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# Motherhood and the allocation of talent

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**ABSTRACT**

In this paper we show that motherhood triggers changes in the allocation of talent in the labour market beyond the well-known effects on gender gaps in employment and earnings. Based on an event study approach around the birth of the first child and retrospective panel data for 28 European countries and Israel, we assess the labour market responses to motherhood across 'talent' groups–i.e. groups with different educational attainment, Math performance at age 10, and personality traits associated to entrepreneurial ability. We show that even the most talented women–both in absolute terms and relative to their husbands–leave the labour market or uptake part-time jobs after the birth of the first child. We also find that motherhood induces a negative selection of female talents into self-employment. Overall, our results suggest relevant changes in the allocation of talent associated to gender differences in non-market responsibilities that can have sizable impacts on aggregate market productivity.

## I. Introduction

A large share of female talent remains untapped in the labour market. For instance, approximately 20% of college-educated women in Europe were not actively participating in the labour market during the last decades of the 20th century, while most men were employed regardless of their educational qualifications (see Figure 1). In this paper we show that motherhood not only significantly contributes to this phenomenon but also profoundly impacts the allocation of female talent in the labour market. Both consequences of motherhood lead to the underutilization of women's human capital, which has been shown to curb economic growth (Hsieh et al. 2019). To the best of our knowledge, this is the first paper showing a link between the arrival of children and the allocation of talent.

Based on harmonized data for 29 countries from the Survey of Health, Ageing and Retirement in Europe (SHARE) and following an event study approach around the birth of the first child, we

provide evidence about the effect of motherhood on the allocation of women's talent in the labour market. We interpret talent as encompassing a diverse range of inherent and acquired skills, capabilities, and attributes, spanning cognitive abilities, creativity, expertise, leadership, and more. While talent may have a natural component, it can be nurtured and developed through education, training, and experience. This aligns with the definition of human capital by Becker (e.g. Becker 2009) and others, as the amalgamation of knowledge, habits, and attributes, contributing to one's ability to generate economic value through labour. We show the results of three exercises. First, we estimate the well-known motherhood effects on women's labour supply for the pooled sample and for each of the 29 countries and correlate these estimates with a measure of underutilization of women's human capital. Our results for the pooled sample of 29 countries show a 25% drop in women's probability of working upon motherhood, which falls close to the upper end of the [−40%, −20%] interval found in the literature (Berniell et al. 2021; Kleven
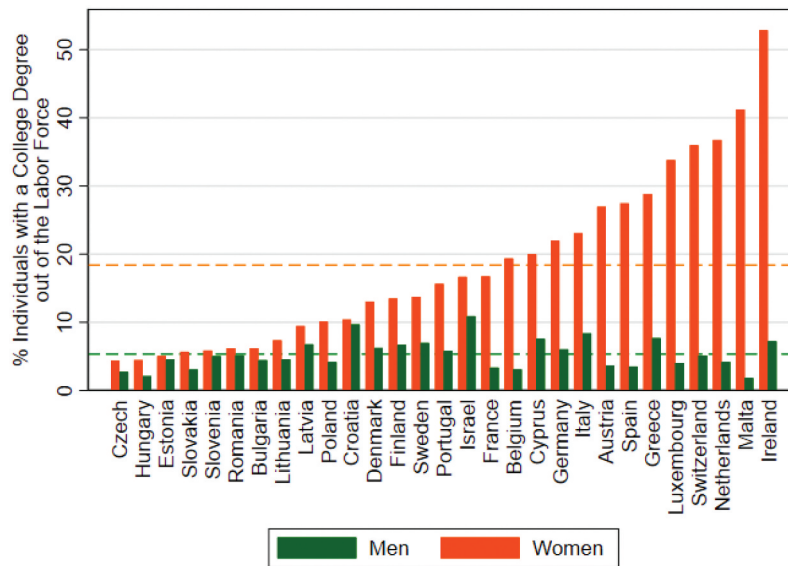
**Figure 1.** Underutilization of human capital in the labor market. Figure shows the percentage of men and women aged 25–60 with a college degree who were out of the labour force in the period 1960–2000. Own elaboration using data from waves 3 and 7 of the Survey of Health, Ageing and Retirement in Europe (SHARE) Job Episodes Panel.

et al. 2019; Kuziemko et al. 2018), and a sharp increase–close to 60%—in part-time employment. While the effects of motherhood remain of the same order of magnitude 15 years after birth, we find no evidence of short-or long-term effects on fathers. More importantly, we find a strong positive cross-country correlation between the magnitude of women's underutilization of human capital–proxied by the share of women with college education out of the labour force–and the magnitude of the motherhood effect on employment.

Second, we examine the heterogeneous impact of the birth of the first child on labour supply for individuals with varying levels of talent–both in absolute terms and relative to their partners. To do this, we leverage the rich human capital data available in SHARE and estimate the effects of motherhood on labour market outcomes for different talent groups. As proxies of talent, we use educational attainment and predetermined cognitive ability measured by relative performance in Math at age 10. Our findings reveal that the labour market supply of women with varying levels of talent is adversely affected by motherhood, and the impact remains substantial even among highly educated women and those who excel in Math. In

contrast, we find almost no effect on fathers, regardless of their level of education or Math performance. Furthermore, we find the same negative effects on mothers–and not on fathers–in a within-couple analysis, regardless of whether the woman is less or more educated than her male partner.

Third, we assess how motherhood alters the probability of becoming self-employed, a relevant dimension of occupational choice for those seeking jobs that offer more flexible arrangements in terms of working hours. We again explore heterogeneous effects for individuals with varying levels of talent. In addition to educational attainment and Math ability as a child, for this analysis we also introduce non-cognitive abilities, which we proxy with two of the 'Big Five' personality traits that have been shown to be positively associated with entrepreneurial success.[1] Our results for the pooled sample of 29 countries show a sharp increase–close to 60% —in the probability of women being self-employed upon the arrival of their first child. Furthermore, we find that the least entrepreneurial women– according to both their cognitive (education and Math abilities as a child) and non-cognitive skills (personality traits)–are leading the shift into self-employment upon motherhood. As such, they are

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[1]Previous literature shows that successful entrepreneurship is positively associated with higher educational attainment (Levine and Rubinstein 2017), higher cognitive ability (Hartog, Van Praag, and Van Der Sluis 2010), and non-cognitive abilities in the form of openness to experience and extraversion (Caliendo, Goethner, and Weißenberger 2020; Levine and Rubinstein 2017).

more likely to belong to the 'misfits' rather than to the 'stars' of self-employment, as conceptualized in Åstebro, Chen, and Thompson (2011), in which labour market frictions induce mismatched workers from the two tails of the ability distribution to opt for self-employment. In contrast, we find no effect on self-employment for fathers, regardless of their level of education, Math ability, or personality traits.

In short, our analysis shows that the birth of the first child changes the use of human capital in the market economy by either pushing many talented women out of the labour market or distorting their occupational choices towards options for which they are less fit. Because we find no effects for men, these results strongly suggest that motherhood negatively alters the allocation of talent in the labour market. Moreover, our evidence shows that not only this is the case for the population as a whole but even within couples where the woman is more talented than her male partner. Of course, to assess whether all this evidence implies a misallocation of talent between market and non-market activities, we would need information on gender differences in home production productivity. This information is not available in SHARE. However, since the literature lacks support for women's comparative advantage in, or preferences for, home production, we interpret our results as suggesting that motherhood results in a misallocation of talent.

Our study relates and contributes to recent literature that shows large impacts on aggregate productivity and welfare from gender differences in non-market responsibilities. Hsieh et al. (2019) show how a sizable part of aggregate growth from 1960 to 2010 in the United States can be explained by the increasing presence of women and black men in occupations from which they were basically banned in the past. Goldin (2014) and Erosa et al. (2020) argue that–even though women are able to access the labour market–the greater time that women allocate to non-market activities may in part explain the existing misallocation. For instance, misallocation and gender wage gaps may arise because children generate career interruptions of mothers at a stage of their life cycle when substantial accumulation of human capital takes place (Erosa, Fuster, and

Restuccia 2016). More recently, Ashraf et al. (2022) study how the gendered division of responsibilities inside and outside the home may lead to misallocation of labour. Using data from a multinational firm based on 101 countries, they show that women are more positively selected into employment than men as female labour force participation decreases. Thus, rising female labour participation would increase firm productivity.

Our paper adds to the existing literature by showing that the misallocation of talent in the labour market can be linked to the arrival of the first child and subsequent non-market obligations. While previous studies have documented child penalties or motherhood effects on employment, working hours and part-time employment (e.g. Berniell et al. 2021; Kleven, Landais, and Sogaard 2019), we uncover heterogeneity in the effect of motherhood on labour market outcomes, as women belonging to different talent groups– defined by educational attainment, childhood cognitive skills and personality traits–follow different career paths upon the arrival of their first child. This is made possible by the rich information on human capital available in SHARE. Notably, we explore an outcome that has been largely overlooked in the related literature (with the exception of Berniell et al. 2021), i.e. self-employment, and find evidence of motherhood triggering a move towards self-employment, which seems to be driven by the least talented women. Additionally, previous studies that have examined the effect of the first child on women's participation in jobs with flexible working schedules have focused on a single country or a small set of countries (Berniell et al. 2021; de Quinto, Hospido, and Sanz 2021; Kleven, Landais, and Sogaard 2019). In contrast, our analysis covers a large set of European countries using comparable data, which is another strength of our study.

The remainder of the paper starts by describing the empirical strategy and the data in Section II. Section III studies the effects of motherhood on labour supply, both in the extensive and intensive margins, as well as the heterogeneous effects across talent groups. Section IV analyzes changes in self-employment upon the arrival of the first child and estimates heterogeneous effects by entrepreneurial

ability. Section V discusses the implications of our results for market and non-market productivity of women relative to men. Finally, Section VI concludes.

## II. Empirical strategy

### Event study

We adopt an event study approach as in Kleven, Landais, and Sogaard (2019) to estimate the impact of the first child—i.e. the first live birth—on mothers' and fathers' labour outcomes. Identification rests on the assumption that labour market outcomes are uncorrelated with the timing of the first birth, conditional on becoming a parent within our sample period and several controls.[2]

Consider a panel of $i = 1, \ldots, N$ individuals observed for all or some $t = 1, \ldots, T$ calendar periods (years). Individual $i$ becomes parent for the first time in calendar period $E_i$, and positive (negative) $e_{it} = t - E_i$ is the number of years since (before) the birth of the child. Let $\tau$ be the relative period or event time index, such that $\tau = 0$ denotes the year of birth of the first child. The relative time index allows us to compare individuals with the same exposure to parenthood even if their children were born in different calendar years. We model outcome $Y$ for individual $i$ in country $c$ and calendar time $t$ as:

$$Y_{itc} = \sum_{\tau \neq -1} \beta_\tau I(\tau = e_{itc}) + \sum_j \gamma_j I(j = age_{itc})$$
$$+ \sum_y \delta_y I(y = t) + \sum_s \lambda_s I(s = c) + \varepsilon_{itc}. \quad (1)$$

The first term on the right hand side includes event time dummies. The event time coefficients $\beta_\tau$ for $\tau \geq 0$ capture the post-child effects.[3] We set $\tau = -1$ as the omitted category, thus all $\beta_\tau$ are measured relative to the year before the first child was born. The following terms include a full set of age-in-years dummies, calendar year dummies, and country dummies. As usual in the related literature, we convert level effects to percentage

effects relative to the counterfactual outcome without children. Formally, the percentage effect for each event time $\tau$ is given by $P_\tau = \frac{\hat{\beta}_\tau}{E[\tilde{Y}_{itc}|\tau]}$, where $\tilde{Y}_{itc}$ is the predicted outcome at event time $\tau$ from model (1) when subtracting the event time terms.

The dependent variable $Y$ represents our three labour market outcomes of interest: (i) whether the individual was working at time $t$, (ii) whether the individual was working part-time at time $t$, and (iii) whether the individual was self-employed at time $t$.

### Data and sample

We use data from the SHARE Job Episodes Panel, which is a single retrospective panel dataset built from waves 3 and 7 of the Survey of Health, Ageing and Retirement in Europe (SHARE).[4] SHARE is a harmonized panel of about 140,000 individuals aged 50 and over in 28 European countries and Israel. What makes waves 3 and 7 of SHARE special is that respondents were asked about their life history including working life and fertility history through a retrospective questionnaire. Our sample is drawn from the 28,465 individuals interviewed in wave 3 (SHARELIFE) and the 62,561 individuals who participated in the life history interview in wave 7—i.e. SHARE respondents taking part in wave 7 who had not participated in wave 3. We merge these data with information on those same respondents from the regular waves of SHARE in order to have information on their socio-demographic characteristics and other variables.

Built in this way, the retrospective panel dataset contains yearly information at the individual level. Each respondent contributes with as many observations as the years of age from her/his birth to the age at the time of interview. In particular, the dataset contains yearly information that allows us to construct the trajectories of our three labour market outcomes of interest: employment status, part-time employment and self-employment. Employment status for each individual-year is defined based on the start and end year of each

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job spell. The dummy variable *employed* takes the value 1 if the respondent in a given year was working and 0 otherwise. The other two outcomes are defined for working individuals only, by attaching job characteristics to each job spell. The dummy variable *part-time* takes the value 1 if the individual was working part-time in the corresponding job spell. Based on the job title–employee, civil servant, or self-employed–we generate the dummy variable *self-employed*. The data also include information on the dates of birth of children.

Using SHARE allows us to estimate both short- and long-term effects of motherhood on labour market outcomes for the 29 countries using comparable data, hence avoiding issues of heterogeneity across questionnaires or survey methods. Had we used administrative data to carry out our analysis, we would have been restricted to a small sample of countries. Even within this reduced sample, we would have had to deal with problematic discrepancies across countries, as ways of computing or reporting labour force status may differ. Moreover, administrative data do not record informal work arrangements, whose incidence varies across countries and affect men and women differently. Survey data has additional perks: it provides information that does not exist in administrative data such as personality traits or childhood circumstances.

We take advantage of the richness of SHARE, which allows us to estimate motherhood effects for different 'talent' groups. We start by groups defined in terms of educational attainment and cognitive abilities in childhood. Educational attainment is collected at the beginning of the first interview, when the respondent is shown a 'showcard' with several different options of primary, secondary, and tertiary education categories, some being country-specific. In our analysis, in order to keep consistency across countries, we discriminate only between individuals with and without college education. Cognitive abilities in childhood refers to self-reported, or more exactly recalled relative performance in Math at age 10, which is asked to the respondent in 15 of the 29 countries in the following terms: 'Now I would like you to think back to

your time in school when you were 10 years old. How did you perform in Maths compared to other children in your class? Did you perform much better, better, about the same, worse or much worse than the average?'

This item–as well as others in the several childhood modules–uses two retrospective survey 'tricks' in order to circumvent potential recall bias: first, 'bounded recall', i.e. an artificial restriction of the reference period that has been shown to increase accuracy (see Börsch-Supan and Schröder 2011). In other words, when asking the respondent to think about his/her childhood, the interviewer aims at anchoring the respondent's memory at a precise point in time, precisely age 10, which individuals usually recall better than a given calendar year. Second, individuals' relative performance with respect to their peers is something they tend to remember better than other objective measures, which would also be less useful to the researcher as they would be unstable across cohorts and space (even across schools). In other words, recalling that one performed above the average in Math at age 10 might convey more accurate information than an A,B,C, or D grade at age 10.[5]

We acknowledge that recall bias is potentially present in SHARELIFE as in any retrospective study: as stated in Börsch-Supan and Schröder (2011), 'the retrospective data collection may suffer from recall bias, as respondents may err on when an event actually happened, or on how an event exactly took place. Also, less information can be extracted by means of a retrospective data collection because memory fades'. Nevertheless, rigorous validation studies were carried out by Garrouste et al. (2011) and Havari and Mazzonna (2015), who find scarce evidence of recall bias in SHARELIFE data. As argued there as well as in Brunello, Weber, and Weiss (2017), this is probably due to 'the state-of-the-art elicitation methods used: respondents are helped to locate events along the time line, starting from domains that are more easily remembered, and then asked progressively more details about them'.

Last, we also exploit an established personality inventory, which was introduced in wave 7 for the

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[5]Moreover, as we show in Figure A.3, there is a strong positive correlation between self-reported early maths skills and educational attainment. Notably, this relationship is remarkably similar for both men and women. This finding underscores the validity of self-reported early maths ability as a predictor of later-life talent.

first time. As explained in Bergmann, Scherpenzeel, and Börsch-Supan (2019), the first six waves of SHARE had not assessed the domain of personality. In light of the growing body of evidence attesting to the relevance of personality traits for a broad range of life outcomes, including income, health, well-being, marital stability, and social participation (Roberts et al. 2007), wave 7 introduced the 10-item Big Five Inventory (BFI-10), following Rammstedt and John (2007), measuring the five 'Big Five' personality dimensions with two items each. The so-called Big Five are openness to experience (vs. closed-mindedness), conscientiousness (vs. lack of direction), extraversion (vs. introversion), agreeableness (vs. antagonism), and neuroticism (vs. emotional stability). They are sometimes referred to by the acronym OCEAN. An important feature of these personality traits is that they have been shown to be quite stable in time (e.g. Cobb-Clark and Schurer 2012; Terracciano, McCrae, and Costa 2010). That being said, motherhood is such a transforming event in one's life history that one may question the stability evidence just mentioned. This would not jeopardize our empirical strategy as we are not after the causal impact of personality on the probability of becoming a parent. Conversely, if labour market decisions, such as entering self-employment, leads to a change in some personality traits, then we cannot reasonably claim a causal interpretation of the impact of personality on motherhood-induced entry to self-employment. Instead, we explore the heterogeneous responses to the birth of a first child for women differing in their personality traits as of 2017 (wave 7), and refrain from making any causal claim when dealing with that precise dimension of talent.

Our sample includes only those individuals we observe at least once before and once after becoming parents, and whose age at the birth of the first child is over 16 years old. The resulting sample contains 45,326 women (1,327,120 person-year observations) and 33,683 men (1,082,997 person-year observations), who had children at some point before the retrospective interview takes place. The number of observations for each individual ranges from 20 years before to 20 years after the birth of their first child. All 29 countries are part of the sample: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and Switzerland.

Tables A.1 and A.2 in the Appendix describe the samples for the pool of countries (pooled sample) and for each country, respectively, in the year prior to the birth of the first child. In our pooled sample, 91% of men were working at that time, compared with 72% of women; self-employment was higher among men, while part-time jobs were more prevalent among women. On average, women first became mothers when they were 24.4 years old (the range varies from 22.2 in Romania and Bulgaria to 26.8 in Ireland), while men first became fathers when they were 27.5 years old. Figure A.1 in the Appendix shows the distribution of age at first birth for men and women across countries. Our sample is made of cohorts born mostly between the 1920s and the 1960s, with an emphasis on early baby-boomers (average year of birth around 1947, as shown in Table A.1). Most individuals in our sample gave birth to their first child between the 1950s and the 1980s. Figure A.2 in the Appendix shows the distribution of years of birth of the first child for the sample of women, with the average in 1972. Hence, our results may be envisioned as the effects of motherhood for women who had their first baby in the early 1970s.

## III. Motherhood, labour supply and talent

We first present the motherhood effects on labour supply obtained from estimating Equation 1 on the pooled sample of 29 countries. Figure 2 shows the normalized estimates of the $\beta_\tau$ (i.e. $P_\tau = \frac{\beta_\tau}{\bar{Y}}$) for employment and part-time employment from five years prior to the birth of the first child to 15 years afterwards. These normalized coefficients are to be interpreted relative to the year before birth ($\tau = -1$).

Our estimates of short- and long-run motherhood effects on the probability of working are −25% ($\tau = 1$) and −21% ($\tau = 15$), respectively (see Figure 2(a)). These estimates fall close to the upper end of the [−40%, −20%] interval found in
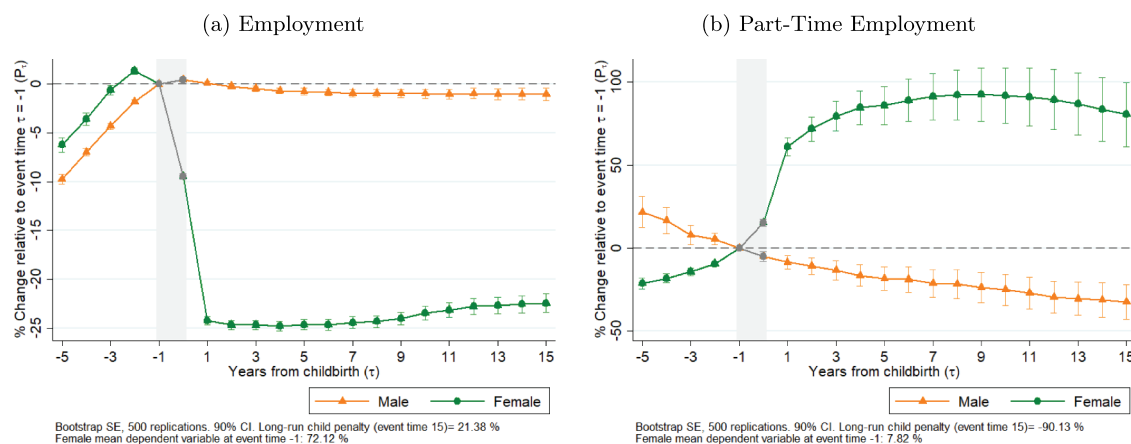
(a) Employment

(b) Part-Time Employment



**Figure 2.** Parenthood effects on labor supply in the pooled sample of 29 countries. These graphs show the normalized effects $P_\tau$, which result from estimating Equation (1) for mothers and fathers separately in the pooled sample of 29 countries. The outcome variables are employment status and working part-time conditional on being employed. See Section II for definitions. The standard errors were computed using 500 (clustered by individual) bootstrap samples.

the literature (Berniell et al. 2021; Kleven et al. 2019; Kleven, Landais, and Sogaard 2019, 2021; Kuziemko et al. 2018).[6]

Our results also point to a sharp increase of about 60% in women's part-time employment immediately after the birth of the first child (see Figure 2(b)).[7] Importantly, 15 years after childbirth, the motherhood effects remain of the same order of magnitude.[8] In contrast, results for men reveal a zero immediate effect of fatherhood on employment and a slightly negative trend on part-time employment, which follows the prebirth pattern. The transition to fatherhood is, therefore, smooth compared to the abrupt transitions to motherhood.

We find similar results for each country as shown in Figures A.4 and A.5 in the Appendix: motherhood causes many women either to stop working or to take up part-time jobs and the effects persist in the long run. While the motherhood effects are qualitative

similar across countries, there exists considerable heterogeneity in magnitude: from stand-alone countries like Malta, Ireland, and the Netherlands exhibiting the largest effects to Northern and Eastern European countries, which display lower or negligible effects. Interestingly, as shown in Figure 3, there exists a strong positive correlation across countries between the size of the motherhood effect on employment and the percentage of women with a college degree out of the labour force–a measure that can be broadly interpreted as a proxy of underutilization of women's talent.[9]

Next, we explore the impact of the arrival of the first child across individuals with different levels of talent. Accordingly, we define two groups based on individuals' educational attainment: individuals with some college education and individuals without college education. Because education is a product of ability and opportunities, we also look at (self-reported) relative performance in

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[6]One challenge when trying to pin down the causal effect of the birth of a first child on labour market outcomes is that it may be hard to disentangle that effect from that of marriage, as marriage and childbirth tend to almost coincide in time. Berniell et al. (2022) show that even though marriage has an effect, the magnitude is much smaller compared to the effect of the first child.

[7]A potential concern with our estimates regarding part-time employment, as well as any other outcome conditioned on employment, is that the estimated effect may also capture selection into employment. Since the existing evidence supports a positive selection into employment (for a review of the literature see Blau and Kahn 2017), our estimates would be a lower bound of the true impact of children.

[8]Identifying short-run effects on event studies relies on a smoothness assumption. However, identifying long-term effects necessitates assuming thatâafter adjusting for age and calendar year effects-the outcome variable in the counterfactual scenario without children shows no trend. Lack of pre-existing trends would bolster this assumption. In our case, there seems to be a certain increasing pre-trend in the proportion of part-time employment for women (see Figure 2(b)), potentially limiting the interpretation of long-term motherhood effects on part-time employment. While the estimation of short-term motherhood effects remains reliable, our estimates may overstate the long-term impact on part-time employment. Formal discussions about the identifying assumptions in an event study can be found, for instance, in Borusyak, Jaravel, and Spiess (2024), Marcus and Sant'anna (2021), and Sun and Abraham (2021). Additionally, when considering long-term effects, it's important to note that they also encompass the influence of subsequent children born after the first child.

[9]Notice that the measure of underutilization of human capital in Figure 3 only considers the extensive margin of labour supply. If we were to include in this measure the intensive margin as well, underutilization would be even larger.
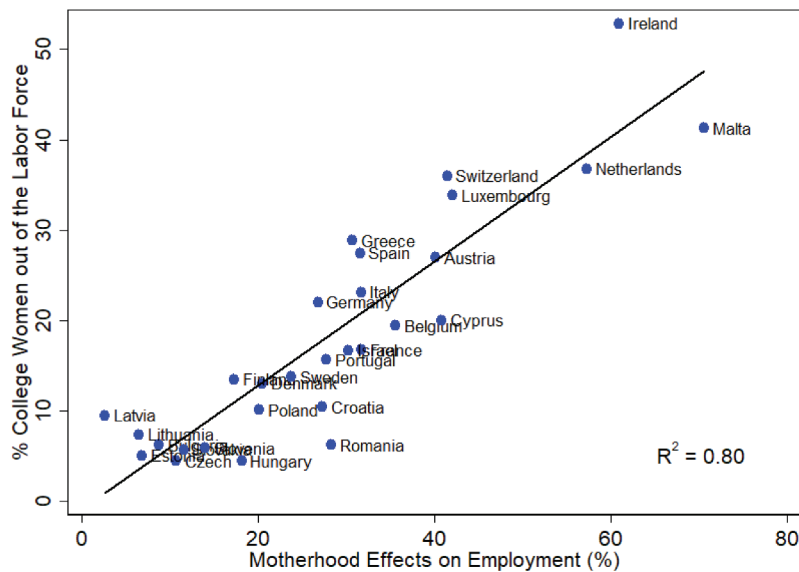
**Figure 3.** Motherhood effects and underutilization of Women's human capital in the labor market. This figure shows the cross-country correlation between the percentage of women with a college degree who are out of the labour force and the motherhood effects on employment obtained from estimating Equation 1 separately for each of the 29 countries. For the former, we take women aged 25–60 in the period 1960–2000 based on data from the Survey of Health, Ageing and Retirement in Europe (SHARE) Job Episodes Panel.

Math at age 10, which is more likely correlated with innate cognitive ability. We thus define a high-performance group that includes those individuals who by the age of 10 were high-achievers in Math and a low-performance group of those who were not high-achievers by that age.

Although the drop in labour supply upon motherhood is more pronounced among women with lower levels of education (Figure 4(a,b)), as well as those who performed poorly in Math during childhood (Figure 4(c, d)), the motherhood effect remains sizable even for highly educated women and those who excelled in Math. In contrast, we find almost no effect on fathers, regardless of their level of education or Math performance: our results show a null immediate impact of fatherhood on employment (Figure 4(a,c)), and a small negative trend–though not always significant– on part-time employment that follows the slightly negative prebirth trend (Figure 4(b,d)).

We complement these results with a within-couple analysis. We find consistent results across the two approaches. We divide all heterosexual couples in our dataset into two groups based on the woman's education level in comparison to her partner's: (1) couples where the woman is more educated than her male partner, and (2) couples

where the woman has less education than her partner. Figure 5(a,b) show that for both groups motherhood has a large negative impact on women's labour supply–both at the extensive and intensive margins–while fathers remain largely unaffected. Figure 5(c,d) show similar results when comparing women with their male partners according to their Math relative performance at the age of 10.

Therefore, while all women–even the most talented, both in absolute terms and relative to their husbands–are likely to exit the labour market or reduce working hours upon the birth of the first child, men's labour supply does not change, not even among the relatively less talented. These results highlight the role of motherhood in explaining the substantial underutilization of skills of many highly talented women in the labour market, while many less talented men remain in the labour force.

## IV. Motherhood and the allocation of entrepreneurial ability

Beyond affecting mothers' labour supply, the arrival of children has effects on occupational choices. For instance, motherhood makes women more likely to prefer jobs that offer more flexible
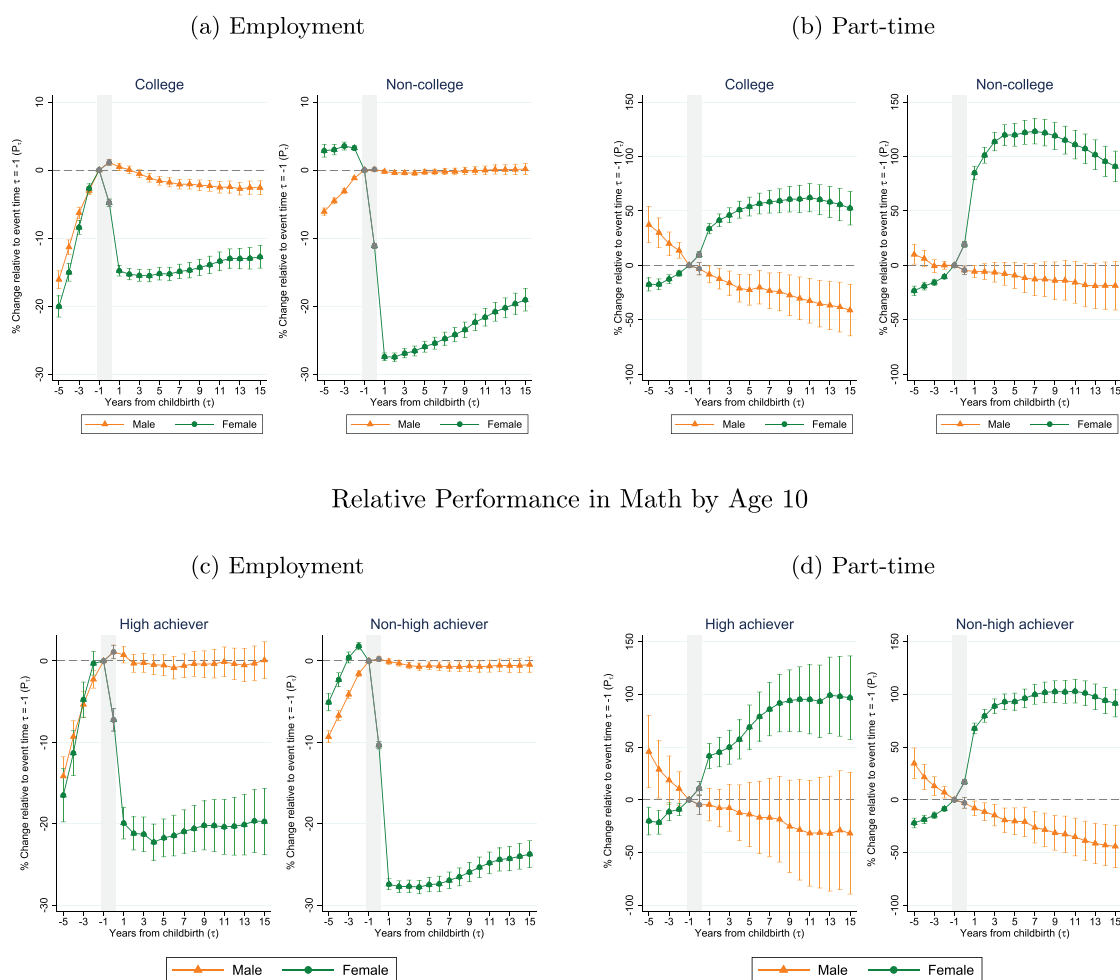
Education

(a) Employment



(b) Part-time



Relative Performance in Math by Age 10

(c) Employment



(d) Part-time



**Figure 4.** Parenthood effects on labor supply by education and relative performance in math. These graphs show the normalized effects $P_\tau$, which result from estimating Equation (1) separately for mothers and fathers, for high and low level of education (Figures (a and b) and for high and non-high achievers in Math (Figures (c and d), in the pooled sample of 29 countries and 15 countries, respectively. The outcome variables are employment status and working part-time conditional on being employed. See Section II for definitions. 90% confidence intervals were computed using standard errors clustered by individual.

arrangements in terms of working hours, such as self employment.[10] In fact, as Figure 6 shows, the birth of the first child results in a sharp increase of about 60% in the probability of becoming self-employed among mothers–but not among fathers.

We explore the impact of the arrival of the first child on self-employment across individuals with different levels of talent for successful entrepreneurship. We begin by examining the motherhood effects on self-employment by educational level and relative performance in Math at age 10. The empirical literature shows evidence of a strong positive

association between education and entrepreneurial performance (see the review by Van der Sluis, Van Praag, and Vijverberg 2008). Several authors claim that there is a positive relationship between educational attainment and successful self-employment. For instance, Levine and Rubinstein (2017) find that more successful entrepreneurs—i.e. incorporated–tend to be more educated and, as teenagers, scored higher on learning aptitude tests. Similarly, Hartog, Van Praag, and Van Der Sluis (2010) find that Mathematical ability has a higher return in entrepreneurship than in wage employment.

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[10]SHARE data for those who are still working at the time of the interview show that self-employment leads to a larger dispersion of working hours. Figure A.6 in the Appendix reveals a distribution of hours worked per week for non-self-employed men and women bunched around 40 hours whereas it is more dispersed for the self-employed, particularly for self-employed women.

### Spousal Education Gap

(a) Employment

(b) Part-time



### Spousal Math-Ability Gap
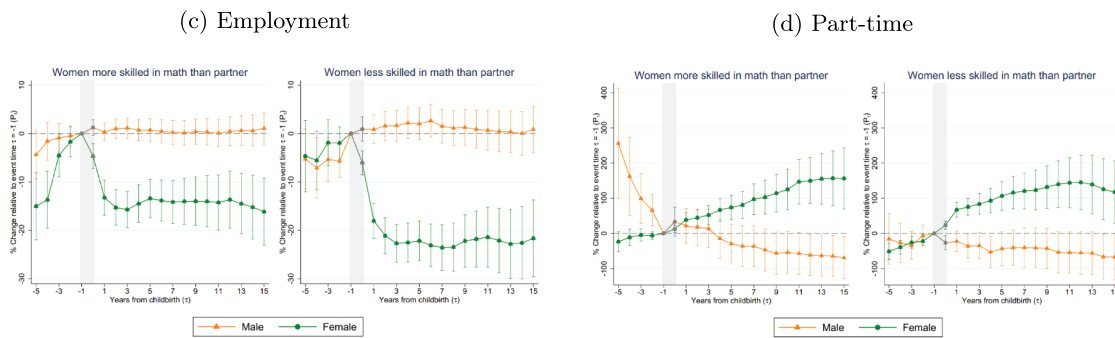
(c) Employment

(d) Part-time
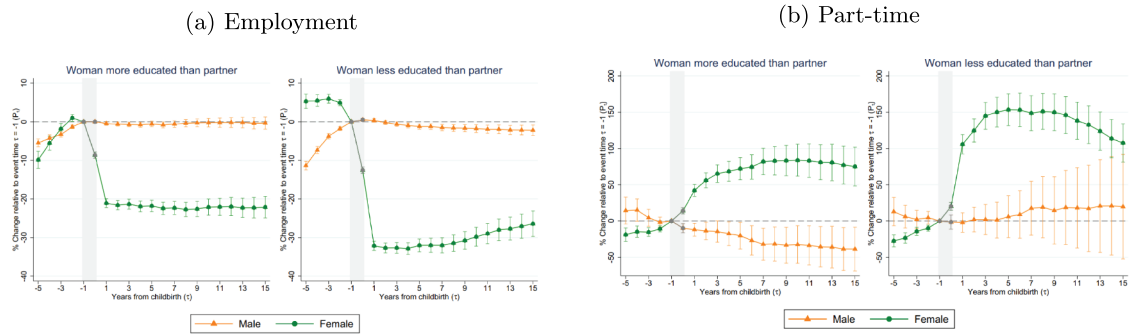


**Figure 5.** Parenthood effects by spousal education gap and spousal math-ability gap. These graphs show the normalized effects $P_\tau$, which result from estimating Equation (1) separately for mothers and fathers for couples where women have higher Education (Panel a) or Math ability at age 10 (Panel b) than their male partners, and couples where women have less Education (Panel a) or Math ability (Panel b) than their male partners, in the pooled sample of 29 countries. The outcome variables are employment status and working part-time conditional on being employed. See Section II for definitions. 90% confidence intervals were computed using standard errors clustered by individual.

Strikingly, our Figure 7(a,b) reveal that–conditional on working–women with lower levels of education or poorer Math skills at age 10—i.e. those with lower entrepreneurial potential–are more likely to turn to self-employment after their first child's birth.[11]

We also analyse the impact of the first child's birth on self-employment among individuals with distinct personality traits, as the literature has shown that certain non-cognitive skills play a crucial role in entrepreneurial success (Caliendo, Goethner, and Weißenberger 2020; Levine and Rubinstein 2017). Caliendo, Fossen, and Kritikos (2014) and Caliendo, Goethner, and Weißenberger (2020) show the association between different personality features included in the Big Five model and successful entrepreneurship. They find that openness to experience, which describes an individual's ability to seek new

experiences and to explore novel ideas, is positively associated with both entry into self-employment and business survival. Also, they show evidence that extraversion, which includes traits such as sociability, activity, assertiveness, and positive emotionality, is negatively related to firm performance, proxied by business survival, whereas none of the remaining factors of the Big Five model, such as neuroticism, conscientiousness, and agreeableness, is associated with either entry into self-employment or business survival.

To explore the effect of motherhood on the selection into self-employment across individuals with different personality traits we take advantage of the information contained in SHARE regarding the Big Five model. We therefore define groups of high (top third) and low (bottom third) of the distribution of openness to experience and

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[11]To keep the exposition of results simple, in this analysis of self-employment we do not show results for fathers, for whom we do not find any type of heterogeneous effect across groups.
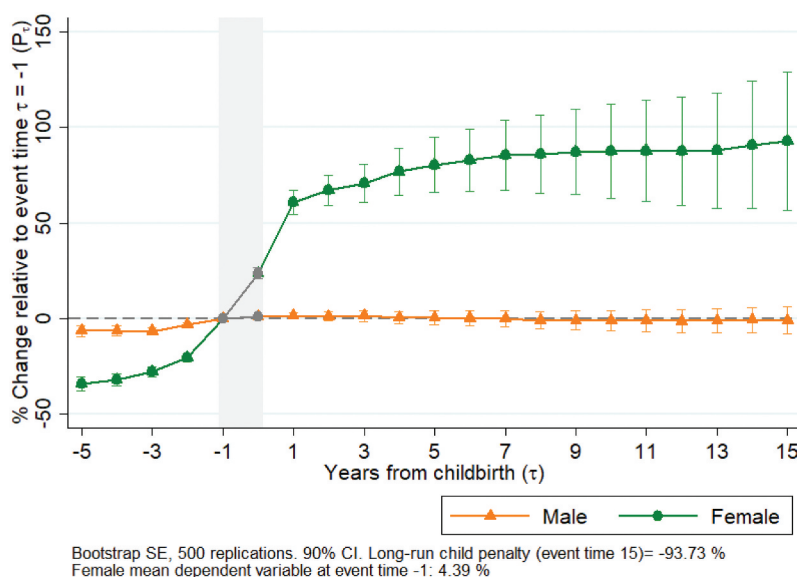
Bootstrap SE, 500 replications. 90% CI. Long-run child penalty (event time 15)= -93.73 %
Female mean dependent variable at event time -1: 4.39 %

**Figure 6.** Parenthood effects on self employment in the pooled sample of 29 countries. The graph shows the normalized effects $P_\tau$, which result from estimating Equation (1) for mothers and fathers separately in the pooled sample of 29 countries. The outcome variable is being self-employed conditional on being employed. The standard errors were computed using 500 (clustered by individual) bootstrap samples.
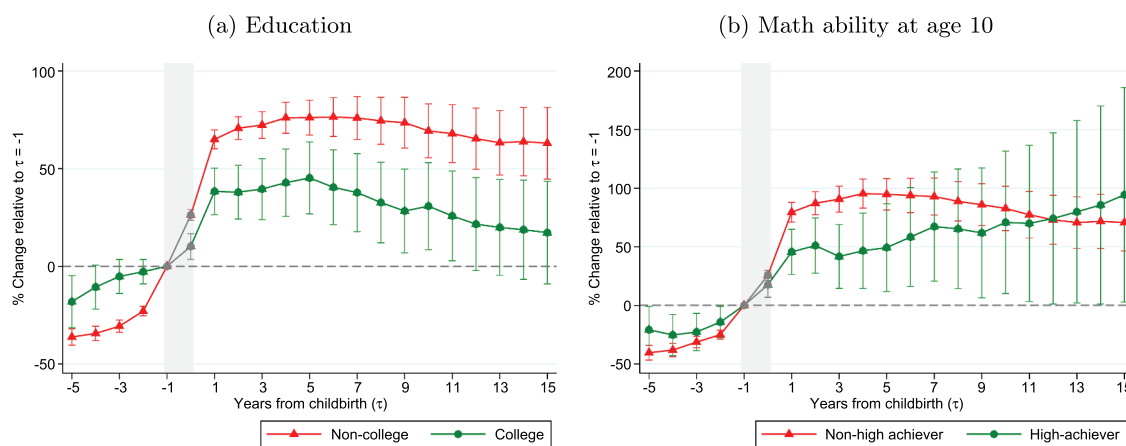


**Figure 7.** Heterogeneous impacts of motherhood on self-employment by cognitive Ability. These graphs show the normalized effects $P_\tau$, which result from estimating Equation (1) for mothers, for high and low level of education (Figure a) and for high and non-high achievers in Math (Figure b), in the pooled sample of 29 countries. The outcome variable is being a self-employed conditional on being employed. See Section II for definitions. 90% confidence intervals were computed using standard errors clustered by individual.

extraversion, respectively, and estimate the corresponding motherhood effects on self-employment. Strikingly, Figure 8(a,b) show that women who are the least open to experience and extraverted at the time of the interview in 2017—traits associated with lower entrepreneurial ability–were more likely to become self-employed upon motherhood.[12]

Figure 8(c,d) show that these results hold true even if we restrict the sample to women with college education, who are the most likely to engage in activities that require more entrepreneurial skills.[13] Of course, because of the smaller sample size the latter estimates are less precise than those in the top panel.

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[12]Interestingly, we do not observe heterogeneous impacts of motherhood on employment across groups defined by women's personality traits. Results available upon request.

[13]The SHARE Job Episodes Panel does not allow to distinguish between own account self-employment, which includes working for family business, and incorporated entrepreneurship. However, according to the main SHARE survey, waves 1, 2, 4, 5 and 6, own-account working women represent 69% of self-employed women at the time of the interview.
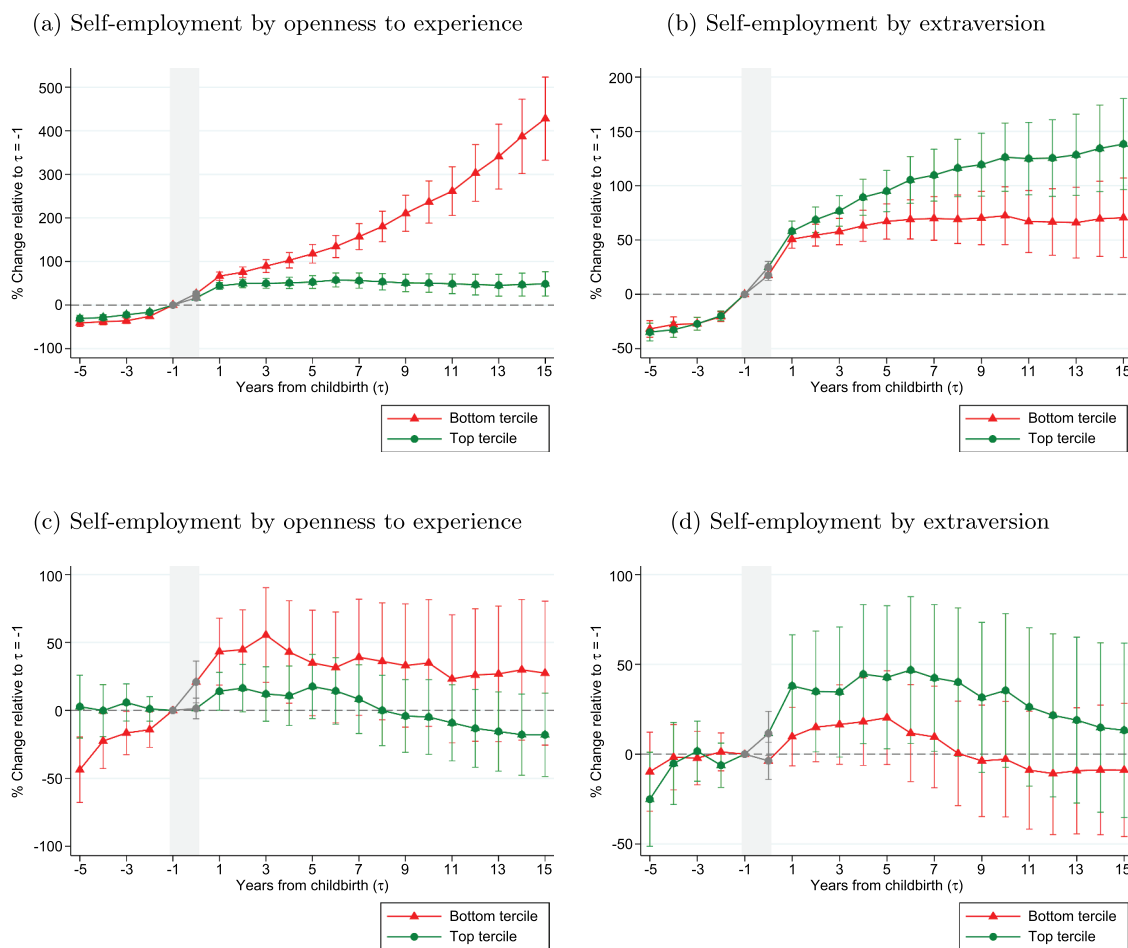
(a) Self-employment by openness to experience



(b) Self-employment by extraversion



(c) Self-employment by openness to experience



(d) Self-employment by extraversion



**Figure 8.** Heterogeneous impacts of motherhood according to personality Traits. These graphs show the normalized effects $P_\tau$, which result from estimating Equation (1) for mothers, for high and low levels of openness to experience (Figures a and b) and for high and low levels of extraversion (Figures c and d), in the pooled sample of 29 countries. The outcome variable is being a self-employed conditional on being employed. See Section II for definitions. 90% confidence intervals were computed using standard errors clustered by individual.

Summing up, when using college education, Math performance during childhood, and certain personality traits as proxies for entrepreneurial skills, we find that motherhood induces a negative selection of women's talent into self-employment.

## V.  Talent for home or market production? A discussion

Our analysis focuses on understanding how parenthood affects the allocation of talent in the labour market. So far we have shown that the arrival of the first child leads to changes in the use of human capital in the market economy by pushing out of the market many talented women and biasing their occupational choices after childbirth. In contrast, men do not show changes in their labour market results upon becoming fathers. These parenthood effects would negatively affect GDP, through both the decrease in the female labour force and the unfavourable changes in talent allocation. For instance, Hsieh et al. (2019) show that the improved allocation of talent resulting from the inclusion of talented women and black men into the labour market can explain between 20% and 40% of the growth in GDP per capita in the US between 1960 and 2010. Thus, we should expect that the cross-country variation in the size of the motherhood effect showed in Figure 3 and Figures A.4 and A.5 in the

Appendix explains part of the variation in the GDP across countries.[14] But, of course, a missing piece to judge whether this evidence also implies a misallocation of talent between market and non-market activities is the (unobservable) gender difference in home production productivity.

We may assess whether there is misallocation in the whole economy by taking into account only the within couple comparative advantages. For example, if women had a comparative advantage in childcare, it may be efficient for them to stay at home even when they are more productive in absolute terms in the market than their partners. However, the weight of the empirical evidence tends to reject or fail to provide robust support for the hypothesis that household specialization after childbirth is based on within-couple comparative advantages. This remains true whether measured using typical factors associated with women's advantages in household production–such as biological factors–or various measures of relative within-couple earning potential reflecting their relative labour market productivity.

On the one hand, the more classical explanation of comparative advantages based on mother's biological link to their children does not seem to hold. According to Kleven, Landais, and Sogaard (2021), motherhood effects are virtually identical when comparing biological and adoptive mothers in Denmark, ruling out the potential effects induced by physical changes upon biologic birth. Andresen and Nix (2022) provide similar results for Norway. Moreover, it would be difficult to reconcile the claim of biological differences driving comparative advantages with the wide range of motherhood effects that we find across countries, a phenomenon also documented by other studies (Kleven et al. 2019; Kleven, Landais, and Leite-Mariante 2023; Marchionni and Pedrazzi 2023).

Such a large cross-country heterogeneity necessarily implies that female comparative advantages differ greatly across countries. Moreover, we are not aware of studies that have attempted to directly measure home production productivity, apart from considering biology advantages of mothers over fathers.

Differences in comparative advantages in home production may arise from nurture, rather than nature. In fact, motherhood effects are related to social norms and, to a much lesser extent, also to policies (Berniell et al. 2023; Kleven 2022; Kleven et al. 2019; Olivetti and Petrongolo 2017).[15] Despite the extent to which these factors can fully explain the significant effects of motherhood on labour market outcomes remains a subject of debate, Cortés and Pan (2023) provide some clues. They develop a household decision-making model to explore gender disparities in labour market outcomes following parenthood, considering preferences for individual versus spousal consumption and the valuation of children among other public goods. The model suggests that in households where the spouses have similar preferences, child earnings penalties for mothers will arise only if women face a lower wage. But if mothers face higher wages than their husbands, earnings penalties for mothers can only be justified if they demonstrate higher productivity at home, prioritize household goods more, or if there's a societal disutility associated with women's market employment. As Cortés and Pan (2023) point, these variations in gender-specific preferences may stem from entrenched social norms regarding gender roles. However, their empirical analysis based on US data indicates that while comparative advantages may play a role, their magnitude would need to be substantial to counterbalance the observed negative effects of motherhood in the labour market. Returning to our results, for example, consider

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[14]It is important to note, however, that this potential increase in GDP as a result of the incorporation of women to the labour market hinges on the fact that national accounts exclude household production. Indeed, different studies have estimated that GDP would significantly increase if household production were to be included. For instance, Bridgman et al. (2012) estimate that the inclusion of household production would increase US nominal GDP by 26% in 2010. Moreover Suh and Folbre (2016) show that if a higher value were imposed to childcare–by avoiding overlapping with other activities, assuming higher wages for supervision of certain child care activities, taking into account educational attainment of caregivers and the ratio of adults to children–the 2010 GDP estimates for the US would increase by 43%.

[15]Indeed, using our data, we find that motherhood effects are related to norms regarding gender roles. We correlate a proxy of country-specific gender norms with the estimated motherhood effects across countries. To proxy gender norms, we used the percentage of people agreeing with the statement 'a working mother cannot establish just as warm and secure a relationship with her children as a non-working mother' from the 1990 European Value Survey. The results showed a strong negative correlation, indicating that in countries where a higher percentage of people agreed with this statement–indicating more conservative gender norms—, the estimated effects of motherhood on labour market outcomes were larger. However, in former Soviet bloc countries, institutional constraints rather than individual choices seemed to influence the size of motherhood estimates.

the case of women with higher education levels than their husbands: despite their absolute advantage in the labour market, we observe significant negative effects following motherhood, contrasting with the absence of such effects for fathers. This raises the question of how much larger their absolute advantages in home production would need to be in order to offset their advantages in labour market skills and thus explain the negative effects found.

On the other hand, another set of complementary papers considers measures of labour market productivity advantages while being silent about or assuming null differences in home production productivity of couples. Overall, they find that household specialization driven by comparative advantage in labour market productivity–an aspect of productivity measurable for both men and women using data from various sources–is not supported. Andresen and Nix (2022) find scant evidence suggesting that the child penalty arises from fathers' labour market advantage. By dismissing comparative advantages related to biology and labour market productivity, they infer that the primary driver of the child penalty in heterosexual couples likely stems from gendered differences in childcare preferences, gender norms, and discrimination, although they cannot untangle these explanations. Similarly, Artmann, Oosterbeek, and van der Klaauw (2022) investigate the relevance of household specialization in the Netherlands, a setting where institutional barriers to a gender-neutral division of household tasks are arguably minimal. They develop several measures of relative within-household earnings potential–such as parents' education levels, field of study, and predicted lifetime earnings–and assess the earning potential of both parents jointly. They find little evidence supporting household specialization based on these three measures of comparative advantage.

Rather than relying on measures of market or home productivity, alternative approaches utilize time-use data to calibrate models of couples' time allocation decisions. For instance, Afridi, Bishnu, and Mahajan (2024) construct a theoretical model for analysing married couples' time allocation, incorporating both home production and market productivity within a collective decision-making framework, where productivity can improve with education. A crucial feature of their model is that the education level not only determines market productivity and wages but also affects productivity at home. Consequently, changes in education can impact labour supply decisions through two channels: market productivity and home productivity. They calibrate their model using time-use data from urban India and the United Kingdom. They find that the model tends to over-predict labour market participation for more educated married women in India compared to observed data. Consequently, this result is inconclusive regarding the productivity advantage of women in home production as an explanation for household specialization, especially among the highly educated, as the model does not adjust to the observed data independently of the context studied. However, when incorporating social norm constraints into the model, it aligns more closely with the data.

Finally, differences in preferences across genders, rather than comparative advantages, have also been advanced as a potential explanation for the sharp changes produced in the labour market upon motherhood. Recent evidence does not support this explanation. Ashraf et al. (2022) investigate the effect of gender roles on talent misallocation using microdata on the gender pay gap among employees in a multinational firm based on 101 countries. They show that for preferences to rationalize the misallocation found in their data, differences in preferences for housework should be orders of magnitude larger than any other gender gap in preferences estimated in the literature to date, including risk aversion, altruism, trust, patience, positive, and negative reciprocity.

Summing up, while the empirical evidence tends to reject or fail to support the hypothesis that household specialization after childbirth is based on within-couple comparative advantages, it does offer compelling evidence compatible with alternative explanations, where allocation is not necessarily based on efficiency. Therefore, the absence of clear evidence regarding women's comparative advantage in or preferences for home production suggests that our findings may indicate that motherhood leads to a misallocation of talent between market and non-market activities.

## VI. Conclusion

Using retrospective data from SHARE for a harmonized sample of 28 European countries and Israel, we show that motherhood affects the allocation of talent in the labour market.

We estimate the effects of motherhood for the 29 countries and find not only that they are widespread and significant–on average, a 25% drop in female employment upon motherhood—, but also that they remain of the same order of magnitude 15 years after the first child is born. Also, we show that motherhood effects go beyond labour market participation decisions to substantially affect the uptaking of alternative modes of employment that are characterized by flexible or reduced work schedules but that are usually associated to lower pay and worse career prospects. For instance, part-time and self-employment increase on average by about 60% upon motherhood.

Our main contribution is to show that these motherhood effects entail changes in women's allocation of talent in the labour market. Based on three alternative proxies of talent–educational attainment, relative performance in Math at age 10, and personality traits associated to entrepreneurial ability–we find that even highly talented women, both in absolute terms and relative to their spouses, are more likely to withdraw from the labour market or work part-time after the birth of their first child, and the least entrepreneurial women are more likely to enter self-employment upon motherhood. In contrast, we find no effects on men, regardless of their talent level. Given the absence of conclusive evidence regarding female relative advantages in or preferences for home production, these long-run impacts of motherhood are probably indicative of misallocation of talent between market and non-market activities. These inefficiencies, adding to the worrying evidence on gender gaps, participate to justifying the incremental costs of policies aimed at reducing them.

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## Disclosure statement

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