Immigration, Family Responsibilities and the Labor Supply of Skilled Native Women*

Lídia Farré
Institut d'Anàlisi Econòmica - CSIC

Libertad González
Universitat Pompeu Fabra

Francesc Ortega
Universitat Pompeu Fabra

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Abstract: We investigate the effect of immigration on the labor supply of skilled native women. We present a simple time-use model that predicts that a reduction in the price of household services (such as cooking or cleaning) should lead to a reduction in the labor-supply gap between women with and without family responsibilities (such as caring for children or elderly). We test this prediction using data on Spain's large recent immigration wave. Methodologically we adopt a spatial correlations approach and instrument for current immigration using pre-existing ethnic networks. Importantly, our data allows us to measure accurately the number of immigrants, including those that are undocumented. First, we show that recent female immigration into a region increases the local availability of household services in that region and reduces their price. Second, our IV estimates suggest that immigration may have accounted for one third of the large increase in the employment rates of college-educated women with family responsibilities. In particular, it allowed them to return to work earlier after childbirth, to continue working while caring for male elderly dependents, and to postpone their own retirement when their husbands retire. Third, we also make a methodological contribution with important policy implications. We show that just a limited amount of registry data is necessary in order to conduct the analysis using annual data, as opposed to having to rely on the decennial Census. Overall, our results suggest that special visa programs targeted to household service workers can be highly effective in helping skilled women cope with child and elderly care. The latter seems particularly relevant in Europe, given the currently ongoing aging of the population.

Keywords: Immigration, Labor supply, Fertility, Retirement, Household services
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1. Introduction

There is a large literature addressing the effects of immigration on the host country's labor market. Most studies focus on the direct effects of immigration on the wages and employment opportunities of natives with the *same* skill level.[1] However, immigration may also affect the labor market decisions of natives with *different* skills through general-equilibrium effects. One such effect may arise if immigration increases the local supply of market-provided services that are close substitutes with housework (such as cleaning, cooking or child and elderly care). As a result, women that can afford to purchase these services may be able to shift time from housework toward market work.[2]

As pointed out by Kremer and Watt (2006), this particular channel through which immigration can affect the labor market of the receiving economy may be quantitatively important. Through a calibration exercise, they estimate that taking this form of skill complementarity into account implies that the immigration surplus in the US may be more than 10 times larger than previously thought.[3] In turn, Cortes and Tessada (2009) provide empirical evidence that supports this mechanism. Their estimates indicate that low-skilled immigration has led to a significant increase in the labor supply of highly educated women (those with a professional degree or a Ph.D.) in the US. This link between immigration and native female labor supply is present in other countries as well. Cortes and Pan (2009) show that educated women with young children in Hong Kong have been able to increase their labor market participation over the last decades thanks to an increased supply of foreign domestic workers.[4]

In this paper, we empirically analyze the effect of female immigration on the labor supply of skilled native women in Spain over the last decade, with an emphasis on the response by women with large family responsibilities. The responsibilities we have in mind are caring for young children, elderly dependents or retired husbands. The former has received some attention in the literature already (Cortes and Pan 2009). However, the latter two responsibilities have not been considered prior to our study. We argue that they are particularly relevant for Europe, where fertility rates are low but the population is aging rapidly due to large increases in life expectancy. As we argue in the next section, these care-giving tasks impose an important constraint on women's resource allocation.

[1] See, among many others, Card (1990), Borjas et al. (1996), Card (2001), Borjas (2003) and Ottaviano and Peri (2006).
[2] Standard aggregate production functions usually feature some complementarity between skilled and unskilled labor (positive cross-derivative). We are suggesting an additional channel that may potentially give rise to a much larger cross-skill complementarity.
[3] The surplus associated with a given immigration flow is defined as the increase in income, net of payments to immigrants. That is, the aggregate increase in income accruing to natives. Borjas (1999) estimates that the immigration surplus associated with a 10 percentage-point increase in the foreign-born share is around 0.1% of GDP.
[4] Hock and Furtado (2009) and Furtado and Hock (2010) suggest that immigration into the US may have increased the fertility rates of college-educated women through a reduction in the price of childcare.

Our paper contributes to the literature on the effects of immigration on the labor supply of female natives. First, we use data for Spain for the period 1999-2008. Over the last decade, Spain has experienced a very large wave of immigration. The foreign-born share in the working-age population increased from 3% in 1999 to 15% in 2008 (Population Registry). In addition, we believe that immigration may have a larger effect on the labor supply of women with family responsibilities in Spain than in the US or in northern European countries. As common in several Mediterranean countries and in Latin America, Spain is still characterized by geographically close family networks and a family-based provision of care for children and elderly dependents. As a result, Spanish females suffer a larger burden on their time than women in countries where the government plays a larger role (e.g. Scandinavian countries) or there is a larger supply of market-provided care (e.g. retirement homes in the US). This may account for Spain's relatively low female employment rates.[5]

Our paper also makes three methodological contributions. First, we focus on female immigration as our main explanatory variable. The reason is that employment in household services has been dramatically affected by female immigration. In 2008, 49% of recent immigrant women were employed as housekeepers or home-providers of child or elderly care.[6] In the same year roughly half of the recorded employment in household services was accounted for by female immigrants, compared to only 12% in 1999.

Secondly, we pay particular attention to the response of women whose labor supply is more heavily constrained by family responsibilities. In the data we are able to identify three types of family situations that impose a burden on women's time: the presence of young children, elderly dependents (typically parents or in-laws), and a retired husband. These responsibilities affect negatively women's labor supply, and may have persistent effects on their work careers. To the best of our knowledge, we are the first to study the effects of immigration on the two latter responsibilities. This fills an important gap in the literature.[7]

Third, we show the benefits of using even a limited amount of Registry data in the analysis. These benefits are twofold. First, Population Registry data make it feasible to conduct the analysis using the relatively small quarterly household surveys.[8] This has important implications for policy-making as it allows researchers to analyze the effects of an immigration episode with just a few years

[5] Despite large progress in recent decades, female employment in Spain remains lower than in the US and most Western European countries. In 2008, the female employment rate was 59% in Spain, compared with 64.5% in the EU-27 and 72% in the US. The gender gap in employment is also among the highest in industrialized countries (21% in Spain, 18% in the EU-27 and 10% in the US).

[6] We define recent immigrants as those that arrived in the last three years.

[7] Storesletten (2000) analyzed whether immigration policy alone can be used to solve the fiscal problems due to ageing in the United States.

[8] Aydemir and Borjas (2006) argue that estimates of regional immigrant concentration based on 5% Census samples (let alone the much smaller Labor Force Survey) may be very noisy, inducing substantial attenuation bias.

of data, as opposed to having to rely on Census data that, in most countries, become available only every ten years.[9] Second, and perhaps more specific to the case of Spain, it allows us to measure regional immigrant concentration accurately. In particular, we are very confident that our measure includes undocumented workers. The reason is that registration in the Local Population Registry is a requirement in order to have access to public healthcare and to be eligible in the event of an amnesty. The process of registration does not require proof of legal residence and the data is confidential (that is, cannot be used to expel undocumented migrants). The latter feature is crucial in our analysis, given that a substantial share of employment in household services is done informally.

Our analysis proceeds in three steps. First, we build a simple model of labor supply. The model shows that a reduction in the price of household services should lead to an increase in the labor supply of skilled native women with family responsibilities, relative to other skilled native women. Second, we analyze empirically the effects of female immigration on the household services sector, in terms of size (employment) and prices (wages in the sector). We define "household services" to include nannies (in-house childcare), housekeepers and in-house personal care workers. Third, we examine the effects of female immigration on the labor supply of skilled native women. We focus on highly educated women. Because of their high earnings potential, these women can afford to purchase household services. In contrast, low-educated women tend to earn lower wages, which makes unprofitable to hire someone to help at home in order to increase one's labor supply. Moreover, immigration is likely to affect low-educated women through an increase in the degree of labor-market competition in low-skill occupations.

Methodologically, we follow a spatial correlations approach. Identification of the labor supply effects is based on correlating changes in immigrant concentration at the regional level with changes in the size of the labor-supply gap between college-educated women with and without family responsibilities. Very relevant to this approach is the fact that there has been large variation in immigration rates across Spanish regions. Over the course of the last decade, immigration has generated large regional differences in the foreign-born share, which ranges from below 4% in some regions to almost 25% in others in year 2008. In order to provide a causal interpretation for our estimates, we adopt an instrumental variables approach based on ethnic networks (Card 2001).

We note that our test of the effects of immigration on the labor supply of skilled women differs from the tests already in the literature. The hypothesis derived from our model is that an increase in female immigration should lead to an increase in the labor supply of skilled women with family

[9] Several Scandinavian countries have high-quality, individual-level, Registry data with a spectacular wealth of information. While invaluable for research purposes, these data are unfortunately not available in other countries. Nevertheless, several other countries, such as Italy or Spain, do have high-quality population registry data, although with a limited scope in terms of variables.

responsibilities relative to skilled women without them. Previous studies (Cortes and Tessada 2009) have focused on the estimation of the effect on the labor supply of all highly skilled women. Our test is theoretically better grounded and sharpens the interpretation of the results as operating through the effect of female immigration on the supply of services that are most useful to women with family responsibilities.[10]

Our analysis produces several interesting findings. First, we find that recent female immigration into a region affected the cost and availability of market-provided household services in the region. We find evidence of a positive effect on the size of the household services sector, and a negative one on average wages in the sector. Second, we also find that immigration led to an increase in the labor supply of college-educated women with family responsibilities, relative to comparable women without. Specifically, our results suggest that immigration allowed women to return to work sooner after childbirth, to continue working while caring for (male) elderly relatives, and to postpone their retirement when their husbands retire. These effects are both statistically significant and quantitatively important, and operate mainly through the extensive margin of labor supply.

The remainder of the paper is organized as follows. Section 2 identifies several types of family arrangements that may represent a burden on women's time. Section 3 presents a time-use decision model. Section 4 describes the empirical strategy and Section 5 introduces the datasets, presents some descriptive statistics, and explains the construction of the main variables. The results are discussed in Sections 6 through 8. Section 9 concludes.

2. Family Responsibilities

The unequal gender distribution of tasks within households imposes a burden on women's labor supply. This is particularly the case in countries where families are important providers of care for children and elderly, as in Spain, and in most Mediterranean countries.

To illustrate this point Table 1 presents data on labor force participation (top panel) and time use (bottom panel) by gender and education. First, we note that participation rates are much lower for women than for men. In the period 2005-2008, 41% of all working-age women were out of the labor force, compared to only 13% for men. Interestingly, the majority of these women (62%) reported that family responsibilities were the main reason for not participating in the labor market, while only 4% of men reported them as the main reason.[11] Second, college-educated women display much higher

[10] Similar to us, Cortes and Pan (2009) focus on the gap in participation rates between women with children below age 5 and mothers of older children.

[11] Table 1 refers to the period 2005-2008 only because the classification of "reasons to be out of the labor force" in the Spanish Labor Force Survey changed in 2005.

labor market participation (only 11% were out of the labor market). However even for those women, family responsibilities were the main reason to be out of the labor force.

Next, we consider three events (family responsibilities) that may affect substantially the labor market participation of skilled females. It is well known that maternity and child rearing influences the labor supply decisions of women.[12] This can be seen clearly in our data as well. In column 5 the non-participation rate of college-educated women with young children (age 7 or below) is only slightly higher than for female college graduates in general. However, 76% of these women reported that family responsibilities were the main reason to exit the labor force.[13] Scrolling down the column we can see that the employment rates of college-educated mothers were lower (77% versus 80% among all female college-graduates) and spent almost two extra hours per day doing housework (6.1 versus 4.4 daily hours among all female college graduates).

The second family responsibility that we consider is having an elderly dependent in the household, which has been shown to affect the labor supply decisions of women in the household (Crespo 2007, Ettner 1995).[14] The frequency of this event is increasing rapidly as a result of a large reduction in mortality among the elderly in Spain.[15] Columns 6 and 7 in Table 1 present data on participation and time use for college-educated women with elderly male and female dependents. Having an elderly dependent in the household does not seem to affect labor market participation rates. Although, interestingly, among those college-educated women with a male elderly dependent (typically, her father or her father in-law) 44% report that family responsibilities are the main reason for having exited the labor force, compared to only 39% among those with a female elderly dependent. There are much larger differences in employment rates, as seen in the bottom panel. The employment rate among college-educated women with a male elderly dependent is 66%, compared to 83% for those with a female elderly dependent (and 80% for college-educated women in general). Along these lines, we also find a 0.4 daily hours difference in housework between the two groups.[16] These findings are consistent with the evidence in Del Boca et al (2005) for Italy, who find that grandmothers play an important role in the labor supply of women with children.

[12] See for example Browning (1992) and Waldfogel (1998).
[13] In our data one out of three college-graduate women had children younger than eight.
[14] This is particularly so in countries as Spain, where families play a key role in caring for the sick and the elderly. For instance, the percentage of institutionalized elderly in Spain is 2.9%, compared with 4.3% in the United States and 7.9% in Sweden (Jacobzone, 1999).
[15] Only 5% of female college-graduates had an elderly person living in their household. This grossly underestimates the number of these women that devote part of their time to providing elderly care. Often elderly parents or in-laws live outside the household but in close proximity. We cannot identify these situations in our data.
[16] None of our datasets contains information on the time devoted to elderly care or on the health status of the members of the household. We can thus only identify potential care givers. For instance, we define as elderly dependent anyone 65 or older (other than the husband) that lives in the household. This may account for the small differences in time devoted to housework associated to elderly dependents, according to our definition.

We also consider a third type of family responsibility: a retired husband. In the retirement literature it is well documented that women tend to drop out of the labor force permanently at the time of their husbands' retirement, despite typically being a few years younger (Blau 1998). Joint retirement decisions may be due to complementarities in leisure between married couples.[17] However, this effect is found to be gender asymmetric (Jiménez-Martín et al 1999), that is, in those instances where the wife reaches retirement age earlier than the husband, he usually does not stop working. This asymmetry suggests that there may be an increase in housework associated to the husband's retirement due, for example, to a greater need for home cooking and cleaning. In some instances, women may decide to exit the labor force as well in order to satisfy those needs. The last two columns of Table 1 compare the participation decisions of college-educated women age 50 or above, depending on the retirement status of their husband. First, we confirm that joint retirement is a frequent event: a retired husband is associated to much lower participation rates. Interestingly, 41% of these women report family responsibilities as the main reason for having dropped out of the labor market. We also note that employment rates are much lower for women with a retired husband (57% versus 76% among 50-plus year-olds with a college degree) and they spend about half an hour more per day on housework.

These figures suggest that having young children at home, a male elderly dependent, or a retired husband are all events that impose an additional burden on the time allocation of (college-educated) women. These women will tend to have a relatively high earnings potential, given their high education level. As a result, they may be buyers of household services and, potentially, may want to increase their labor supply in response to a reduction in the price of these services. The model in the next section analyzes this time-use problem.

3. A simple time-use model

As we show later on, an inflow of immigrant women into a regional economy leads to a reduction in the price of household services in that region. The model here focuses on the effects of a reduction in the price of household services on the time-use of skilled women. The goal is to derive a testable prediction that will be carried out in the following sections.

We consider a time-use problem in the tradition of Gronau (1977), where an individual has to allocate time between three competing uses: market work, home production and leisure. Following Cortes and Tessada (2009), we include the option of purchasing household services as an alternative to using one's own time for home production.

[17] Laitner and Silverman (2008), for example. study retirement decisions in an environment where consumption and leisure are non-separable.

More specifically, an individual maximizes a utility function of the form: $u(y) + \phi(l)$, where y is consumption and l is leisure, operating under a budget constraint, a time constraint and a home production constraint. Respectively,

(1) $y + px = wn + I$

(2) $n + l + h = 1$

(3) $x + \alpha f(h) = R$.

Consider the budget constraint (1). The left-hand side is the total expenditure on consumption good y (which price has been normalized to one) and in household services (x units times price p). The right-hand side is total income, which is the sum of labor income (n hours of work times hourly wage w) and wealth I. Equation (2) is the time constraint: one unit of time can be used for market work (n), for leisure (l) or for home production (h). Obviously, we restrict all quantities to be non-negative.

Equation (3) states that home production can be undertaken either through one's own time h (delivering $\alpha f(h)$ units of home output) or by purchasing household services x in the market. Note that there is a required level of home production $R>0$, which we interpret as family responsibilities.[18] These responsibilities do not generate utility but impose a constraint on resource allocation.[19]

Departing from Cortes and Tessada (2009), we assume that all individuals face the same wage rate but there is heterogeneity in the burden imposed by family responsibilities. In particular, some individuals have family responsibilities that need to be fulfilled ($R>0$) while others do not ($R=0$). These care-giving services can be bought in the market (x) or produced using one's own time (h). Clearly, individuals without family responsibilities will not purchase any of these household services and will not devote any time to home production, that is, $x = h = 0$. Their time will be divided solely between market work (n) and leisure (h).[20]

We are interested in the comparative statics of a change in the price of household services. In particular, we focus on the differential response of individuals with and without family responsibilities. Let us start by examining the optimality conditions associated with the time-use problem of individuals *with* family responsibilities ($R>0$). First, the time devoted to home production is determined by equating the value of the marginal product of home production (where p is the price of household services) to its opportunity cost (given by the wage rate):

[18] Without loss of generality we assume that all constraints are binding.
[19] We assume that functions ϕ, u, and f are increasing and strictly concave.
[20] Cortes and Tessada (2009) focus on individual heterogeneity in wages, assuming that all individuals have the same family responsibilities R.

(4) $w=p\alpha f'(h^*)$.

We denote the optimal home production time by $h^*(w,p)$, which is decreasing in w and increasing in p. Second, the demand for household services is given by

(5) $x^*(w,p,R) = R - \alpha f(h^*)$.

Finally, consumption and labor supply, (y^*, n^*), are pinned down by the following two equations:

(6a) $w = MRS(1 - h^* - n , y)$

(7a) $y = wn + I - px^*$.

Equation (6a) equates the marginal rate of substitution between leisure and consumption to the ratio of prices ($w/1$), and equation (7a) is the budget constraint after plugging in the optimal expenditure in household services.[21] [22]

We now turn to the optimal time use for individuals *without* family responsibilities ($R=0$). Trivially, for these individuals $h^* = x^* = 0$ and the amount of work and consumption are given by the solution to the following system of equations:

(6b) $w = MRS(1 - n , y)$

(7b) $y = wn + I$.

We note that the time allocation for these individuals is not a function of the price of household services.[23] The proposition below summarizes the effects of a reduction in the price of household services on the time-use allocation of individuals with and without family responsibilities.

[21] $MRS(l,y) = \phi'(l)/u'(y)$.

[22] It can be shown that if w is high enough relative to p, market work hours (n) and purchases of household services (x) are both positive. The intuition is straightforward: individuals with a high wage have a high opportunity cost of time. For them it pays off to hire someone else (at rate p) and offer their own time to the market (at rate w). See Cortes and Tessada (2009) for a proof.

[23] This is a feature of the Cortes and Tessada (2009) model. It would not be the case if the home-produced good entered the utility function.

Proposition 1. *As a result of a reduction in the price of household services (p),*

i) The time use of individuals without family responsibilities is unaffected.

ii) Individuals with family responsibilities reduce the time devoted to home production (h) and increase their purchases of household services (x*).*

iii) If home production is sufficiently productive (high α), a reduction in p leads to an increase in the labor supply of women with family responsibilities.

Proof. In appendix.

The first statement in the Proposition follows trivially from the fact that individuals without family responsibilities never devote any resources to family responsibilities. Statement ii) is also straightforward. Equation (4) implies that a reduction in the price of household services, *p*, leads to a reduction in the time devoted to home production and, thus, an increase in the purchases of domestic services.

Regarding the third item in the Proposition, in general, the effect of a reduction in the price of household services on labor supply depends on parameters. The reason is the standard opposing income and substitution effects (Cortes and Tessada, 2009). The intuition behind our sufficient condition is the following. When the home production technology is highly effective, the bulk of family responsibilities is satisfied by means of one's own time, rather than by purchasing household services. As a result, a reduction in the price of these services has a negligible income effect. Therefore, a marginal reduction in the price of household services leads to a reduction in housework, an increase in the purchases of market-provided household services, and a larger supply of labor to the market. Whether the sufficient condition holds (point iii in the proposition) is an empirical question.

Our focus is the time-use of highly skilled individuals. Nevertheless we devote two comments to the effects of a reduction in the price of household services on the choices of less skilled individuals. First, low-wage individuals with family responsibilities will tend to home-produce using their own time. It does not pay off to pay someone else *p* units per hour in order to earn *w* units per hour when these two prices are similar. Furthermore, in our application the reduction in the price of household services is triggered by immigration. Low-wage native individuals are likely to face greater labor market competition as a result of large recent immigration flows. This effect of immigration will be confounded with the cheaper household services. For very low-wage natives, the former is likely to dominate since these individuals will most likely not employ household service workers.

In conclusion, this section has shown that a reduction in the price of household services will (under some conditions) lead to an increase in the labor supply (to the market) of highly skilled individuals with large family responsibilities. In the model, the time use of highly skilled individuals without family responsibilities remains unaffected. Therefore the key implication of this section is that a reduction in the price of household services will lead to an increase in the labor supply of skilled women with family responsibilities relative to skilled women without responsibilities.

4. Empirical Strategy

This section presents our empirical approach and identification strategy. Methodologically, we adopt a spatial correlation approach. Namely, in our main regression models we correlate changes in the labor supply of skilled native females with female immigration rates across Spanish regions. We use instrumental variables to identify causal effects.

Our main explanatory variable is a measure of immigrant concentration at the regional level. Specifically, we use the number of females with foreign nationality residing in the region at the beginning of the year, normalized by the working-age female population in the region at the beginning of the period. For short, we refer to this variable as the Female Immigrant Share (FIS).[24] Our decision to use the FIS built using Registry data as the main explanatory variable in the analysis is based on three reasons. First, we are confident that our variable accurately reflects the size of the immigrant population, including also undocumented workers. This feature is important in our analysis, since our focus is on the relationship between immigration and the supply of household services, which is a sector with a high rate of informal (off-the-books) employment. Second, we focus on female immigrants because the overwhelming majority (95%) of workers in this sector are women. Third, we note that our female immigrant share does not distinguish immigrants by educational attainment. The reason is that years since arrival appears to be more tied to employment in the household services than (low) educational attainment. In particular, our data show that half of all female recent immigrants (in the sense of not having Spanish nationality) are employed in household services.[25]

Our empirical analysis proceeds in two steps. First, we examine the connection between female immigration and the household services sector (section 4.1). In particular, we are interested in establishing whether immigration flows into a region drive down the price of household services in

[24] Due to lack of data it is infeasible to use the price of household services as the main explanatory variable, as Cortes and Tessada (2009). We can only build a noisy estimate of the price for a limited number of years. Moreover, measurement error problems are likely to be amplified by the high degree of informal employment in this sector.
[25] Bertoli et al (2010) show that the average wages of recently arrived Ecuadorians in Spain with and without a college degree are extremely similar. Wage differences within this group only arise across occupations.

that region. Second, we estimate the effects of immigration on the labor supply of female natives (section 4.2). Building on Proposition 1, our main testable hypothesis is that immigration will lead to increases in the labor supply of skilled women with family responsibilities relative to skilled women without such responsibilities.[26] After discussing our main specifications, section 4.3 describes our instrumental-variable approach.

4.1. Immigration and household services

Our goal here is to establish a link between female immigration flows into a region and the price and availability of household services sector in that region. In particular, we are interested in the effects on the size (measured by employment) of the sector as well as the average wage received by household service workers.

We propose the following empirical models:

$$EHS_{r,t} = \lambda_t + \phi_r + \beta_e FIS_{r,t} + \varepsilon_{r,t} \quad (8)$$

$$WHS_{r,t} = \lambda_t + \phi_r + \beta_w FIS_{r,t} + \varepsilon_{r,t}\,. \quad (9)$$

The dependent variables are, respectively, region *r*'s total employment in household services in year *t*, normalized by the working-age female population in the region (*EHS*) and the average hourly wage (in logs) in the household services sector (*WHS*). In both equations, the main explanatory variable (*FIS*) is the female immigrant share in the region at the beginning of the year. The specification includes year (λ_t) and region (ϕ_r) fixed effects. Accordingly, identification is based on within-regional changes over time in the household services sector and the annual female immigration rate in the region.

Our coefficients of interest, β_e and β_w, indicate to what extent immigration flows are associated with changes in employment and average wages in the household services sector. Note that β_e will be zero if either no immigrant becomes employed in household services, or if immigrants fully displace natives working in that sector. A positive coefficient implies that female immigration is associated with a net increase in the size of the household services sector. Naturally, if immigration did not affect the size of the sector we would not expect changes in wages either ($\beta_w = 0$).

[26] We do not have clear predictions on the effect of immigration on the labor supply of low-skilled natives. As we argue below, immigration will affect the price of household services and possibly other low skilled occupations. Thus, immigration increases the degree of labor market competition faced by low skilled natives, possibly depressing their wages. This mechanism is not present in our time-use problem, which assumes (skilled) wages to be independent of the price of household services.

4.2. Immigration and the labor supply of skilled women with family responsibilities

We next analyze the effects of immigration on the labor supply of skilled native women. In particular, we want to test the prediction that immigration will increase the labor supply of skilled women with family responsibilities relative to skilled women without responsibilities.

We estimate the following individual labor supply model:

$$(10) \qquad y_{irt} = \lambda_t + \mu_r + \alpha D_{irt} + \beta FIS_{rt} + \gamma D_{irt} FIS_{rt} + X'_{irt}\Lambda + \varepsilon_{irt}.$$

The dependent variable (y) is a measure of labor supply (employment or hours) for highly skilled individual i located in region r in year t. The right-hand side contains year (λ_t) and region (ϕ_r) fixed-effects, a dummy variable (D) that takes value one when the individual has any of the family responsibilities identified in Section 2, the female immigrant share (FIS) at the beginning of the year, an interaction of this variable with the dummy for family responsibilities ($D*FIS$) and, finally, a vector of individual controls (X), such as age, marital status, number of children in the household, and so on.[27] We allow the disturbance term to be correlated across individuals in the same region-year cell.

We expect $\alpha<0$, since family responsibilities impose a burden on women's time, which is likely to constrain their labor supply. Based on Proposition 1, we expect the coefficient on the female immigrant share (β) to be zero since the time use of women without family responsibilities should not be affected by changes in the price of household services (driven by female immigration). However, there are reasons to believe that β may be negative (if immigrants compete in the labor market with natives) or positive (if natives and immigrants are complementary factors in production).

Estimation of β was the main goal in Cortes and Tessada (2009). However, our model suggests that the key parameter is γ, the coefficient associated to the interaction term ($FIS*D$). In particular, we expect a positive value of γ. In words, we expect increases in the female immigrant share to lead to increases in the labor supply of skilled females with family responsibilities relative to skilled women without responsibilities.

Identification is based on correlating changes in the gap between the labor supply of skilled women with family responsibilities and similar women without responsibilities, to female

[27] In the empirical analysis we also allow the effect of immigration to vary by type of family responsibility.

immigration rates across Spanish regions. Presumably, other channels by which female immigration can affect the time use of skilled native females (e.g. labor market competition) will affect both groups of skilled women similarly.[28]

4.3. The Instrument

Clearly, OLS estimates of equation (10) are likely to suffer from an endogeneity problem. If immigrants move to regions where *skilled* natives are increasing their labor supply for reasons other than immigration, then the OLS estimate will be biased upwards. However, it is also possible that recent immigrants and highly skilled natives are attracted to different regions (e.g. due to skill-specific regional labor demand shocks), which would lead to a downward bias.[29]

Following Cortes and Tessada (2009), we account for the potential endogeneity of migrants' location choices using an instrumental variables approach. Specifically, we build a version of the widely used ethnic networks instrument à la Card (2001). This instrument exploits the fact that recent immigrants tend to locate in regions with large communities of previous immigrants from the same country of origin. More formally, consider the following predictor for the size of the immigrant population in a region r in a given year t:

$$Z_{r,t} = \sum_c Z_{c,r,t} = \sum_c \left(\frac{FB_{r,c,t_0}}{FB_{c,t_0}} \right) FB_{c,t} \tag{11}$$

for $t_0<t$. The term in brackets denotes the share of the foreign-born population from country of origin c living in Spain's region r in some base year t_0. As discussed below the base year in this analysis is 1991. $FB_{c,t}$ is the total size of the population from country c residing in Spain in year t. We include both men and women since our definition of networks is based purely on ethnicity, not gender.

Our main explanatory variable will be the female immigrant share (*FIS*), defined as the number of foreign females in a region in a given year relative to the 1991 female working-age population. Consequently, we shall instrument it with the predicted share of immigrants (*ZS*), defined as the predicted immigrant population (*Z*) relative to the 1991 working-age population.

Our empirical models include region (and year) fixed effects. Thus, effectively, the instrument is used to predict regional *changes* in the immigrant population by using past *time-invariant* regional data interacted with the current change in the Spain-wide foreign-born population.

The instrumental variables approach based on ethnic networks has been widely used in countries

[28] Implicitly, we are assuming that family responsibilities are exogenous to unobserved determinants of labor supply.
[29] If we analyzed the effects of unskilled immigration on the labor supply of unskilled natives, this argument would not apply. In that case, we would expect OLS to be unequivocally biased upwards.

such as the US, with a long history of immigration. The immigration episode in Spain started timidly during the second half of the 1980s and accelerated over the 1990s. Thus we employ data from the 1991 Census to compute the distribution of immigrants by country of origin across Spanish provinces in that year, and then predict the distributions over our period of analysis. Our exogeneity assumption is that regional shocks to the demand for female *skilled* labor between 1999 and 2008 are uncorrelated with immigrant location patterns prior to 1991. Section 6.1 provides a detailed discussion on the validity of the instrument for the Spanish case.

5. Data

5.1. Sources and Definitions

We exploit the regional variation in migration densities across the 52 Spanish regions. We combine data from four different sources: the Labor Force Survey (1999-2008), the Household Budget Survey (1999-2005), the Local Population Registry (1999-2008), and the 1991 Decennial Census.

Our main data source is the Labor Force Survey (LFS or "Encuesta de Población Activa"). This survey interviews about 60,000 households on a quarterly basis and is essentially standardized with the labor force surveys in other European countries. We use the second quarter interviews for each year between 1999 and 2008.[30] We use the Labor Force Survey (LFS) to calculate the share of (female) workers employed in household services by region and year, the dependent variable in equation (8). The Labor Force Survey, however, does not provide information on wages or earnings. Therefore, in order to construct the dependent variable in the wage equation (9) (average hourly wages in household services by region and year), we combine data on hours worked by household service workers from the LFS with information on expenditure on household services from the Household Budget Survey (HBS). Average hourly wage of household service workers is constructed as total expenditure on household services in a region and year, divided by total hours worked by household service workers in the same region and year.[31]

We also use the LFS data to build our two measures of individual labor supply (a binary employment indicator and a continuous variable of weekly hours worked) in equation (10), the vector of individual characteristics (age, gender, education, marital status, and number and age of children in the household), and to construct our indicators for women with family responsibilities. More specifically, we define four indicator (or dummy) variables for the following situations. The first indicator identifies women with young children (younger than 8 years old). The second indicator

[30] We focus on the second quarter of each year to minimize seasonality effects.
[31] The HBS does not report the 52 regions, but it contains information at a higher level of regional aggregation (18 regional units). The wage analysis is aggregated accordingly.

(male elderly dependent) takes a value of one for women that live in households where there is a male 65 or older (other than the husband). Typically, this is the woman's father or father-in-law. As discussed earlier, this definition is somewhat limited. We do not know whether the woman in providing care services for this elderly co-resident. Likewise we do not know if women are caring for other elderly that live in different households. The third indicator (retired husband) takes a value of one if the husband is 65 or older, the legal retirement age in Spain, or while being younger he has already retired.[32] Finally, we build an indicator (family responsibilities) that takes a value of one if any of the previous four indicators is one.

Our third source of data is the 1991 Spanish Decennial Census. We use the Census in the construction of the instrument (*Z*) and take 1991 as the base year. We compute the proportion of immigrants that lived in each Spanish region in 1991, separately by country of origin.

Finally, we use data from the Local Population Registry ("Padron Continuo") to construct immigration rates. The Registry is collected by municipalities and published annually since 1996. We use these data in the construction of our instrument (*Z*) and our main explanatory variable, the female immigrant share (*FIS*). The Registry reports the population in each municipality on January 1st, providing a limited amount of demographic information (age, gender, nationality, and country of birth). [33] All immigrants (and natives) have an incentive to register in the Local Population Registry, as this is necessary to have access to public healthcare and education. In particular, undocumented migrants also register since it is well known that being in the Registry is a valid proof of residence in the event of an amnesty. At the moment of registration no proof of legal residence has to be shown. Thus these records are not useful to identify undocumented migrants. Accordingly the Registry provides a very accurate measure of immigrant concentration.

In our regression models we instrument *FIS* using *ZS*, which is defined as the predictor for the foreign-born population in a given region and year over the 1991 working-age population in the region. Thus, both variables have a common denominator. We prefer to normalize stock variables using the 1991 population, as opposed to the current population in the region, because it is more plausibly exogenous to current labor market conditions.

5.2. Measurement Error

As pointed out by Aydemir and Borjas (2006), the spatial correlations approach is likely to suffer, in practice, from substantial attenuation bias due to measurement error in the main explanatory variable

[32] The vast majority of individuals age 65 or older are retired (96%), according to our data.
[33] The Registry data made publicly available contain no information on educational attainment.

(some measure of regional immigration concentration).[34] Their warning is highly relevant in our analysis, since our main data source is the relatively small (compared with the Census) quarterly Labor Force Survey.[35] In addition, our focus on the household services sector requires a measure of the immigrant population that accurately accounts for undocumented migrants.

Fortunately, we can get around this data limitation thanks to the existing Population Registry data. The whole population, rather than a sample, is in the Registry. Thus we can argue that our main explanatory variable, the *female immigration share* (*FIS*), is virtually free of measurement error. To construct this variable we employ women with foreign nationality and include all education levels (since no education data is available in the Registry). We define immigration based on nationality rather than country of birth, which provides a better measure of recent immigration.[36]

For comparison purposes, we construct two alternative measures of immigrant concentration using the Labor Force Survey. First, following the approach in Cortes and Tessada (2009), we compute the *female unskilled share* (*FUS*) in each region and year, including both natives and immigrants. Low-skill workers are defined as those having at most a high-school degree. As discussed earlier, educational attainment is very loosely correlated with occupation in the case of recent immigrants in Spain (Bertoli et al 2010). Thus we only use this measure as a robustness check. Second, to investigate the effect of measurement error in the immigrant concentration variable we also build the *female immigrant share* using the Labor Force Survey (*FISS*).[37] As expected, for some regions in the early years in our sample period, the number of observations is quite low.

5.3. Descriptive statistics

Our identification strategy exploits the variation in immigrant concentration across regions. Fortunately, the size of immigration flows over the last decade has differed a great deal across Spanish regions. Figure 1 plots the regional distribution of immigrants in 2008 (as a fraction of the working-age population). Regions on the Mediterranean coast, Madrid and the islands have been the main hosting regions. The foreign-born share in many of these areas (e.g. Alicante, the Balearic

[34] Aydemir and Borjas (2006) focus on regression models where the dependent variable is the wage of a given group and the main explanatory variable is the immigrant share in the same group. In our case, the dependent variable of interest is the labor supply of skilled natives and we are examining a cross-skill effect.
[35] Conducting our analysis using solely Census data for our main variables would require waiting for several years until the 2011 Census data becomes available. Clearly, policy-makers need more timely analysis to make pressing policy decisions.
[36] After a few years of residence many immigrants become naturalized. At the same time, we have shown that the fraction of recent female immigrants employed in household services declines rapidly with years of residence in Spain. Thus a measure of recent immigration (foreign females) seems more appropriate than the stock of foreign-born females.
[37] These measures of immigrant concentration are also normalized using the 1991 female working-age population.

Islands and Girona) increased from around 5% in 1999 to more than 20% in 2008. In contrast, in the South and West immigration rates were very low, with foreign-born shares in 2008 well below 5%.

Compared to natives, recent immigrants were on average younger, less educated, and more heavily concentrated in low-earnings occupations. In 2008, immigrants were, on average, 5 years younger than natives, and had slightly lower levels of education (85% had at most a high-school degree, compared with 82% of natives). Despite the very small difference in this measure of educational attainment, immigrants were disproportionately employed in low-earnings occupations (83% compared with 33% of natives). In particular, a large number of recent female immigrants held household service jobs.[38] Fuelled by immigration, this sector expanded vigorously. As a share of total employment, it increased from 3% in 1999 to 4.4% in 2008.

Table 2 (bottom panel) summarizes our main explanatory variables, that is, our measures of female immigrant concentration. Our main variable is the Registry-based female immigrant share (*FIS*). For the average region, this share increased from 2.6% to 17.9% between 1999 and 2008. The row below reports the analog variable but computed using the Labor Force Survey (*FISS*), with very similar mean values. The share of unskilled females (*FUS*) also increases over the period, from 90% to 96%. Finally, the last row of the bottom panel reports the average predicted share of foreign-born individuals (*ZS*), which increased by 16 percentage points between 1999 (4.5%) and 2008 (21.1%).

The top panel of Table 2 presents summary statistics regarding the labor supply of native women across education groups, distinguishing by type of family responsibility. We shall focus on the last two columns, which report on women with a college degree. Several points are worth noting. First, there was remarkable skill upgrading among the Spanish women between 1999 and 2008. Over this period the share of women with a university degree doubled (from 4.6% to 9.3%). Second, roughly 35-40% of college-graduate women are in one of the three family responsibilities that we have defined. By far, having young children at home is the most common responsibility among these women, affecting 38% of them in 1999 and 33% in 2008. In comparison, the group of all women (in age group 25-64) is characterized by a lower share of mothers of young children and a higher frequency of elderly dependents or retired husbands, reflecting the lower average age among college-graduate women. Third, the employment rates of college-educated women increased by 8 percentage points, from 79% to 87%. In the same period the employment rates of all women increased by 17 percentage points, from 38% to 55%. These large increases reflect the strong economy of this period.

[38] We define recent immigrants as those that arrived in Spain less than 3 years ago. These figures suggest that it is more relevant to distinguish immigrants by years since arrival, rather than by educational attainment. Reinforcing the small effects of education on the wages of recent immigrants, Bertoli et al (2010) show that among recent Ecuadorian migrants in Spain in 2007 the average annual labor income of individuals with and without a college degree were practically the same.

Interestingly, the employment rates of skilled women with young children and retired husbands also increased substantially during the period, by 10 and 6 percentage points respectively. We next turn to work hours. Clearly, college-graduate women work more hours on average than women as a whole (31.4 versus 19.2 in 2008, respectively).[39] We also note that family responsibilities are associated to lower hours of market work. Moreover, between 1999 and 2008, the average weekly hours of work increased by 3 hours for college-educated women as a whole (from 28.5 to 31.4) and by roughly the same amount for those with young children (from 26.5 to 29.4) and for those with a retired husband (15.4 to 19.9). In contrast, the average hours of work among skilled women with male elderly dependents fell by 3 hours. This reflects the increase in the frequency of this event, which has led to lower employment rates among this group of women.

6. Instrument validity

We follow an instrumental variables approach in order to provide a causal interpretation of the associations modeled by equations (8) through (10). Following Card (2001), we aim at exploiting the influence of ethnic networks by country of origin established in the past on the location choices of current immigrant arrivals from that same country of origin. The validity of this instrument has been argued extensively in applications involving US data. It is less clear that ethnic networks are helpful in predicting actual immigration flows in countries with a shorter history of immigration.[40] As a sign of hope we provide the following figure. According to the National Immigrant Survey ("Encuesta Nacional de Inmigrantes"), over 80% of immigrants in Spain in 2007 reported that they had a local contact (a friend or relative) that they could go to upon arrival in Spain. This suggests that the first location upon arrival in Spain was, at least in part, driven by networks of friends and relatives from one's country of origin. Next, we discuss the exogeneity and relevance of the instrument in the context of our application.

6.1. Exogeneity

As explained earlier, we instrument the female immigrant share (*FIS*) using the predicted stock of immigrants as a share of the 1991 working-age population (*ZS*), where the latter is the sum of country-specific predictors for each origin country.

[39] Our computation of the average hours of work includes women with zero hours of work. Thus changes in participation rates also affect average hours.

[40] Gonzalez and Ortega (2009) are the first to build a version of the ethnic networks instrument using Spanish data. Unlike here, their predictor does not use Population Registry data, disaggregates immigration flows by education, and covers only the period 2001-2006.

Instrumental variables estimation of equation (10) will be consistent provided that the geographical location patterns of the 1991 stock of immigrants are uncorrelated with region-specific shocks that affect the labor supply of skilled native women between 1999 and 2008. Note that the typical analysis of the labor market effects of immigration using the ethnic networks instrument has to rely on a stronger assumption. Namely, it has to assume that shocks to the labor demand for, say, unskilled labor in the past are uncorrelated with recent shocks to the demand for that same type of labor. Our assumption would only be violated if the regions that received above-average aggregate economic shocks in the mid 1980s have also received systematically high (or low) shocks to female skilled labor over the period 1999-2008.

Next, we provide two pieces of evidence that support our exogeneity assumption. First, it is informative to compare the current location choices of the two groups that have a relatively long history of immigration into Spain, namely, Latinos and Moroccans. The predictive power of the instrument is primarily based on the networks of these two groups.[41] Specifically, we compute each region's share in the total Moroccan population and the analogous Latino share using the Population Registry in 2008. Figure A1 in the Appendix reports these values. Note first that the Latino and Moroccan shares are positively correlated. This is not surprising since large provinces have larger shares of all immigrant groups. The correlation coefficient is 0.84, but drops to 0.44 when we exclude the four largest provinces. The Figure also reveals important differences in the distribution of the two ethnic groups. For instance, in 2008 Madrid hosted 12.3% of all Moroccans and 25.7% of all Latinos.[42] Finally, these differences have a clear geographic interpretation. Below Barcelona and Madrid, all other provinces with an over-representation of Moroccans lie along the Mediterranean coast.[43]

These observations have two important implications. Firstly, the geographic distribution of immigrants differs by country of origin, which suggests that current local economic conditions are not the only determinant of migrants' location. There is room for other variables, such as ethnic networks. Secondly, at least for the case of Moroccans, proximity to the country of origin seems to be a key determinant of current location. To the extent that earlier Moroccans also took this into account, distance is another reason that can account for the predictive power of the 1991 shares by country of origin that is not related to current local economic conditions.

[41] Grouping Latin American countries together is done partly because of casual evidence that ethnic networks often spill over from one country of origin to others that share a common language and partly because of the coarse partition of countries in the 1991 Census.
[42] In comparison, Barcelona hosted 17.7% of all Moroccans and 17.0% of all Latinos in 2008.
[43] Murcia (7.9%), Malaga (5.5%), Almeria (5%) and so on.

Our second piece of evidence is based on the main determinants of the 1991 geographical distribution of immigrants. We show that the relative size (in terms of GDP) and the sectoral composition of each region in 1991 account for much of the variation in the distribution of immigrants at that time, while they do not appear to be correlated with the 1999-2008 increase in the regional demand for female skilled labor. This evidence supports the exogeneity assumption required for the consistent estimation of (10) using the ethnic networks instrument.

Let us start by analyzing the determinants of the cross-sectional distribution of immigrants in 1991. We estimate a cross-sectional regression where the dependent variable is the foreign-born share in 1991 at the regional level. The right-hand side variables are the economic size of the region (measured as the regional share in the national GDP) and its sector composition (value added in the primary sector and in tourism plus retail over total value added at the regional level). The results are presented in Table A1 in the Appendix (column 1). Clearly, the relative economic size and the share of services (tourism and retails) over GDP are both highly significant determinants of the foreign-born share.[44] Together these variables account for an 89% of the total variation in the data.

We next examine whether these 1991 variables are correlated with the evolution of the labor supply of skilled women. In doing so, we estimate the previous cross-sectional regression, but replacing the dependent variable by the increase in the regional employment-population ratio of college-graduate females between 1999 and 2008. Column 2 in Table A1 presents the results. None of the explanatory variables are now statistically significant and the associated R^2 is very low. In conclusion, the main determinants of the 1991 location of immigrants do not appear to be correlated with recent changes in the labor supply of college educated women. Of course, we cannot rule out that other determinants of the past location of immigrants may be correlated with current changes in the demand for skilled female labor. However, on the basis of the high goodness of fit of the first regression (column 1, Table A1) this seems unlikely.

6.2. Relevance

Having argued that it is reasonable to assume that the cross-sectional distribution of immigrants in 1991 is uncorrelated to shocks to the labor demand for skilled females over the last decade, we now turn to examining the relevance of our instrument. That is, we now evaluate the predictive power of *ZS*, the predicted immigrant share, on the actual annual immigration rates over the period 1999-2008.

More specifically, we turn to the first-stage regressions associated to the regression model (10) and test the null of a weak instrument. Table 3 presents the results. Let us focus first on the top panel,

[44] The tourism sector (restaurants and hotels) as well as the retail sector employ a large proportion of low-skilled workers and are thus very popular occupations among immigrants.

where the instrument (*ZS*) has been built using Population Registry data (and the 1991 Census). The first column presents our main specification, where the female immigrant share has also been built using the Population Registry. The coefficient associated to *ZS* is 0.288, positive and highly significant. The associated t and F statistics are, respectively, 8.1 and 65.5, which allow us to clearly reject the null of weak instruments.[45] The partial R^2 is 16%. In words, a predicted increase in the immigrant population of 100 individuals in a given province between one year and the next is associated to an actual increase of almost 30 foreign females. There are at least two reasons that can account for a coefficient lower than one. First, even if networks accounted perfectly for each immigrant's first location in Spain, local labor demand shocks taking place later in time may induce some relocation. Second, as time goes by, some foreign-born individuals will become Spanish citizens and, therefore, will stop counting toward the population of foreigners. Columns 2 and 3 report on the ability of the instrument to predict the female unskilled share (*FUS*) and the female immigrant share built using survey data in place of the population registry (*FISS*). In both cases, the main coefficient of interest ranges between 0.2 and 0.3, and remains highly significant, even though the partial R^2 falls substantially.

The benefits from using Population Registry data are illustrated in the bottom panel of Table 3. Absent these data, we would have had to build our instrument and the immigrant concentration variables using the quarterly Labor Force Survey (and the 1991 Census). As noted by Borjas and Aydemir (2006), the limited sample size of the Labor Force Survey is likely to introduce a large attenuation bias due to measurement error. Consider the last column in the panel, where both the dependent and the main explanatory variable in this first-stage regression are based on the Labor Force Survey. The point estimate is 0.256, similar in size to our preferred estimate (0.288) but much less precisely estimated. The F-statistic is now only 22.37, compared to 65.61 earlier, and the partial R^2 has dropped by half. The F-statistics are even lower in columns 1 and 2, where they fall below the threshold that allows us to reject the null of weak instruments. In conclusion, the availability of even limited population registry data (as in the case of Spain) is very helpful. It allows for a strong first-stage, and relatively small standard errors in the final IV estimates of the parameters of interest.

[45] The critical value, as reported by Stock and Yogo (2005), is 16.4.

7. Immigration and household services

In this section we examine the effects of female immigration on the household services sector. We expect immigration inflows into a region to increase the availability of household services and to reduce its price (wage). Given its non-traded nature, inter-regional trade cannot help accommodate for changes in the local supply. Thus standard models predict an adjustment via prices and wages.

In order to test these hypotheses, we estimate the regional aggregate regressions (8) and (9). In the former the dependent variable is employment in household services relative to total employment. In the latter it is the log of the average hourly wage for household service workers in the region. In both cases, the right hand side contains region and year fixed effects, together with the female immigrant share (*FIS*).[46]

Table 4 reports the OLS and IV estimates. The top panel reports the estimates of the employment regression. The OLS results for our preferred specification, which uses the Registry-based female immigrant share (*FIS*), show that the arrival of 100 female immigrants into a region is associated with an increase in the number of household service workers equal to 14. However, it could well be that immigrants are drawn to regions with increasing demand for service workers. If this is the case, then our OLS estimates will overestimate the impact of immigration. The second column reports the IV estimates. As expected, the coefficient is now smaller, but it remains positive and strongly significant. An inflow of 100 female immigrants into a region leads to an increase in the number of workers in household service occupations equal to about 9.[47]

Let us now turn to the average wage regressions, reported in the bottom panel of Table 4. According to our data, the average hourly wage for household service workers in the period 1999-2005 was 4 euros, with a standard deviation of 2. The OLS results suggest that a 1 percentage point increase in the female immigration rate in the region is associated with household service wages that are 3.2% lower. However, if immigrants are attracted to regions with increasing (household service) wages, the OLS coefficient may underestimate the actual wage effect. The second column thus reports the IV coefficient, which indeed points to a larger effect. The IV results suggest that a 1 percentage point increase in the share of female immigrants in the region leads to a significant 5.9% decline in household service wages. This effect is very large, and we should be cautious in its interpretation given the large associated standard errors.

[46] As explained earlier, data limitations require the use of larger regions in the wage regression. Instead of 52 regions we use the 18 aggregate regional units (i.e. autonomous communities) and can only use data for years 1999-2005, delivering a total of 126 observations. In comparison the employment regression has 520 region-year observations.

[47] Our results are unaffected by the use of alternative measures of immigrant concentration and they are available upon request from the authors. Note that the exogeneity assumption required for the validity of our instrument in these regressions is that the 1991 geographical distributions of immigrants should be uncorrelated with annual shocks to the demand for household service workers at the regional level over the period 1999-2008.

Overall, the results in this section provide clear evidence that female immigration into a region leads to an increase in the size of the household services sector and to a decline in the average hourly wage of household service workers, though the latter effect has been estimated with a limited degree of precision.

8. The labor supply of skilled women with family responsibilities

The goal of this section is to test the main implication of our theoretical model. Namely, a reduction in the price of household services in a region should lead to an increase in the labor supply of skilled women with family responsibilities, relative to its effect on skilled women without such responsibilities.

Unfortunately, we lack precise estimates of the price of household services for the whole period at the disaggregated regional level. Our approach is to estimate a reduced-form regression, where the main explanatory variable is the share of female immigrants in a region and year. The justification for this regression was provided in the previous section, where we established a link between female immigration into a region and the supply (and price) of household services in that region. We are relatively confident in providing a structural interpretation for the estimates from our reduced-form regression. The reason is twofold. First, we focus on skilled native women, who probably do not face labor market competition from recent female immigrants. As we noted earlier, the occupational distribution of the two groups differs sharply. Second, we focus on the differential effect of female immigration on the labor supply of skilled women with family responsibilities, relative to skilled women in the same region that do not have such responsibilities. Any other channel through which immigration affects all skilled native women, regardless of their family situation, will not affect our results.

Let us then turn to the estimation of the labor supply model in equation (10). For now, the "family responsibilities" dummy (D) takes a value of one for all women in any of the following family situations: with children younger than 8, a male elderly dependent, or a retired husband.[48] We consider two measures of labor supply: a dummy for being employed and the number of weekly hours worked.[49] Table 5 presents the OLS and IV estimates. The top panel estimates the models on a sample of college-graduate native women. For comparison, the middle and bottom panels use increasingly larger samples: native women with at least a high-school degree, and all women, respectively.

[48] Recall that the family responsibility with the highest frequency is, by far, having young children in the household.
[49] We define hours worked for all individuals, including those with zero hours. Thus the sample size is the same in the employment and hours regressions. Obviously, the employment regression captures responses along the extensive margin of labor supply. Our hours regression will pick up responses along both the intensive and the extensive margin.

Let us focus on the main sample, native females with a college degree. First, the coefficient of the family responsibilities dummy (α) is negative and highly significant, as expected. The point estimates indicate that family responsibilities are associated with lower employment rates (about 5 percentage points) and fewer hours worked (about 2 per week). Second, we do not find any significant effect of immigration on the labor supply of skilled women without family responsibilities. This is consistent with the predictions of our theoretical model.

We now focus on γ, our main coefficient of interest. This coefficient captures the differential effect of an increase in the female immigrant concentration on the labor supply of skilled women with family responsibilities, relative to skilled women without such responsibilities in the same region. Both in OLS and IV we find a positive and significant effect on the probability of employment, as predicted by the theory.[50] According to the IV estimates, a 10 percentage point increase in the share of foreign females in the region leads to an increase of 2 percentage points in the employment rate of college educated women with family responsibilities, relative to other college educated women in the same region. Since the female immigration rate in the average region increased by 15 percentage points between 1999 and 2008, the overall increase in employment that can be attributed to the immigration inflow equals almost 3 percentage points. The employment rate of college educated women with family responsibilities increased by 10 percentage points in this period (see Table 2), hence we conclude that the immigration episode can account for more than a third of the increase, and thus represents a crucial factor for the labor market success of educated native women during the last decade.

Regarding the model for hours worked, we note that the coefficient on the interaction is also positive, both in OLS and IV, although we cannot reject the null of no effect. At face value, the point estimate implies that a 10 percentage-point increase in the female immigrant share leads to an increase in weekly hours worked of 0.28 (16.8 minutes). It is possible that we fail to detect an effect on hours because of a larger degree of measurement error in this variable. To investigate this possibility, we re-estimate the models using the sample of women with at least a high-school degree (middle panel), which is five times larger than the sample of college graduate females. Two observations are worth noting. First, the IV point estimates of the interaction of the family responsibilities dummy and the female immigrant share are practically identical to the analogous estimates under the more stringent definition of skilled worker. This is an important robustness check on the earlier estimates. Second, the coefficients on *FIS* are smaller than for the college-graduate sample according to the IV estimates. In particular, the estimate on the probability of employment is

[50] Note that the IV estimate is slightly above the OLS one, suggesting a negative correlation between the labor market shocks for college educated natives and (low-skilled) foreign females.

negative and significantly different from zero. Our interpretation is that there is larger degree of labor market competition between high-school graduate natives and recent immigrants even though native females with at least a high-school degree are potential users of household services.

Finally, we estimate the models on the sample of all women, which more than doubles the sample size. Interestingly, we cannot reject a value of zero on the interaction term. This is because the average individual in the sample is now low skilled. As argued earlier, low-skilled women with family responsibilities have a low earnings potential and, as a result, cannot afford household services. Consequently, recent female immigration flows do not have a differential effect on women with family responsibilities in this skill group. Furthermore, the negative IV estimate on the coefficient of the female immigrant share is significant for both labor supply variables at the usual confidence levels.

For comparison purposes with previous studies we re-estimate the empirical models in Table 5 while employing as main explanatory variable the share of low-skilled females (*FUS*), which includes both natives and immigrants. Cortes and Tessada (2009) use this alternative explanatory variable to account for the potential increase in competition among low-skilled workers that results from the immigration inflow. The results are presented in Table A2 in the Appendix. Our previous conclusions remain mostly unaffected. However, two points seems worth mentioning. First, the share of low-skilled females increased by 6 percentage points over the period. Thus the predicted effects of the immigration inflow are slightly smaller under this alternative specification. Second, the point estimates are less precisely estimated (large standard errors), most probably due to the larger measurement error in the immigrant share obtained from the Labor Force Survey.

In the remainder of the section we estimate labor supply models as (10), where we consider each of our three types of family responsibilities separately.

8.1. Mothers of young children

To investigate the labor market response of mothers with young children, we restrict the sample to college-educated women younger than 45. We depart slightly from the specification in (10) by including two indicators for the presence of young children (younger than 4 years old and between 4 and 7 years old).

The estimation results are presented in Table 6, both for OLS and IV. First, we note that the coefficients associated to the young children dummies are negative. In particular, according to our IV estimates, having a child younger than 4 is associated to a probability of employment almost 4 percentage points lower, compared to only 2 points for children age 5 to 8. Second, the coefficient on the female immigrant share is never significantly different from zero. Third, the coefficient on the

interaction between the immigrant share and the dummy for children younger than 8 years old is positive and highly significant. Additionally, the point estimates we obtain are very similar to those in Table 5. A 10 percentage point increase in the female immigrant share leads to an increase in the employment rate of skilled women (younger than 45) with this family responsibility equal to 2.2 percentage points, relative to comparable women without children younger than 8 years old. This is perhaps not too surprising given that having young children is the responsibility with the highest frequency in our sample.

We re-estimated the model including yearly indicators for the age of the youngest child as well as their interaction with the female immigration rate. This alternative specification suggests that the bulk of the effect comes from the labor supply response of mothers with children younger than 1 year, suggesting that the lower wages of foreign domestic workers allow skilled women to return to work earlier after childbirth.

8.2. Male elderly dependents

We next analyze the effect of female immigration on the labor supply of women cohabiting with a male elderly relative (most likely the father or father-in-law). Though middle-age women are more likely to lie in this category, we do not have strong arguments to restrict the sample to a particular age range and thus we consider the whole sample of college-educated women.

Table 7 displays the estimation results. Several features are worth noting. First, the coefficient associated to the indicator for a male elderly dependent is negative, large (in absolute value), and highly significant. In fact it is more than twice as large as the analogous coefficient in the specification for young children in the house. Having a male elderly dependent is associated to a lower employment probability (10.7 percentage points) as well as lower working hours (4.3 hours per week).[51] Second, the coefficient on the female immigrant share is again not statistically significant.

Let us now turn to the main coefficient of interest, that is, the interaction term between the male elderly dummy and the female immigrant share. We find a significant and positive IV estimate for the probability of being employed, while no significant effects on hours worked. The coefficient is twice as large as in the previous section, but we note that the standard errors are also relatively high. Taken at face value, the IV estimate suggests that a 10 percentage point increase in the share of

[51] We also estimate the models in table 7 with an indicator for the presence of a female elderly dependent, and we do not find evidence that such a family arrangement is related to the labor supply of working-age women. Elderly women in the household may not represent an increase in housework on average either because of better health than old men, or because they are able to help with the house work (by taking care of children, cooking, cleaning, doing laundry, etc). These results are available upon request from the authors.

foreign females in the region increases the employment probability of educated women with male elderly relatives by 4.6 percentage points, relative to college-educated women without this responsibility. The IV point estimate for the interaction term in the hours regression is positive but we cannot reject the null of a zero value.

8.3. Retired Husbands

We now turn to the family responsibilities arising from a woman's husband going into retirement. In this case we restrict the sample to college-educated women older than 50 years old.[52] We now consider three different measures of labor supply: an indicator for being employed, hours worked, and an indicator for being retired.

Table 8 reports the estimates. We first note that the OLS and IV estimates are rather similar, both in magnitude and significance. Three observations are worth noting. First, the coefficient of the dummy variable is significant for the three outcomes. According to the IV estimates having a retired husband is associated to a lower probability of employment (17.8 percentage points), to lower hours of work (6.2 hours weekly) and to a higher probability of own retirement (5.8 percentage points). Second, as was the case with the two previous responsibilities, the coefficient on the female immigrant share is never statistically significant.

Third, the coefficient on the interaction term is statistically significant for the probability of employment and for weekly hours worked. An increase in the female immigrant share equal to 10 percentage points is associated to a probability of employment that is 7.7 percentage points higher and to an increase of 2.6 hours worked per week. The point estimate for the retirement regression has the expected negative sign but it is not statistically different from zero. Compared to the previous family responsibilities, the estimated coefficients here are somewhat larger, although we cannot reject a null of equal effects due to large standard errors.

On the whole, our results suggest that female immigration, by increasing the local availability of household services and reducing their price, has allowed skilled women with a retired husband to continue working and postpone their retirement. The validity of our results may not be universal. As noted earlier, child and elderly care in Spain is still provided largely by families. This is the case in several other southern European countries and in Latin America. However, it is much less so among northern European countries and the US.

[52] We impose this age restriction to rule out the possibility the indicator for having a retired husband captures the behavior of women near retirement age, independently of the labor market status of the husband. Our results are unaffected when we consider the sample of all women.

9. Conclusions

Our results provide evidence that female immigration into a region leads to an increase in the labor supply of skilled women with family responsibilities, relative to other skilled women living in that region. Based on the link between recent female immigration flows and the household services sector provided earlier, we interpret our results as follows. Female immigration into a region led to cheaper household services in that region, which allowed skilled women with family responsibilities to increase their labor supply.

Two further observations are due. First, we have shown a differential response for skilled women with family responsibilities, relative to skilled women without such responsibilities in the same region. This supports our interpretation that the main channel through which female immigration affected the time use of skilled females was through household services. Second, our results suggest that the main effects operated through changes on the extensive margin of labor supply. Specifically, we find that immigration allowed skilled women to reconcile their family responsibilities and their careers. These women were able to go back to work earlier after childbirth, to continue working even when caring for elderly dependents, and to postpone retirement when their husbands retired.

Our results indicate that the effect of immigration was also quantitatively important. According to our estimates, recent female immigration flows were responsible for an increase in 3 percentage points in the employment rates of skilled women with family responsibilities over the period 1999-2008. This is a large effect, compared to the 8 percentage-point increase in the employment rates of college-educated women or the 10.5 percentage-point increase for the subset of these women with young children over the period. The larger wave of immigration, relative to population, in Spain accounts for the larger effect that we find, in comparison with the findings by Cortes and Tessada (2009) for the US. Their results suggest that the low-skilled immigration wave of 1980-2000 can explain approximately 16 percent of the observed increase in several dimensions of the labor supply. Interestingly, they identify responses along the intensive margin of labor supply. Our findings are also consistent with those for Hong Kong in Cortes and Pan (2009), who show that the arrival of foreign domestic workers between 1976 and 2006 was crucial to eliminate the gap in labor force participation rates between mothers of younger and older children.

Several countries have already introduced special visa programs for foreign caregivers (Canada, Israel or Hong Kong). The main goal in these programs has been to help skilled native women with young children balance their careers and their family responsibilities. Our results suggest an even larger scope for these programs on the grounds of the positive effect on the employment rates of

women caring for elderly or retired husbands. This result is particularly relevant in Europe, where fertility rates are low and the population is rapidly aging.

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Table 1: Family responsibilities and labor supply

Education level Gender (age) Family Responsibility	All levels Women	 Men	College Graduates [1] Women	 Men	College Graduates Women Children[2]	 Male elderly[3]	 Female elderly[3]	College Graduates Women (age 50 or higher) Retired husband[4]	 Not Retired husband
Panel A: Labor Force Survey, 2005-2008 merged									
% Out of the Labor Force	41	13	11	5	12	13	12	38	15
Reasons:									
Family Responsibilities	62	4	52	7	76	44	39	41	46
Retired	3	35	9	34	0	20	21	38	14
Other reasons [5]	35	61	39	59	24	36	40	21	47
Observations	139,686	124,771	12,262	12,646	4,001	192	457	264	2,084
Panel B: Time Use Survey, 2002									
% Employed [6]	46	.	80	.	77	66	83	57	76
Daily hours household work	5.6	.	4.44	.	6.15	4.6	4.22	4.42	3.86
Observations	12,845	.	1,938	.	571	94	109	67	297

Sources: For panel A, 2nd quarter LFS 2005-2008 merged. For panel B, 2002 Time Use Survey 2002.
Sample: individuals age 25-64.
(1) College graduates are those with a four-year college degree or higher education.
(2) Children are defined as less than 8 years old.
(3) Elderly dependents are individuals 65 and older co-habiting with the respondent (other than the husband).
(4) Retired husband includes also husbands 65 or older, not necessarily retired.
(5) "Other reasons" includes: studying, discouraged, disabled or other reasons not specified.
(6) Employed over working-age population.

Table 2: Mean values in 1999 and 2008 for main variables

Education level	All levels		HS Graduates and Above		College Graduates [1]	
Year	1999	2008	1999	2008	1999	2008
Frequency						
Over all women	100	100	22.55	44.59	4.63	9.28
Over women with same education						
Children	20.78	19.49	33.31	27.69	37.69	32.97
Male elderly	1.99	2.27	1.34	1.86	1.07	1.41
Retired husband	12.64	9.76	3.32	4.17	1.71	2.46
% Employed						
Over women with same education	37.98	55.23	66.9	74.38	79.05	87.11
Over women with same education and FR [2]						
Children [3]	42.96	61.91	63.48	73.24	74.82	85.36
Male elderly [4]	36.77	51.9	68.85	66.56	80	76.6
Retired husband [5]	15.57	22.5	38.94	44.39	50	56.1
Average hours worked in market						
Over women with same education	13.81	19.16	24.55	26.42	28.47	31.43
Over women with same education and FR						
Children	15.22	20.69	22.89	24.83	26.5	29.42
Male elderly	14.35	18.97	25.73	24.59	30.35	27.7
Retired husband	5.89	7.49	13.63	14.94	15.41	19.94
Observations	40,499	35,374	9,132	15,760	1,876	3,264
Main explanatory variables						
Female Immigrant Share (FIS) [6]	0.026	0.179				
Female Immigrant Share Survey Data (FISS) [7]	0.024	0.174				
Female Unskilled Share (FUS) [8]	0.902	0.961				
Instrument, Predicted Immigrant Share (ZS) [9]	0.045	0.211				
Observations	52	52				

Sources: 2nd quarter LFS 1999-2008. Sample: Individuals age 25-64. (1) College graduates are those with a four-year college degree or higher education. (2) Family Responsibility. (3) Children are defined as less than 8 years old. (4) Elderly dependents are individuals 65 and older co-habiting with the respondent (other than the husband). (5) Retired husband includes also husbands 65 or older, not necessarily retired. (6) FIS is the number of foreign females over the 1991 female working-age population. Population registry and 1991 Census. (7) FISS is the number of foreign females (from the LFS) over the 1991 female working-age population. LFS and 1991 Census. (8) FUS is the number of women with at most a high-school degree (native or immigrant) over the 1991 female working-age population. LFS and 1991 Census. (9) ZS is the predicted number of immigrants (both genders) over the 1991 working-age population (both genders). Population Registry and 1991 Census.

Table 3: First-stage regressions

Dependent variable:	[1] Female Immigrant Share (FIS)	[2] Female Unskilled Share (FUS)	[3] Female Immigrant Share Survey (FISS)
ZS (Population Registry) (1)	0.288***	0.297***	0.205***
t-stat (2)	8.1	9.07	5.35
Cragg-Donald F stat (3)	65.61	82.26	28.62
Partial R2	0.16	0.1	0.07
ZS (Labor Force Survey)	0.251***	0.183***	0.256***
t-stat	3.99	3.77	4.73
Cragg-Donald F stat	15.92	14.21	22.37
Partial R2	0.08	0.03	0.08

(1) *ZS* stands for predicted stock of immigrants as a share of the 1991 working-age population.
(2) All specifications include province and year fixed effects, age, age squared, marital status and the presence of children in several age brackets. Standard errors clustered by province. Three asterisks indicate significant at 99% confidence level.
(3) Threshold value for the test of weak instruments is 16.38 (Stock and Yogo 2005).

Table 4: Immigration and the household services sector

Dependent Variable: Employment in household services over total employment[(1)]

	OLS	IV
Female immigrant share (FIS)	0.144***	0.086***
	[0.011]	[0.021]
Observations	520	520
R-squared	0.81	0.798

Dependent Variable: Average log hourly wage household service workers [(1), (2)]

	OLS	IV
Female immigrant share (FIS)	-3.22***	-5.87***
	[0.889]	[2.17]
Observations	126	126
R-squared	0.597	0.562

Sources: Dependent variable in top panel A constructed from the Labor Force Survey (1999-2008) at the regional level (52 regions). Dependent variable in bottom panel constructed from the Labor Force Survey (hours worked) and the Household Budget Survey (expenditure) for the period 1999-2005, at a higher level of regional aggregation (18 regional units).
(1) Top regression includes region and year dummies. Bottom regression includes aggregate regions and year dummies. Both regressions are weighted using the 1991 female population. Standard errors are reported in brackets. One asterisk indicates significance at the 90% confidence level, two indicate 95% and three indicate 99%.
(2) Average hourly wage for household service workers in an aggregate region and year is constructed as total expenditure on household services divided by total hours worked by household service workers in the aggregate region.

Table 5: Immigration and the labor supply of native women

Dependent variable: Estimation method:	Employed[(1)] OLS [1]	Hours worked[(2)] OLS [2]	Employed IV [3]	Hours worked IV [4]
COLLEGE GRAD. AND ABOVE				
Dummy for Family Responsibilities (*D*)	-0.050*** [0.013]	-2.165*** [0.483]	-0.055*** [0.012]	-2.347*** [0.506]
Female Immigrant Share (*FIS*)	-0.052 [0.075]	-1.611 [3.848]	-0.119 [0.148]	-1.129 [7.354]
Interaction (*FIS* x *D*)	0.153*** [0.057]	1.143 [2.397]	0.204*** [0.059]	2.823 [2.606]
Observations	25,529	25,272	25,529	25,272
HIGH SCHOOL GRAD. AND ABOVE				
Dummy for Family Responsibilities (*D*)	-0.048*** [0.006]	-1.900*** [0.229]	-0.053*** [0.006]	-2.166*** [0.252]
Female Immigrant Share (*FIS*)	-0.083 [0.062]	-1.854 [2.428]	-0.256** [0.129]	-5.039 [3.607]
Interaction (*FIS* x *D*)	0.102*** [0.028]	0.3 [1.208]	0.147*** [0.032]	2.888** [1.415]
Observations	128,953	127,919	128,953	127,919
ALL EDUCATION LEVELS				
Dummy for Family Responsibilities (*D*)	-0.033*** [0.003]	-1.017*** [0.140]	-0.037*** [0.004]	-1.245*** [0.168]
Female Immigrant Share (*FIS*)	0.037 [0.051]	3.983** [1.797]	-0.226** [0.102]	-5.341* [2.951]
Interaction (*FIS* x *D*)	-0.060*** [0.021]	-4.433*** [1.118]	-0.015 [0.026]	-1.888 [1.236]
Observations	362,613	360,222	362,613	360,222

Note: Each set of estimates comes from a different regression. All regressions include region and year fixed effects, age, age squared, marital status and the presence of children in several age brackets. D is the indicator for family responsibilities that takes value 1 in the presence of children younger than 8, retired husband, or male elderly dependent (65 and older). Standard errors clustered by region are reported in brackets. One asterisk indicates significance at the 90% confidence level, two indicate 95% and three indicate 99%.

(1) Dependent variable is a dummy for being employed.

(2) Dependent variable is the (unconditional) weekly hours worked. Non-employed individuals have zero hours worked.

Table 6: Immigration and the labor supply of skilled women with young children.
Sample: College graduates, younger than 45

Dependent variable: Estimation method:	Employed OLS [1]	Hours worked OLS [2]	Employed IV [3]	Hours worked IV [4]
COLLEGE GRAD. AND ABOVE				
Dummy for child younger than 4	-0.036*** [0.012]	-1.945*** [0.439]	-0.039*** [0.011]	-2.042*** [0.444]
Dummy for child between 4 and 7	-0.021 [0.015]	-0.980* [0.500]	-0.025* [0.015]	-1.091** [0.516]
Female Immigrant Share (*FIS*)	-0.077 [0.112]	-4.639 [5.560]	-0.312 [0.250]	-9.717 [12.03]
Interaction (*FIS* x *D_child*) (1)	0.150** [0.066]	2.025 [2.447]	0.220** [0.098]	4.281 [3.961]
Observations	17,116	16,971	17,116	16,971

Note: Each column corresponds to a different regression. All estimates include region and year fixed effects, age, age squared, marital status and the presence of children in several age brackets. Standard errors clustered by region are reported in brackets. One asterisk indicates significance at the 90% confidence level, two indicate 95% and three indicate 99%.

(1) *D_child* takes a value of one if there is a child younger than 8 in the household.

Table 7: Immigration and the labor supply of skilled women with male elderly dependents
Sample: College graduates, all ages

Dependent variable: Estimation method:	Employed OLS [1]	Hours worked OLS [2]	Employed IV [3]	Hours worked IV [4]
COLLEGE GRAD. AND ABOVE				
Dummy for *male elderly dependent (D_eld)*	-0.079* [0.040]	-3.816** [1.592]	-0.107** [0.042]	-4.308** [1.682]
Female immigrant share (*FIS*)	-0.005 [0.076]	-1.42 [3.964]	-0.081 [0.149]	-0.794 [7.566]
Interaction (*FIS x D_eld*)	0.211 [0.202]	6.473 [8.033]	0.464** [0.203]	10.93 [9.396]
Observations	25529	25272	25529	25272

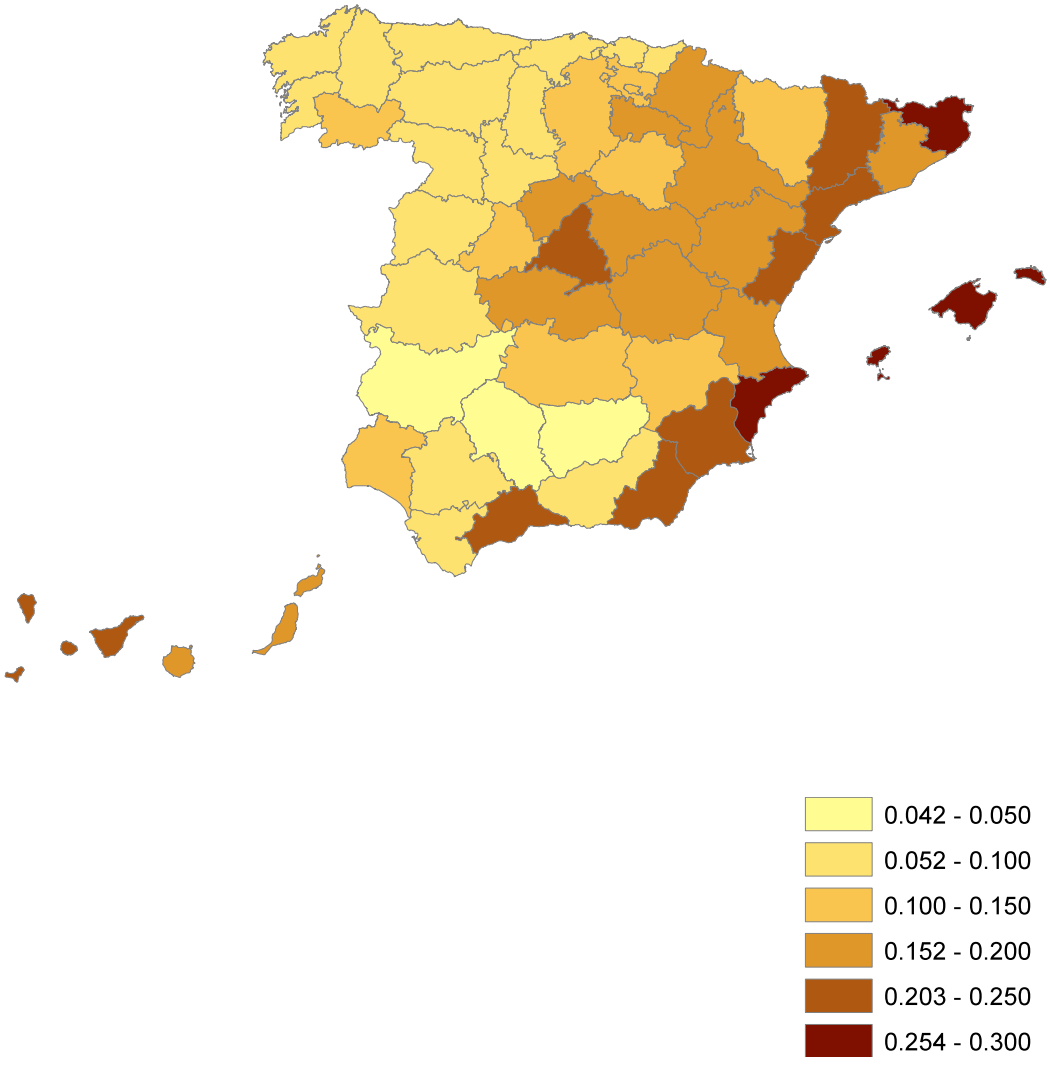
Note: Each column corresponds to a different regression. All regressions include region and year fixed effects, age, age squared, marital status and the presence of children in several age brackets. Standard errors clustered by region are reported in brackets. One asterisk indicates significance at the 90% confidence level, two indicate 95% and three indicate 99%.

Table 8: Immigration and the labor supply of skilled women with retired husbands
Sample: College graduates, age 50 or higher

Dependent variable: Estimation method:	Employed OLS [1]	Hours worked OLS [2]	Retired OLS [3]	Employed IV [4]	Hours worked IV [5]	Retired IV [6]
Dummy for *retired husband (D_ret)*	-0.143*** [0.047]	-5.113*** [1.527]	0.038* [0.022]	-0.178*** [0.053]	-6.190*** [1.670]	0.058** [0.026]
Female immigrant share (*FIS*)	0.008 [0.131]	7.746 [5.557]	0.055 [0.069]	0.109 [0.301]	10.09 [14.07]	0.078 [0.174]
Interaction (*FIS* x D_ret)	0.493** [0.223]	17.61** [7.182]	0.001 [0.103]	0.769*** [0.259]	25.99*** [7.627]	-0.151 [0.154]
Observations	4,466	4,466	4,466	4,466	4,466	4,466

Note: Each column corresponds to a different regression. All regressions include region and year fixed effects, age, age squared, marital status and the presence of children in several age brackets. Standard errors clustered by region are reported in brackets. One asterisk indicates significance at the 90% confidence level, two indicate 95% and three indicate 99%.

Figure 1. Foreign-born share in the working-age population by region, 2008



Appendix

Proof Proposition 1. Statement i) is obvious. The first-order conditions associated to the problem of individuals without family responsibilities do not depend on p, the price of household services. Statement ii) is equivalent to showing that h^* and x^* are, respectively, increasing and decreasing functions in p for individuals with family responsibilities. For these individuals, their first-order conditions imply:

$$w = p\alpha f'(h) \quad \text{and} \quad x = R - \alpha f(h).$$

It follows from strict concavity of f that the optimal time devoted to home production is a function $h^*(p\alpha,w)$, increasing in $p\alpha$ and decreasing in w. Moreover, the optimal purchases of household services are given by $x^*(R,p\alpha,w) = R - \alpha f(h^*)$, which is decreasing in p for any $\alpha>0$.

Let us now turn to statement iii). Implicit differentiation of the first-order conditions for individuals with family responsibilities leads to the following expression:

$$\left(-\frac{dn^*}{dp}\right) = \frac{dh^*}{dp} - \frac{wu'' x^*}{\phi''+w^2u''}$$

We already established that the first term on the right-hand side is positive. Under our assumptions (strictly concave u and ϕ), the second term is also positive. As a result, the sign of the right-hand side depends on parameters.

We next provide a sufficient condition for x^* to be close to zero. As a result, the monotonicity of h^* as a function of p is inherited by n^*. We proceed in four steps. First, let H be implicitly defined by $R = \alpha f(H)$, that is, the time devoted to home production that fulfills the required family responsibilities. Obviously, in this case the purchases of household services are zero. Second, recall that we derived earlier the following demand functions $h^*(p\alpha,w)$ and $x^*(R,p\alpha,w)$. Third, given p and w, observe that there exists α' such that $h^*(\alpha' p,w)=H$ and $x^*(R,\alpha' p,w)=0$. Fourth, for values of α close enough (from below) to α',

$$\left(-\frac{dn^*}{dp}\right) \cong \frac{dh^*}{dp} > 0.$$

That is, the supply of work hours to the market is locally monotonically increasing. QED

Example: Suppose $f(x) = \phi(x) = u(x) = x^{0.5}$. Then

$$\left(-\frac{dn^*}{dp}\right) = \frac{1}{1+w}\left(\frac{\alpha^2 p}{w}\left(\frac{1}{2}+\frac{1}{w}\right) - \frac{R}{w}\right).$$

It is easy to check that the expression is positive if and only if $\alpha^2 > \dfrac{R}{p\left(\frac{1}{2}+\frac{1}{w}\right)}$.

Table A1: Exogeneity instrument (Supporting regressions)

Dependent variable	FB share 1991 (1) [1]	Ch. Employment Skilled Females (2) [2]
Share GDP 1991 (3)	0.890***	0.356
	[0.065]	[0.675]
Share Primary 1991 (4)	-0.024	-0.068
	[0.042]	[0.431]
Share services 1991 (5)	0.098***	-0.203
	[0.020]	[0.207]
R^2	0.89	0.02
Observations	50	50

Note: 50 regions. Ceuta and Melilla excluded due to lack of data.
(1) Dependent variable is the foreign-born share in 1991 (stock of foreign-born over working-age population).
(2) Dependent variable is the change in the employment rate of college educated women between 1999 and 2008.
(3) Regional GDP over Spain's GDP in 1991.
(4) Value added in primary sector over total value added in the region in 1991.
(5) Value added in services over total value added in the region in 1991.

Table A.2: Immigration and the labor supply of native women

Dependent variable: Estimation method:	Employed[(1)] OLS [1]	Hours worked[(2)] OLS [2]	Employed IV [3]	Hours worked IV [4]
COLLEGE GRAD. AND ABOVE				
Dummy for Family Responsibilities (*D*)	-0.095*** [0.034]	-4.306*** [1.227]	-0.262** [0.103]	-5.222 [3.240]
Female Unskilled Share (*FUS*)	0.017 [0.057]	-1.044 [2.573]	-0.133 [0.150]	-1.338 [7.139]
Interaction (*FUS* x *D*)	0.068** [0.034]	2.491** [1.224]	0.253** [0.111]	3.499 [3.488]
Observations	25529	25272	25529	25272
HIGH SCHOOL GRAD. AND ABOVE				
Dummy for Family Responsibilities (*D*)	-0.054*** [0.018]	-2.369*** [0.731]	-0.191*** [0.052]	-4.877*** [1.609]
Female Unskilled Share (*FUS*)[(3)]	-0.062 [0.051]	-2.422 [1.848]	-0.248** [0.119]	-4.892 [3.476]
Interaction (*FUS* x *D*)	0.018 [0.019]	0.547 [0.701]	0.168*** [0.057]	3.294* [1.759]
Observations	128953	127919	128953	127919
ALL EDUCATION LEVELS				
Dummy for Family Responsibilities (*D*)	-0.035** [0.014]	-0.705 [0.724]	-0.024 [0.029]	0.57 [1.467]
Female Unskilled Share (*FUS*)	-0.066 [0.040]	-0.812 [1.305]	-0.217** [0.085]	-5.010** [2.438]
Interaction (*FUS* x *D*)	-0.004 [0.015]	-0.777 [0.812]	-0.015 [0.032]	-2.162 [1.576]
Observations	362613	360222	362613	360222

Note: Each set of estimates corresponds to a different regression. All regressions include region and year fixed effects, age, age squared, marital status and the presence of children in several age brackets. D is the indicator for family responsibilities that takes value 1 in the presence of children younger than 8, retired husband, or male elderly dependent (65 and older). Standard errors clustered by region are reported in brackets. One asterisk indicates significance at the 90% confidence level, two indicate 95% and three indicate 99%.

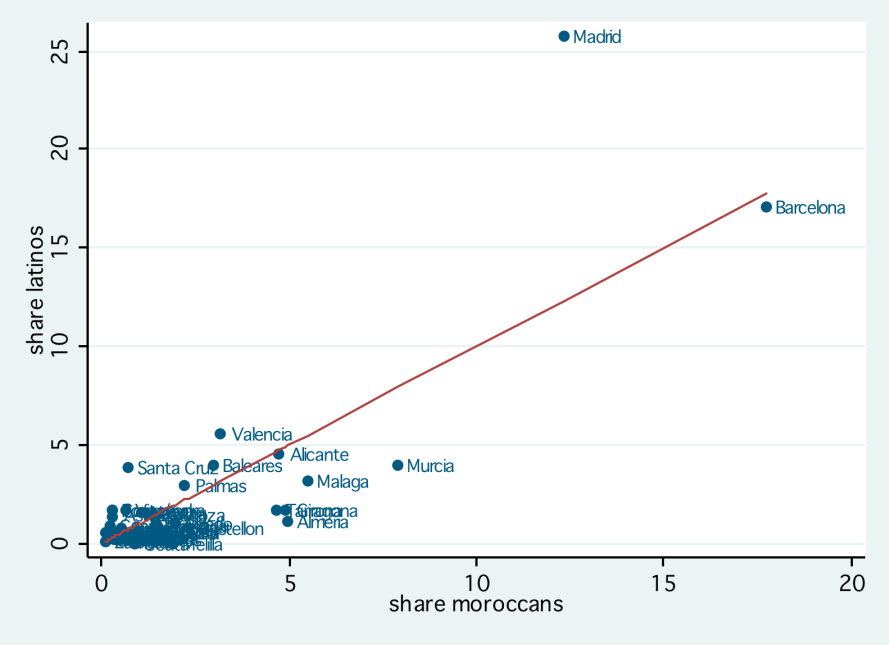
(1) Dependent variable is a dummy for being employed.

(2) Dependent variable is the (unconditional) weekly hours worked. Non-employed individuals have zero hours worked.

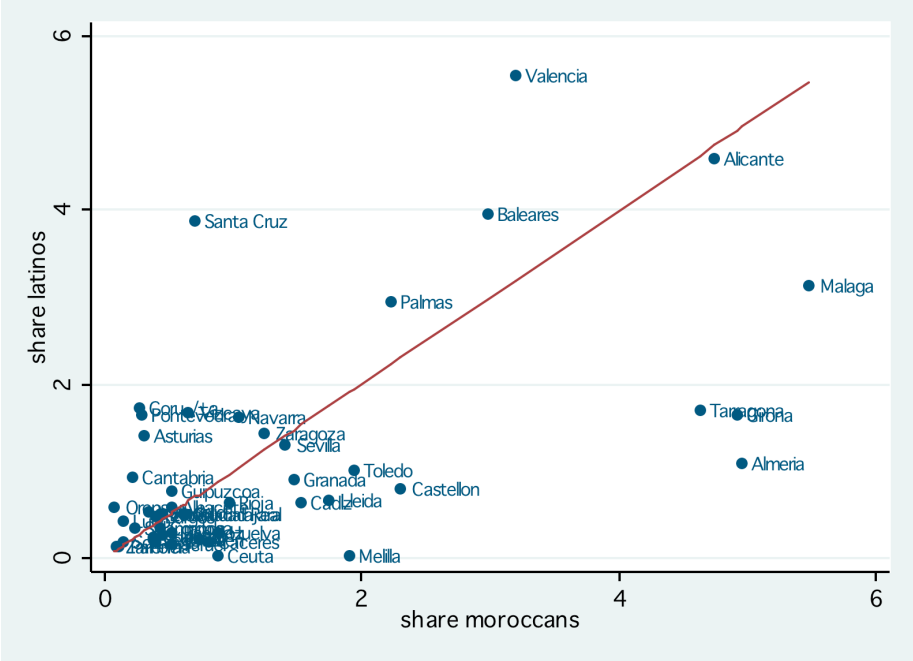
(3) FUS is the number of women with at most a high-school degree (native or immigrant) over the 1991 female working-age population.

Figure A1: Share of immigrants by region in 2008.

a) All regions (52 observations).



b) Excluding largest regions (48 observations).



Notes: The figures include a 45 degree line. The 2008 share of Moroccans is defined as the number of Moroccans in region *r* over the total number of Moroccans in Spain, times one hundred. The 2008 share of Latinos is defined likewise.