblers.

6. Preliminary 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 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. Yet, this 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 some of the implications of the increase in the share of foreign-born in the Spanish market. In particular, we explore whether immigration has encouraged native specialization in occupations that differ from those held by immigrants, thus explaining recent native and immigrant employment patterns, as well as recent findings regarding the lack of a negative wage impact of immigration.

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. Therefore, using a 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 are able to confirm Peri and Sparber's first model hypothesis, i.e. the fact that an increase in the share of foreign-born workers provokes a relocation of natives towards jobs with a lower intensity of manual (as opposed to non-manual) tasks. However, we are unable to confirm the second hypothesis from their model, i.e. the fact that an increase in the share of foreign-born workers results in an overall increase in the relative supply of manual to non-manual tasks in the economy. We conjecture that a potential explanation for this finding may be found in the important boost in native female labor force participation (FLFP) that Spain experienced during the period under consideration. Indeed, the immigration shock coincided with a

notable growth in FLFP between 1999 and 2007 of almost 10 percentage points (from 39.6 percent to 48.7 percent). More importantly, these women occupied jobs with lower relative manual task content. We incorporate this information, along with the empirically validated assumption that native female workers lowered the relative supply of manual to non-manual tasks, to the theoretical model. We then derive a third hypothesis regarding the impact that native female workers may have had on the relative supply of manual to non-manual tasks in the Spanish economy. Specifically, we show that this impact was negative and, despite needing to work further on our estimates, we find some preliminary empirical evidence of this being the case using one of the measures of the relative intensity of manual to non-manual tasks. As such, it is possible that the increase in the share of foreign-born workers, which may have contributed to raising the relative supply of manual to non-manual tasks, was accompanied by a simultaneous increase in the share of native female workers that had the opposite effect on the relative supply of manual to non-manual tasks in the economy. As such, the increase in the share of foreign-born workers may not have translated in an increase in the relative supply of manual to non-manual tasks in the economy. Instead, the latter may have remained unchanged.

Finally, we investigate a bit further the relocation of natives to jobs with a lower content of manual, as opposed to non-manual, tasks following the increase in the share of foreign-born workers experienced by the Spanish economy. Specifically, we look more closely at the impact that immigration inflows may have had on the occupational distribution of natives in Spain. We find that natives fled occupations with a higher content of manual as opposed to non-manual tasks, such as crafts and related trades, machine operations and assembly, or other low skilled jobs, as domestic help. Where did they go? They moved to jobs with a lower content of manual tasks, such as technical and alike professional occupations, clerical support jobs, and sales and service occupations.

In sum, foreign-born workers do not seem to be substitutes of similarly skilled native workers in the Spanish case. This may help understand the lack of a significant wage impact of recent immigration inflows on native wages. What impact did immigration then have on the Spanish labor market? We find evidence that immigration affected the occupational distribution of natives. Specifically, owing to the comparative advantage of foreign-born workers in manual as opposed to non-manual tasks, natives relocated to occupations with a lower content of manual tasks. However, possibly owing to the significant and simultaneous reduction in the manual to non-manual task supply resulting from the increase in the share of native female workers, the increase in the relative supply of manual to non-manual tasks from foreign-born workers does not appear to have significantly changed the overall manual to non-manual task supply in the Spanish economy.

In ongoing research, we are working to polish our estimates with the use of stronger instruments for the share of foreign-born and native female workers in the economy.

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

Variables	Natives	Recent Immigrants	All Immigrants
Average Age	39.2	33.1	35.3
<i>Distribution by age categories (%):</i>			
<30 years	26.7	44.1	36.08
31-35 years	12.9	19.4	19.2
36-40 years	13.7	14.7	16.6
41-45 years	13.8	10.2	11.8
>45 years	32.7	11.6	16.3
Percentage Female (%)	38.8	45.5	42.9
<i>Education (%):</i>			
Primary or Less	28.4	23.09	25.9
Secondary	44.9	55.04	52.05
University	26.5	21.04	21.9
Average Hourly Log Wage	6.78 (4.40)	(*)	6.00 (5.05)
Observations (in Spanish CPS)	574,074	12,309	19,111

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-SILK does not contain information on the length of stay of immigrants in Spain.

Table 2
Occupational Distribution (%) - Natives and Immigrants (1999-2007)

Occupations	Natives	Recent Immigrants	All Immigrants	Average Hourly Log Wage
Managers	8.06	2.2	4.63	10.76
Professionals	12.6	3.3	4.84	10.11
Technicians and professionals	10.6	3.3	4.41	7.84
Clerical support workers	9.0	3.02	3.55	6.61
Service and sales workers	14.7	18.8	18.56	6.24
Skilled agricultural/forestry/fishery workers	4.4	2.08	1.95	5.65
Craft and related trade workers	17.05	18.3	18.53	5.13
Plant/machine operators and assemblers	10.25	5.3	5.99	4.67
Elementary Occupations	13.3	43.5	37.54	4.39

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-SILK survey for Spain. Natives are of all working individuals between 16 and 65 years of age. 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

	University			Secondary			Primary or less		
	Natives	Recent Immigrant	All Immigrants	Natives	Recent Immigrant	All Immigrants	Natives	Recent Immigrant	All Immigrants
Managers	7.6	4.9	8.39	7.8	1.6	3.87	9.0	1.1	4.63
Professionals	41.4	14.6	19.48	0.7	0.4	0.70	0.1	0	4.84
Technicians and professionals	18.4	8.8	10.55	9.6	2.4	3.53	2.3	0.4	4.41
Clerical support workers	11.2	6.2	6.05	10.4	2.6	3.54	2.8	1.1	3.55
Service and sales workers	7.8	17.01	15.64	20.1	22.2	22.63	12.2	12.4	18.56
Skilled agricultural/forestry/fishery workers	0.6	1.31	1.05	3.7	2.11	1.86	10.9	2.7	1.95
Craft and related trade workers	6.8	13.8	12.80	19.8	19.4	19.38	24.5	19.9	18.53
Plant/machine operators and assemblers	3.5	4.6	4.77	12.8	6.05	6.77	13.7	4.1	5.99
Elementary Occupations	2.5	28.7	21.30	14.8	43.21	37.73	24.4	58.1	37.54

Note: Pooled sample of 1999-2007 Current Population Survey for Spain. All are working individuals between 16 and 65 years of age. Recent immigrants refer to those with at most 5 years of residence in Spain.

Table 4
Average Log Wages of Natives and Immigrants across Skill Groups
Average Wage Gap within Skills

Skills	Natives		All Immigrants		Average Wage Gap
	Mean Log Wage	Distribution across skills (%)	Mean Log Wage	Distribution across skills (%)	
<30, Primary	4.50 (1.68)	9.44	4.55 (1.42)	9.20	-0.05
<30, Secondary	4.64 (1.95)	10.63	4.59 (1.69)	19.66	0.05
<30, University	6.12 (3.42)	9.72	4.95 (1.83)	13.13	1.17
31-35, Primary	5.34 (1.87)	4.15	4.62 (1.35)	4.14	0.72
31-35, Secondary	5.66 (2.22)	4.65	5.10 (1.58)	6.70	0.56
31-35, University	7.79 (3.67)	6.30	7.46 (5.09)	8.55	0.33
36-40, Primary	5.53 (2.11)	4.21	4.96 (1.24)	2.51	0.57
36-40, Secondary	6.00 (2.59)	4.69	4.82 (2.35)	6.43	1.18
36-40, University	9.52 (5.98)	5.27	9.00 (9.79)	4.58	0.52
41-45, Primary	5.42 (2.28)	4.23	4.75 (1.31)	2.72	0.67
41-45, Secondary	6.77 (4.05)	4.62	5.60 (2.90)	4.63	1.17
41-45, University	10.96 (6.32)	4.68	7.47 (6.08)	3.21	3.49
>45, Primary	6.00 (2.74)	12.53	4.62 (1.93)	3.16	1.38
>45, Secondary	7.35 (4.14)	7.13	4.67 (1.73)	5.50	2.68
>45, University	12.21 (6.68)	7.76	10.38 (11.15)	5.88	1.83

Source: 2004-2006 Pooled EU-SILK Survey for Spain.

Table 5
Tasks Intensity in Occupations with the lowest and largest share of immigrants

Occupations (CNO94 code)	EHF	DCP	ehf/((ehf+dcp)	No. of workers	Share of Foreign Born (%)
<i>Occupations with the lowest share of immigrants (among occup. with at least 1% of workers)</i>					
34	1.27	2.18	0.36	10092	0.26
40	0.20	1.94	0.09	5037	0.29
12	0.45	8.5	0.05	21332	0.45
14	1.38	9.06	0.13	6741	0.59
<i>Occupations with the highest share of immigrants (among occup. with at least 1% of workers)</i>					
50	0.93	0.96	0.49	18804	5.3
91	1.47	0.38	0.79	27287	7.9
96	2.51	0.01	0.99	10564	8.0
94	2.23	0.57	0.79	7988	10.4

Notes: The CNO94 codes listed above refer to the following occupations:

CNO94 no. 34: Professional administrative personnel.

CNO94 no. 40: Support personnel providing accounting, financial, and other similar services in the manufacturing and transportation sectors.

CNO94 no. 12: Direction of trade firms with less than 10 employees.

CNO94 no. 14: Direction of firms, other than trade firms listed above, with less than 10 employees.

CNO94 no. 50: Employees in restaurant and catering services.

CNO94 no. 91: Domestic employees and cleaning personnel in other buildings, e.g. hotels and offices.

CNO94 no. 96: Construction laborers.

CNO94 no. 94: Agriculture/Fishing laborers.

Table 6
Impact of the Share of Foreign-Born on the Supply of Tasks

Dependent Variable	Estimation Method	
	OLS	IV
Task Measure 1:		
$\text{Ln}((\text{ehf})/(\text{ehf}+\text{dcp}))_{\text{natives}}$	-0.902*** (0.22)	-1.289*** (0.43)
$\text{Ln}((\text{ehf})/(\text{ehf}+\text{dcp}))_{\text{immig}}$	-1.92 (1.79)	-1.34 (2.47)
$\text{Ln}((\text{ehf})/(\text{ehf}+\text{dcp}))_{\text{overall}}$	-0.406** (0.233)	-0.807** (0.469)
Task measure 2:		
$\text{Ln}(\text{BC}/(\text{BC}+\text{WC}))_{\text{natives}}$	-0.525** (0.27)	-1.24*** (0.43)
$\text{Ln}(\text{BC}/(\text{BC}+\text{WC}))_{\text{immig}}$	1.17 (1.29)	2.87 (1.75)
$\text{Ln}(\text{BC}/(\text{BC}+\text{WC}))_{\text{overall}}$	-0.12 (0.24)	-0.358 (0.35)

Notes: *** indicates significant at the 1% level and ** indicates significant at the 5% level. Each reported coefficient is the impact of the share of foreign born on each of the dependent variables stated in the left column. Each coefficient is the result of a different regression. All regressions include a full set of region dummies (51) plus controls for time (7 dummies). All regressions are weighted by the cell (province, year) size and standard errors are corrected for clustering at cell level. Instruments for the share of foreign-born and for the share of native female workers in the IV regressions are the share of non-recent immigrants with more than five years of residence and average fertility rates at the cell level, respectively.

Table 7
Impact of the Share of Foreign-Born and the Share of Native Women on the Supply of Tasks

Dependent Variable	Share of foreign-born		Share of Native Women	
	OLS	IV	OLS	IV
$\text{Ln}(\text{ehf}/(\text{ehf}+\text{dcp}))_{\text{overall}}$	-0.468*** (0.237)	-1.476 (2.161)	-0.184 (0.158)	-1.419 (8.322)
$\text{Ln}(\text{BC}/(\text{BC}+\text{WC}))_{\text{overall}}$	-0.312 (0.233)	-1.212 (1.795)	-0.569*** (0.138)	-2.998 (6.922)

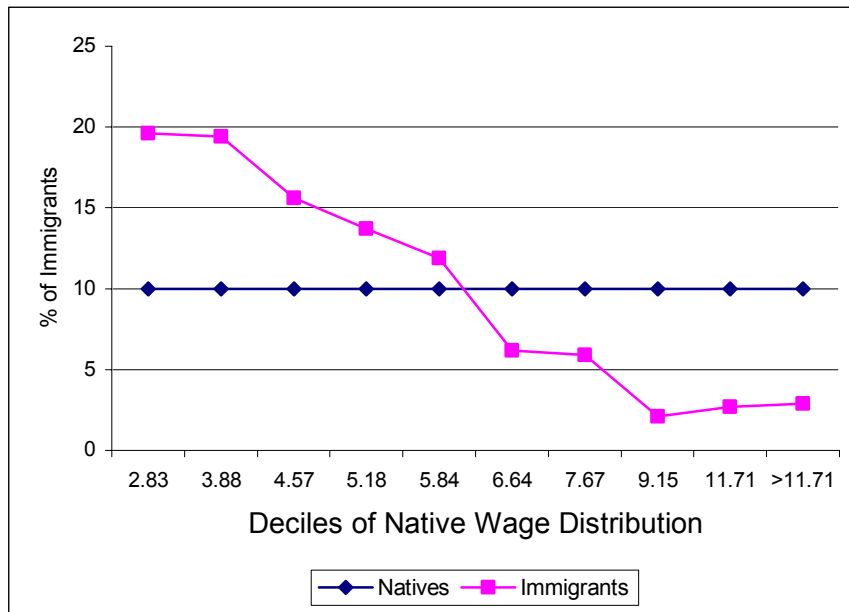
Notes: *** indicates significant at the 1% level and ** indicates significant at the 5% level. Each reported coefficient is the impact of the share of foreign born or the share of female on each of the dependent variables stated in the left column. Each row is the result of a different regression. All regressions include a full set of region dummies (51) plus controls for time (7 dummies). All regressions are weighted by the cell size and standard errors are corrected for clustering at cell level. Instruments for the share of foreign-born and for the share of native female workers in the IV regressions are the share of non-recent immigrants with more than five years of residence and average fertility rates at the cell level, respectively.

Table 8
Impact of the Share of Foreign Born on the Change in the Distribution of Natives across Occupations

Occupational Distribution	OLS	IV
Managers	0.050 ^{***} (0.023)	0.039 (0.029)
Professionals	0.036 [*] (0.019)	0.019 (0.023)
Technicians and professionals	0.176 ^{***} (0.025)	0.173 ^{***} (0.031)
Clerical support workers	0.077 ^{***} (0.026)	0.084 ^{***} (0.03)
Service and sales workers	0.127 ^{***} (0.031)	0.109 ^{***} (0.039)
Craft and related trade workers	-0.076 ^{***} (0.036)	-0.136 ^{***} (0.04)
Plant/machine operators and assemblers	-0.066 ^{***} (0.029)	-0.086 ^{***} (0.035)
Elementary Occupations	-0.118 ^{***} (0.031)	-0.139 ^{***} (0.04)

Notes: *** indicates significant at the 1% level and * indicates significant at the 10% level. The dependent variable is the change in the distribution of natives across occupations by province and year. The independent variable is the relative share of foreign born in each cell (province year). Instruments for the share of foreign born include region and time dummies and the share of long term immigrants by cell. For Agricultural/forestry/fishery workers have been dropped from this analysis, given that less than 2% of workers are currently working in that occupational category.

Figure 1
Distribution of Immigrants in Native Wage Distribution



Source: European Survey of Living Conditions, Spain. Pooled 2004-2006 Data.

Figures 2a and 2b
Relative Manual to Non-Manual Task Supply by Native and Foreign-Born Workers

Figure 2a: Using $[ehf/(ehf+dcp)]$

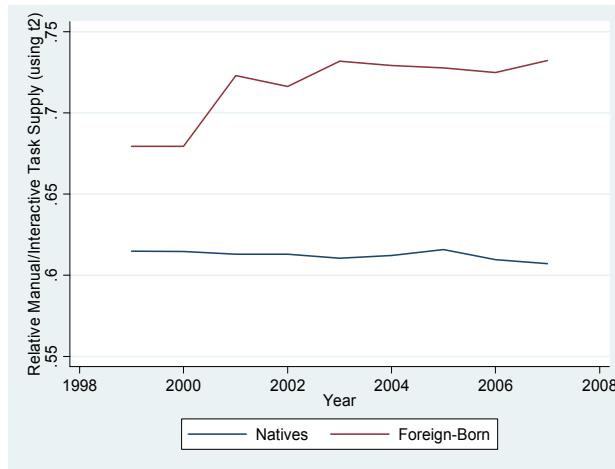
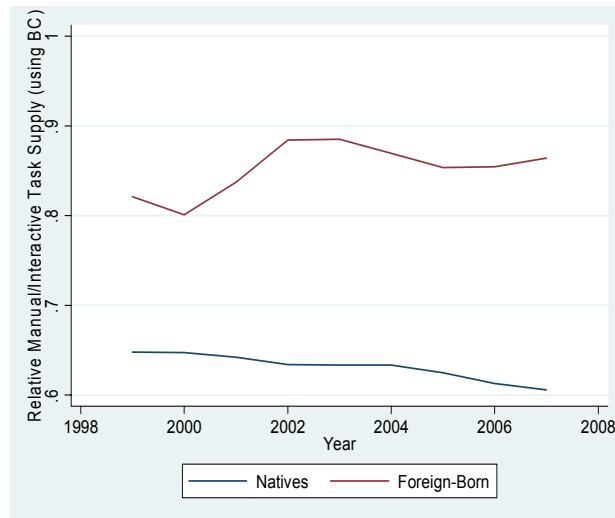


Figure 2b: Using $[bc/(bc+wc)]$



**Figures 3a and 3b:
Relative Manual to Non-Manual Intensity of Native versus Immigrant Tasks**

Figure 3a: Using $[ehf/(ehf+dcp)]$

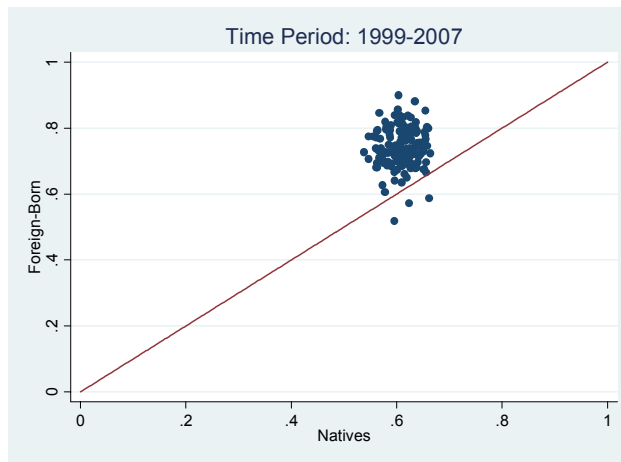
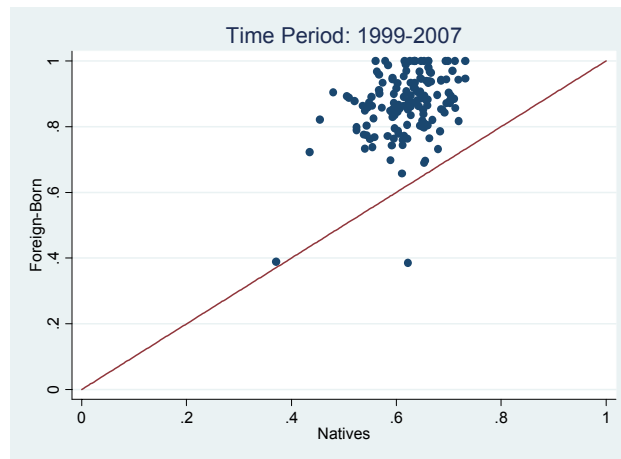


Figure 3b: Using $[bc/(bc+wc)]$



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.

Figures 4a and 4b
Relative Manual to Non-Manual Task Supply by Native Men and Women

Figure 4a: Using $[ehf/(ehf+dcp)]$

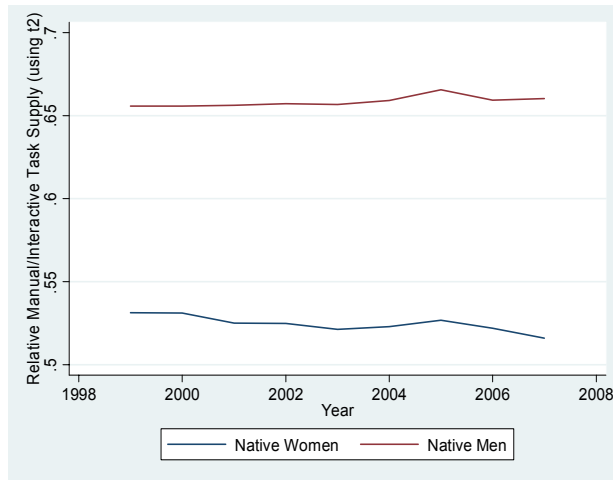
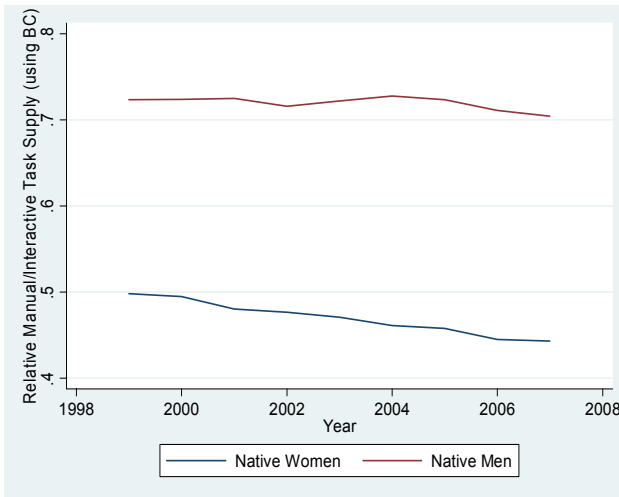


Figure 4b: Using $[bc/(bc+wc)]$



**Figures 5a and 5b:
Relative Manual to Non-Manual Intensity of Native Male and Female Tasks**

Figure 5a: Using $[ehf/(ehf+dcp)]$

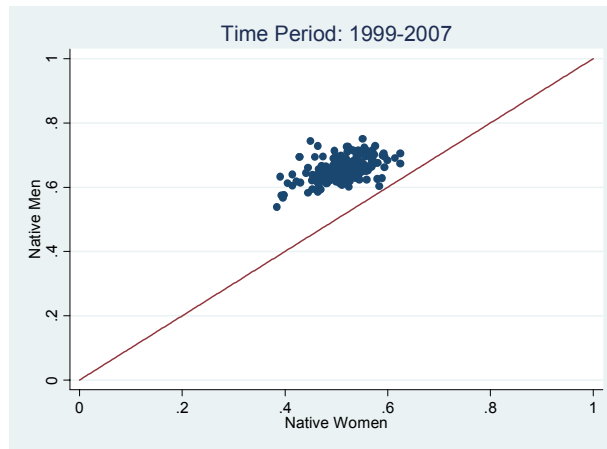
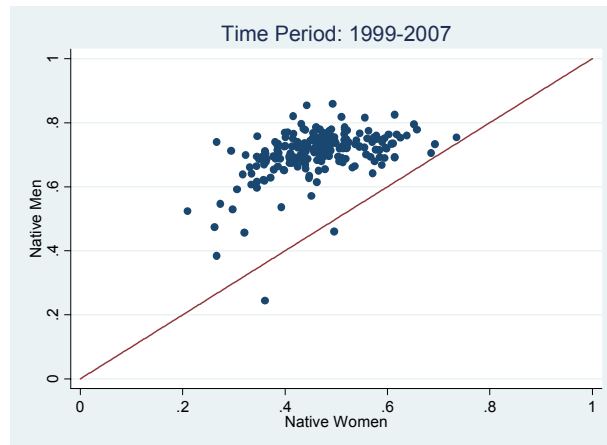


Figure 5b: Using $[bc/(bc+wc)]$



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.

Appendix No. 1

Figure A

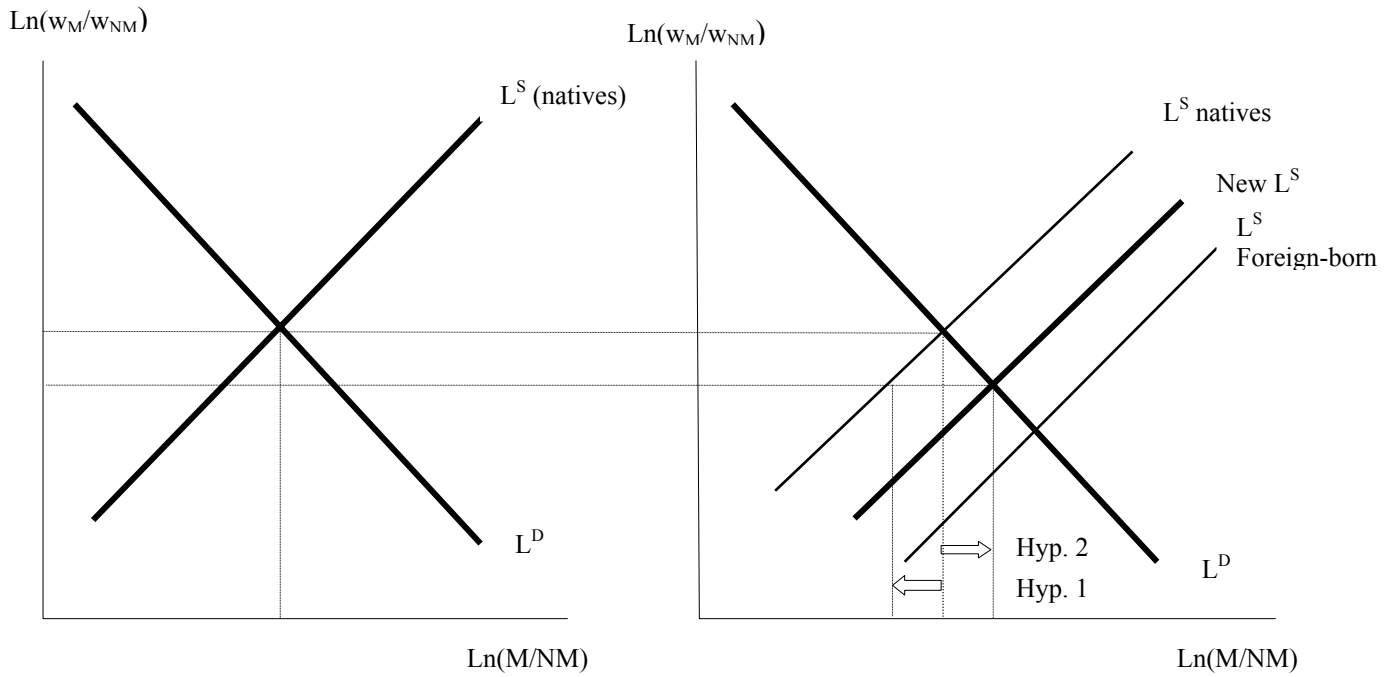
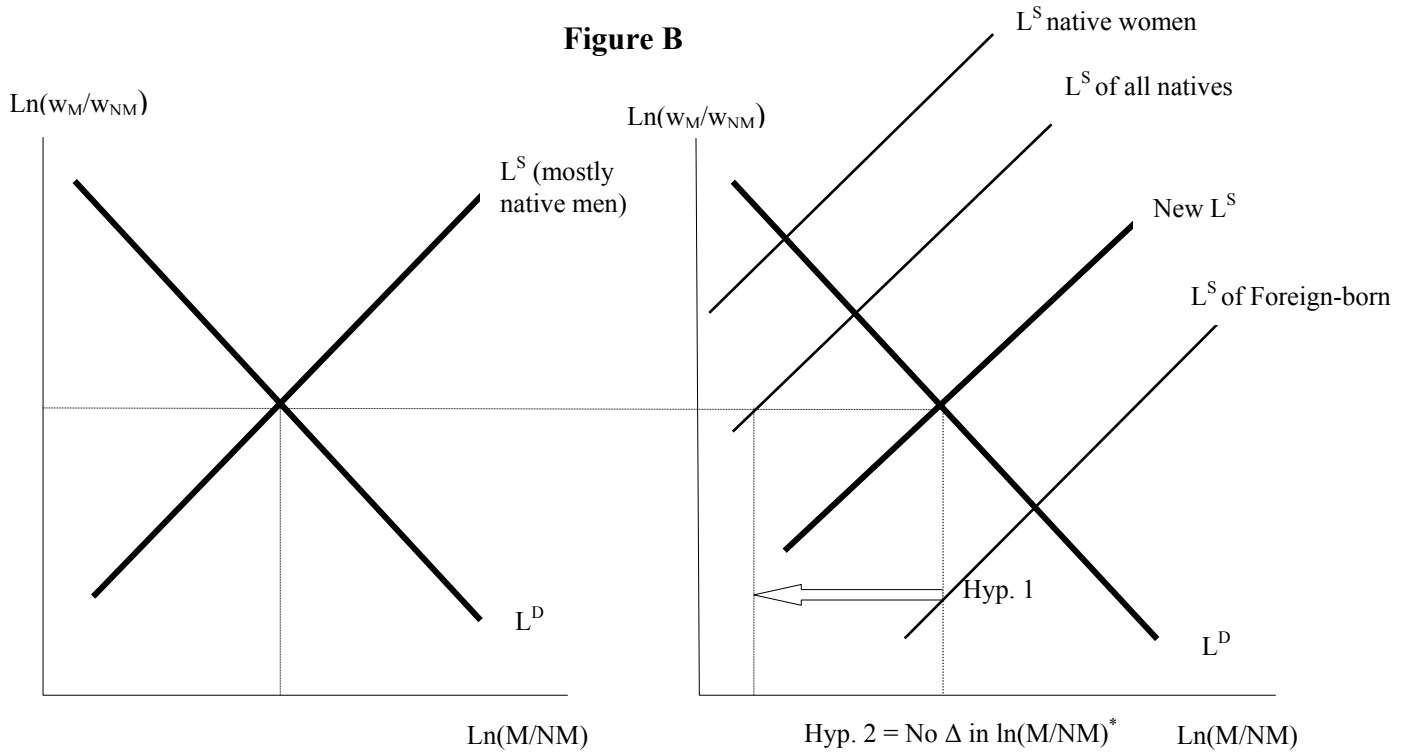


Figure B



Appendix No. 2

Equilibrium provision of manual versus non-manual tasks for the overall economy when we allow for heterogeneity between immigrants and natives and between native men and women.

We now expand the model to allow for differences in the relative efficiency of native men and women in performing manual and non-manual tasks. Specifically, we assume that men have comparative advantage in the manual versus non-manual tasks relative to women, which leads to women providing lower manual relative to non-manual tasks relative to men. We re-write the aggregate supply of manual versus non-manual tasks in this economy, i.e., equation (9) as follows:

$$\left(\frac{M}{NM} \right) = \left(\frac{M_I + M_N}{NM_I + NM_N} \right) = f \frac{M_I}{NM_I} + (1-f) \left[g \frac{M_{NFem}}{NM_{NFem}} + (1-g) \frac{M_{NMen}}{NM_{NMen}} \right] \quad (9A)$$

where g is the share of non-manual tasks provided by native women (which is a monotonic transformation of the native female share of our sample of low-educated workers). In turn, the relative efficiency of all low educated workers in performing manual versus non-manual tasks can now be expressed as:

$$\left(\frac{e_M}{e_{NM}} \right) = \left[f \left(\frac{e_{mi}}{e_{nmi}} \right)^{\frac{1}{1-\alpha}} + (1-f) \left[g \left(\frac{e_{mFem}}{e_{nmFem}} \right)^{\frac{1}{1-\alpha}} + (1-g) \left(\frac{e_{mMale}}{e_{nmMale}} \right)^{\frac{1}{1-\alpha}} \right]^{\frac{1}{1-\alpha}} \right]^{(1-\alpha)} \quad (10A)$$

We can then substitute equation (10A) into equation (7) and rewrite the equilibrium provision of manual to non-manual tasks as a function of the relative efficiency of native men and women and immigrants in manual and non-manual tasks as follows:

$$\frac{M^*}{NM^*} = \left(\frac{\beta_L}{1-\beta_L} \right)^{\frac{\alpha\lambda}{(1-\alpha)\lambda+\alpha}} \left[f \left(\frac{e_{mi}}{e_{nmi}} \right)^{\frac{1}{1-\alpha}} + (1-f) \left[g \left(\frac{e_{mFem}}{e_{nmFem}} \right)^{\frac{1}{1-\alpha}} + (1-g) \left(\frac{e_{mMale}}{e_{nmMale}} \right)^{\frac{1}{1-\alpha}} \right]^{\frac{1}{1-\alpha}} \right]^{\frac{\lambda(1-\alpha)}{(1-\alpha)\lambda+\alpha}} \quad (11A)$$

Using equation (11A), we can compute the partial derivatives of the overall provision of manual to non-manual tasks in the economy with respect to f and g to assess how the economy relative supply increases or decreases with: (a) the share of foreign born workers, and (b) the share of female native workers, respectively. In particular, assuming that

$\left(\frac{e_M}{e_{NM}} \right)_i > \left(\frac{e_M}{e_{NM}} \right)_N$, we continue to have hypothesis no.2, i.e. $\frac{\partial(M^* / NM^*)}{\partial f} > 0$. However,

assuming that $\left(\frac{e_M}{e_{NM}} \right)_{women} < \left(\frac{e_M}{e_{NM}} \right)_{Men}$, it is immediate to derive hypothesis no.3, i.e.:

$$\frac{\partial(M^* / NM^*)}{\partial g} < 0.$$

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