Innovation and motherhood

Clemens Mueller[†], Stefan Obernberger[†], and Arnim Seidlitz[‡]

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Abstract

We study the impact of childbirth on the careers of inventors, a predominantly male occupation. We document pronounced gender differences in post-birth career outcomes. After childbirth, female inventors are substantially less likely to file patents and the quality of filed patents decreases. A large share of the decline in patenting can be attributed to temporary labor market exits, increased part-time work, and reduced job mobility. Most female inventors postpone childbearing until after filing their first patent application, underscoring the substantial career costs associated with motherhood. Fathers also experience declines in innovation output following childbirth, but these effects are considerably smaller than those observed for women. Both men and women are much less likely to enter inventive careers after starting a family. Our findings highlight the challenges of combining parenthood with careers in innovation, particularly for women.

Keywords: innovation, patents, motherhood, fertility, child penalty

† Clemens Mueller and Stefan Obernberger are at the Erasmus School of Economics. Email: c.mueller@ese.eur.nl; obernberger@ese.eur.nl. ‡ Arnim Seidlitz is at the Institute for Employment Research. Email: arnim.seidlitz@iab.de. We thank Ingolf Dittmann, Daniel Karpati, and Daniel Urban for helpful comments and seminar participants at Nova School of Business & Economics, Tsinghua University, and WHU – Otto Beisheim School of Management for valuable discussions.

1. Introduction

Women remain severely underrepresented in innovation, and female inventors produce fewer patents than men over their life cycle.[1] Despite the central role of innovation in economic growth and social progress, we still know little about the underlying causes of women's underrepresentation in this field.

Why do relatively few women pursue careers as inventors? In this paper, we ask whether such careers are difficult to reconcile with motherhood. To this end, we examine how family planning affects inventors' life cycles and estimate the impact of childbirth on patent output. The literature provides several reasons why motherhood may be difficult to reconcile with a career in innovation. Innovation is characterized by uncertainty and unpredictable outcomes (Fleming, 2001; Rosenberg, 2009), making it challenging to align with family planning. Moreover, mobility is a key driver of innovation (Topel and Ward, 1992; Trajtenberg, 1990), yet mobility tends to decline once individuals have children.

We build on these insights using a unique dataset that links European patent records to German administrative data, allowing us to observe patenting histories, biographical information, childbirth events, and career trajectories for 11,634 female inventors and 140,677 male inventors. To identify inventor fathers and inventors' spouses, we further leverage a novel linkage of married couples in the German administrative labor market data (Bächmann et al., 2021).

We begin by examining how the decision to start a family shapes the innovation lifecycle of inventors. We document several systematic differences between inventors who even-

[1]Based on data from the World Intellectual Property Organization, only 13% of inventors worldwide over the last two decades are women (World Intellectual Property Organization 2023). Data from the European Patent Office show that the share of women has risen from 2% in 1978 to around 13% in 2018—a marked improvement, yet far from gender parity.

tually become parents and those who remain childless. Inventors who become parents exhibit higher productivity early in their careers, and the timing of peak productivity closely coincides with the average age at first birth, suggesting a tight link between career trajectories and family formation. Consistent with this interpretation, entry into inventive careers becomes markedly less frequent after individuals start a family.

The alignment of career milestones with family planning appears particularly prevalent among female inventors: we observe a sharp discontinuity in childbirth around the first patent filing, with the vast majority of births occurring afterward. As a result, female inventors delay childbearing by approximately three years relative to a carefully selected control group. Overall, these patterns suggest that parenthood reshapes the innovation life cycle, with a sharp, career-coordinated transition for women and a more gradual adjustment for men.

We then estimate the effect of childbirth on innovation output using a sample of 3,090 female inventors who become mothers and have an established patenting track record. Following recent advances in difference-in-differences methodology (Melentyeva and Riedel, 2025; Wooldridge, 2025), we compare mothers with soon-to-be mothers, those who give birth within the subsequent five years. We find that childbirth has profound and lasting effects on mothers' productivity: patent applications drop by 83% one year after childbirth and remain 50% lower four years later. Citations and granted patents follow a similar pattern. Importantly, the impact of childbirth extends beyond the extensive margin. Patents filed after childbirth receive fewer citations, consistent with a reduction in patent quality, potentially reflecting time constraints, rushed filings, or lower innovative significance.

These declines translate directly into altered career trajectories. Four years after childbirth, mothers are 25 percentage points less likely to be employed and 55 percentage points less likely to work full-time. They also experience lower promotion rates and reduced job mobility. Annual earnings fall sharply—by €17,700 in the year of childbirth and by €49,700 four years later—leaving earnings at no more than one third of their pre-childbirth level. Approximately half of these losses can be explained by labor market exits and transitions to part-time work. Changes in career progression and innovation output account for little of the remaining earnings decline. We conclude that childbirth has a profound impact on the human capital of female inventors, potentially reflecting the highly specialized nature of inventive human capital, which may be difficult to deploy outside the research team or innovation environment.

We also study the impact of fatherhood on innovation output and career trajectories to assess the innovation child penalty—defined as the effects of parenthood on women going beyond the effect on men. Male inventors do show small but measurable declines in patenting and earnings after childbirth, a notable result given that losses in earnings after childbirth are usually documented only for women. Yet these effects are far less pronounced, and fathers even experience modest long-run gains in promotion prospects. This contrast highlights that the challenge of balancing parenthood and innovation falls overwhelmingly on women. These results also suggest that innovation stands out as an occupation, working in which appears to be particularly demanding and difficult to reconcile with having and raising children.

Our contribution is twofold. First, we provide the first study of how motherhood affects the careers of female inventors, thereby highlighting a key mechanism behind the gender gap in innovation. This complements prior work documenting disparities in inventive output and recognition (Bell et al., 2018; Kaltenberg et al., 2023; Hoisl and Mariani, 2017; Di Addario et al., 2025; Chien and Grennan, 2024; Hochberg et al., 2023).

Second, we contribute to the literature on child penalties (Kleven et al., 2019; Kleven et al., 2019; Kleven et al., 2024; Kim and Moser, 2025; Rutigliano, 2024; Ginzinger et al., 2024; Lassen and Ivandić (2024); Cairo and Tatari (2025); Bonney et al., 2025). While this literature has established that women's labor market outcomes are negatively affected by childbirth, our study is the first to examine innovation outcomes.[2] Unlike most settings, we find that fathers in innovation are not immune to adverse consequences of childbirth, suggesting that the costs of parenthood do not entirely fall on women and are particularly high in careers characterized by uncertainty, mobility, and demanding work.

In the child penalty literature, our paper is most closely related to Kim and Moser (2025), Lassen and Ivandić (2024), and Cairo and Tatari (2025), who study the impact of motherhood on careers in science. These studies document negative outcomes for mothers, but the results for fathers are mixed.

2. Data

Our project is based on a record linkage of German inventors identified in Patent Statistics (PATSTAT), a comprehensive global patent database maintained by the European Patent Office (EPO), with German employment biographies provided by the Institute of Employment Research (IAB). The Integrated Employment Biographies (IEB) data set administered by the IAB includes information on all employees in Gemany who are subject to social security contributions. The data provide precise daily information on employees' gross earnings, part-time status, education, and occupation.[3] Self-employed employees are not covered by social security contributions and are, therefore, not part of

[2]A large literature has occupied itself with identifying and understanding gender inequality (for reviews see Altonji and Blank, 1999, Bertrand, 2011, and Blau and Kahn, 2017).

[3]For detailed information see the documentation of the SIAB, the scientific use file comprising a two percent sample of the IEB (Schmucker and vom Berge, 2025).

our analysis.[4]

Patent-related variables are recorded at the patent family level and include all patents under the jurisdiction of the European Patent office.[5] A patent family comprises all patent applications that refer to the same technical content. The data include the quarter of patent application, the grant date (if granted) and the publication date. Moreover, the data contain forward-looking citations, that is, the number of citations a patent receives within a given number of years from the grant application. Patent identifiers allow us to identify co-inventors in the data set as well as the number of co-inventors for each patent. Finally, the data include measures of generality and originality, the presence of foreign inventors, and the technology area of the patent.

To be included in the record linkage, inventors must have filed at least one patent application between 1999 and 2011. For those inventors included in the sample, we observe their complete patenting activity from 1980 to 2014. The corresponding employment biographies are available from the start of the IAB's employment records–1975 for West Germany and 1992 for East Germany. This record linkage, known as INV-BIO-ADIAB, is available as a data product through the IAB's Research Data Center.[6] INV-BIO-ADIAB comprises 152,335 inventors, of which 11,632 (7.6%) are female. The dataset has been used in several studies, including Pöge et al. (2022), who examine the effects of collaborator loss in corporate R&D, and Harhoff et al. (2024), who analyze the roles of firms, industries, and mobility in explaining variation in inventor earnings.

[4]This excludes only a small fraction of inventors as 98% of all patents originate from corporate research.

[5]For a detailed description of patent families, see: https://www.epo.org/en/searching-for-patents/helpful-resources/first-time-here/patent-families

[6]Because patent records do not include a unique, disambiguated inventor identifier, the research data center of the IAB matched patent data to employment histories using machine learning algorithms. For further details regarding the record linkage, see Dorner et al. (2019).

We provide detailed descriptions and definitions of all variables included into our analyses in Section A.1. Variable Definitions.

2.1. Identifying mothers

The employment biographies record information on the reasons for the termination of employment spells. This information allows us to estimate, with a high degree of precision, when women gave birth to a child. We rely on the algorithm developed and described by Müller et al. (2022), which identifies childbirth based on exits from employment due to mandatory maternity leave, beginning six weeks prior to the expected delivery date. We focus on an inventor's first child because the algorithm cannot identify births occurring during periods of non-employment. This limitation is particularly relevant in Germany, where long employment interruptions after the first birth are common, making it likely that second or higher-order births are not preceded by employment. We identify births until women reach the age of 43. Afterwards, the algorithm is increasingly prone to false positives because exits from employment due to long-term illness are recorded in the same way as exits for maternity leave.[7]

2.2. Identifying couples and fathers

The record linkage (INV-BIO-ADIAB) does not allow us to identify fathers in the same way we identify mothers, as the algorithm relies on mandatory maternity-leave information that is only recorded for women.[8] To determine whether male inventors have their first child, we therefore draw on an additional database that links married couples in

[7]For more details on the trade-off between type 1 and type 2 errors see Müller and Strauch (2017) and Müller et al. (2022).

[8]From 2007 onward, fathers may take a voluntary parental leave, which could in principle be identified, but using this information would yield a highly selective sample because we have no information on fathers who do not take leave.

German administrative data. The underlying algorithm, developed in Bächmann et al. (2021), identifies a couple when a male and a female employee share the same surname,[9] live at the same address, and differ in age by no more than 15 years. After matching female partners to our male inventors, we identify the first childbirth of the female partner using the algorithm of Müller et al. (2022) discussed above. The couple dataset links people who are recorded in the IEB between 30 June 2001 and 30 June 2014.[10] We assign fatherhood to men whose spouse has an identified birth in the year following their appearance in the IEB. Consequently, we can identify childbirths for men only from mid-2001 to mid-2015.

2.3. Sample restrictions to address sample selection issues

We take several steps to ensure that the composition of our inventor sample is not biasing our results. Table 1 summarizes these steps. First, we restrict the sample to female inventors whose prime fertility years fall within the period during which inventors are selected into the database (1999–2010). This restriction mitigates survivorship bias among mother inventors who can only enter the database if they patent after childbirth. We define women's prime fertility as ages 25 to 38 and retain only those female inventors born between 1961 (= 1999 - 38) and 1985 (= 2010 - 25). For comparability, we impose the same birth-year restrictions on male inventors. This step reduces the sample from 152,311 to 96,865 observations.

Next, we require all male inventors to appear in the couple database so that we can

[9] In the relevant period, couples might either choose the wife's or the husband's name as their shared "family name" or keep their "birth names" each (in that case we cannot identify the couple). A third option, a "double name" used by one spouse, can be detected by the algorithm in the same way as a shared family name.

[10] We fill gaps in the couple database in the sense that two people appearing as a couple in two years are also linked in all years in between. As long as they are not linked to another person in that year.

identify them as either fathers or non-fathers. The resulting sample contains 52,695 inventors, including 9,421 women (17.9 percent), and is used to graph inventor life-cycles (cf. Figure 1).

In the following step, we retain only individuals whom we identify as parents, yielding a sample of 11,136 inventors. Of these, 4,870 are women (43.7 percent).[11] We use this sample to plot the timing of parenthood around patent applications in Figure 3.

We impose two additional sample restrictions in our main "child penalty" regressions. First, we require that the child's birth occurs no later than 2015, because births after 2015 do not allow for the observation of post-birth innovation outcomes. This restriction reduces the sample to X inventors.

Second, inclusion in the record linkage requires inventors to have filed at least one patent application between 1999 and 2011. This requirement can introduce survivorship bias if an inventor's first patent application within this period occurs after childbirth, since such inventors would be selected only if they returned to innovative activity following childbirth. To mitigate this concern, we further restrict the sample to inventors who were active—i.e., filed at least one patent application—between 1999 and the year of childbirth. Applying this restriction yields a final sample of 9,285 inventors, of whom 3,090 are women (33.2 percent). This is the sample used in the main analyses of the paper.

2.4. Descriptive statistics

Table 2 presents summary statistics for our sample of mother inventors, while Table 3 reports the corresponding statistics for fathers. Female inventors who become mothers

[11] The relatively small number of men identified as fathers reflects limitations of the couple-identification algorithm. The low number does not reflect male inventors' fertility.

file at least one patent in 24% of firm–year observations, and 46% of these applications are eventually granted (=0.11/0.24). In the year preceding the birth of their first child, female inventors appear to be particularly productive. Nearly all female inventors in the sample are employed, and 88% work full time. Their innovation output is roughly 50% higher than the sample average reported in Panel A, and their earnings are about 20% higher.

Fathers in our sample are more productive than mothers across all measures of innovation output. Father inventors' application success rates are also slightly higher (0.50=0.15/0.30). Similar to female inventors, male inventors also exhibit markedly higher productivity in the year prior to the birth of their first child.

Table A1 provides additional information on the organization and focus of research of our inventors. Mother inventors work in larger teams than father inventors, with an average of 3.75 team members compared to 3.04. Most mothers work in chemistry (54%), whereas fathers more frequently specialize in mechanics (38%). Nevertheless, chemistry is also an important field for fathers, accounting for 23% of their research activity. Similar conclusions can be derived from taking a look at the occupations of inventors in our sample (Table A2).

3. Identification strategy

The "child penalty" literature offers various approaches to estimate the impact of childbirth on womens' labor outcomes. We follow recent advancements in this literature (Melentyeva and Riedel, 2025) and compare mothers with soon-to-be-mothers and fathers with soon-to-be-fathers. In this setup, the key source of variation comes from comparing inventors who have their first child at a given age (the treatment group) with inventors who have their first child a few years older (the control group). This ensures that all individuals are "at risk" of treatment, mitigating concerns that would arise if controls included inventors who never have children. Put differently, in matching terminology, we condition on a single characteristic: control inventors are those who shortly after also self-select into treatment. Variation is provided by sharp changes induced by childbirth, whereas other observed and unobserved factors arguably evolve smoothly over event time.

Our set-up largely follows Melentyeva and Riedel (2025) and we construct a stacked sample as follows. Inventors entering parenthood at a given age c are compared to a control group who enters parenthood in the following five years, latest in c+5. Once they have their first child, control observations exit the control group. This way the last period for which an estimation is possible is when the treatment group is of age c+4, i.e. four years after the birth of the child. We do not use calendar years but center the periods around birth. That means that year 0 ends for the treatment group with the quarter of birth such that this year captures roughly the period of pregnancy. The other periods are defined accordingly. This guarantees that year -1 is not contaminated with anticipation effects, at least not with respect to a concrete treatment time.

The following specification estimates the full dynamics around the time an inventor has her first child, using treated and control inventors five years before having the first child until 4 years afterwards.

$$Y_{ict} = \sum_{l=-5,\, l\neq -1}^{4} \beta_l \left[D_{ic} \times \mathbf{1}\{t - A_i = l\} \right] + \gamma_{ic} + \eta_{ca_{it}} + \lambda_t + \varepsilon_{ict}, \qquad (1)$$

where Y_{ict} are outcomes on an inventor-cohort-year level. We use i for each individual inventor, c for cohort, which is defined as the age at first birth, and we use t for the time dimension, in this case on a relative yearly level. We employ a full set of leads and lags around the time of first childbirth, captured by the coefficients β_l.

$l \in \{-5, -4, -3, -2, 0, 1, 2, 3, 4\}$ denotes event time relative to treatment, with $l = -1$ omitted as the baseline. D_{ic} flags treated units within age-at-birth cohorts c. $\mathbf{1}\{t - A_i = l\}$ are event-time dummies. We include rich fixed effects such as γ_{ic} which are inventor-by-cohort fixed effects, as well as $\eta_{ca_{it}}$ which are cohort-by-age fixed effects (with a_{it} denoting the age of inventor i in year t). λ_t are year fixed effects. Standard errors are clustered on an inventor level.

We estimate this regression separately for mothers and fathers. We define cohorts for mothers to be starting at age 25 until age 37.[12] For fathers, cohorts are defined from 30 to 42. We do not consider earlier ages, as the number of observations within-cohort is small for earlier ages. We do identify fathers above the mentioned age ranges, however they only serve as controls.

4. Empirical analysis

Women are markedly underrepresented in innovation in Germany, consistent with global evidence (for US: Bell et al., 2018). In our sample, only 9.9 percent of inventors are female. Beyond their lower numbers, female inventors also appear less productive than their male counterparts.

Figure 1, Panel A, plots patenting activity over the life cycle. Women are more active than men early in their careers: in their twenties, female inventors are more likely to file at least one patent per year. However, their patenting activity peaks in the early thirties (peak at age 34), whereas men reach their peak almost five years later and at a substantially higher level (peak at age 38). As a result, lifetime patenting output is

[12]This estimation is possible since the maximum age for identification is set to 42. This choice incorporates the risks of including observations as mothers who are exiting employment because of long term sick-leave. However, those observations enter only the control group.

considerably lower for women than for men (Figure 1, Panel B).

In this section, we explore potential reasons for this gender gap in innovation. Our main hypothesis is that the adverse effects of childbirth on career paths are particularly pronounced in innovation, potentially discouraging many women from pursuing innovative careers. We examine this hypothesis along two dimensions. Section 4.1 studies how the innovation lifecycle is affected by the decision to start a family, while Section 4.2 analyzes the impact of childbirth on women's patent output and career trajectories.

4.1. Family planning and productivity over the inventor Life Cycle

We begin our analysis by examining how family planning shapes the innovation lifecycle of inventors. Figure 2 distinguishes inventors' output over the life course according to whether they have children. For both men and women, inventors who become parents at any point in their lives outperform in their early career those who remain childless. Consistent with this pattern, inventors who start a family reach their productivity peak earlier. These trends are similar for men and women, but two important differences emerge. Mothers peak at a level comparable to non-mothers, whereas fathers reach a five percentage points higher peak than non-fathers. Despite this higher peak, non-fathers are more productive over their entire careers than fathers. By contrast, there is no meaningful lifetime productivity difference between mothers and non-mothers; if anything, mothers exhibit a relatively strong late-career rebound.

For both mothers and fathers, the timing of peak productivity closely aligns with the average age at which their first child is born. Mothers' productivity peaks at age 32, while their first child is born, on average, about a year later, at age 33.5. Notably, this is roughly three years later than the average age at first birth among women who are not inventors (30.5). For men, productivity peaks at age 34, and the average age at first birth is 35.5.

These patterns raise the question of whether inventors coordinate family planning with career milestones. Figure 3 addresses this question by plotting childbirth around major patenting events. Panel A shows that women are significantly more likely to give birth after filing their first patent, indicating a sharp discontinuity in timing. No comparable discontinuity is observed for men.

Panels B–D of Figure 3 examine whether the transition to parenthood depends on the eventual granting of a patent. Panel B shows a gradual decline in childbirths following the first patent grant, which is contrary to the notion that female inventors delay childbirth until after a patent is granted for the first time. Panel C provides no evidence that childbirth decisions depend on mothers' expectations about whether a patent application will be granted. Finally, Panel D suggests that, for at least some female inventors, the outcome of the first application does matter: we observe a weak discontinuity in childbirth around the granting of the first patent application.

An apparent puzzle remains: why do we observe a decline in patent applications among fathers in the second half of their careers, even though Figure 4 suggests that men do not coordinate family planning with career milestones? We conjecture that men, like women, are less likely to enter an inventive career after starting a family. Figure 4 supports this interpretation. In particular, male inventors who remain childless are substantially more likely to file their first patent in the second half of their careers.

Taken together, these results suggest that childbirth represents a major turning point, after which parents' increased focus on family life is associated with less frequent patenting relative to non-parents. For women, this transition occurs sharply after the first patent filing, whereas for men the shift appears more gradual.

4.2. Child penalties in innovation

In this section, we seek to identify the impact of childbirth on inventors' careers. Following the approach outlined in Section 3 to disentangle selection effects from treatment effects, we compare innovation and labor market outcomes of inventor parents with those of individuals who are about to become parents.

Figure 5 presents the impact of childbirth on innovation outcomes (the coefficient estimates are tabulated in Table A4 for female inventors and Table A5 for male inventors). We find that parenthood generally has an adverse impact on innovation output, but there is substantial variation across genders and measures.

In Panel A, we examine the impact of childbirth on the probability of filing at least one patent application. For mothers, we observe a steep decline from one year prior to one year after childbirth of 20 percentage points, which is a reduction by just over half relative to the year before childbirth. For men, the effect is similar but amounts to about a third in size. For both men and women, the decline persists until the end of the observation period, at which point the decline has about halfed relative to the year after birth. The declines observed in Panel B for patent grants follow the same pattern and have about the same economic magnitudes, considering, that only every second patent is actually granted. Looking at the number of patents instead of a binary variable does neither change the qualitative nor quantitative conclusions (Panel C and D).

In Panels E and F, we examine the impact of forward-looking citations on childbirth. These measures convey changes on the intensive margin, that is, the impact of childbirth on the quality of patents that are filed after childbirth. We observe that only the quality of patents of female inventors is adversely affected after childbirth. These adverse effects show up only in the two years following childbirth when we only consider inventor years with at least one patent filing (Panel F).

Figure 6 presents the impact of childbirth on inventor's labor outcomes. We observe that childbirth has dramatic consequences for female inventors' earnings. Over the four years after childbirth, female inventors face a decline in earnings of about 50,000 Euros annually. About half of this decline can be explained by changes in Days employed and Full-time employment (cf. Table 6, column 2). Panel D highlights that female inventors also are compensated less for their work and this loss cannot be explained by changes in their innovation output (cf. Table 6, column 5). For male inventors, the impact of childbirth on labor outcomes is limited. The impact on earnings is roughly 5,000 Euros in the year after childbirth and roughly 4,000 Euros four years after childbirth. Again, roughly half of the drop can be explained by lower full-time employment. A loss in productivity, captured by Daily wage, is only present in the year after buyout.

Figure 7 highlights the extent to which childbirth changes inventors' career paths. Here, we find that female inventors are more likely to have a career path change four years ahead of childbirth, while they are less likely to have a career path change shortly after child birth. Female inventors are increasingly unlikely to be promoted to manager after childbirth. In contrast, male inventors' career paths remain largely unaffected, with the exception of a temporary increase in occupational changes in the two years after childbirth.

5. Conclusion

This paper shows that family formation is closely intertwined with inventors' life-cycle dynamics and that the consequences of childbirth extend to innovative activity itself. The post-birth adjustments are strongly gendered: women's family timing is sharply synchronized with early inventive milestones, and motherhood is associated with persistent reductions in both the likelihood of patenting and the influence of patents, alongside pronounced and long-lasting changes in employment, mobility, and earnings. Fathers also exhibit measurable post-birth adjustments, but these are substantially smaller.

Our findings suggest that the underrepresentation of women in innovation cannot be understood solely through selection into inventive careers or differences in early-career performance. Instead, the interaction of family formation with a career characterized by uncertainty, long horizons, and mobility demands appears to generate sizable and uneven costs.

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Figure 1 – Life-cycle Patenting men vs. women
This figure depicts the innovation output of men and women over their lifetime. Panel A plots the likelihood of filing a patent application over inventors' age. Panel B plots the cumulated number of patent applications over inventors' age.

Panel A: Application Dummy **Panel B: Cumulative Applications**

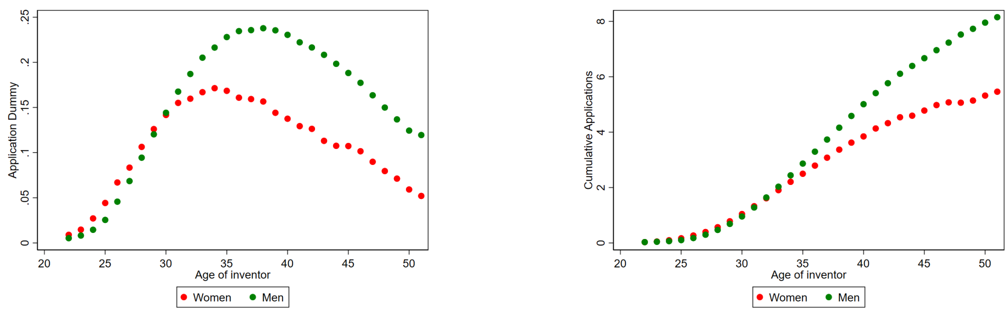
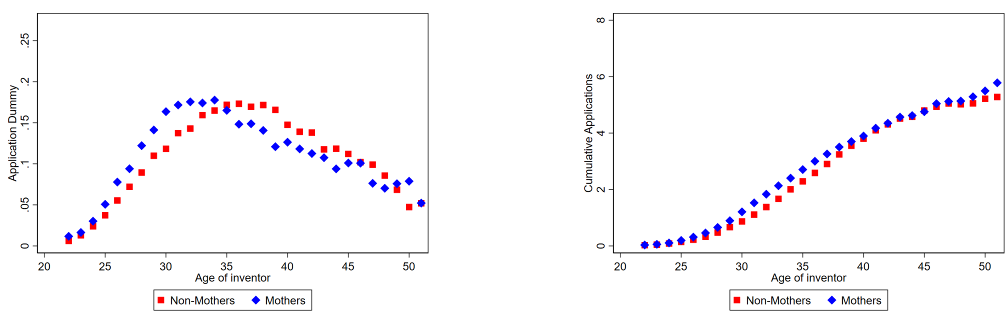


Figure 2 – Life-cycle Patenting: Mothers/fathers vs. Non-Mothers/Non-Fathers
This figure depicts the the innovation output of mothers and fathers over their lifetime. Panel A plots the likelihood of filing a patent over inventors' age for mothers and non-mothers. Panel B plots the cumulated number of patent applications over inventors' age for mothers and non-mothers. Panel C plots the likelihood of filing a patent over inventors' age for fathers and non-fathers. Panel D plots the cumulated number of patent applications over inventors' age for fathers and non-fathers.

Panel A: Application Dummy - Mothers **Panel B: Cumulative Applications - Mothers**



Panel C: Application Dummy - Fathers **Panel D: Cumulative Applications - Fathers**

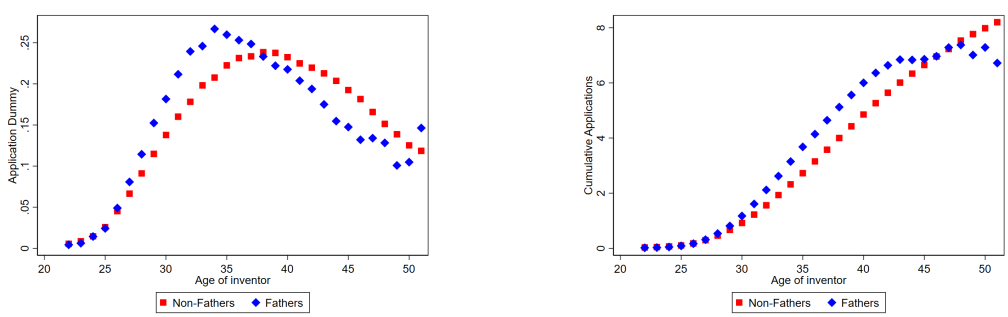
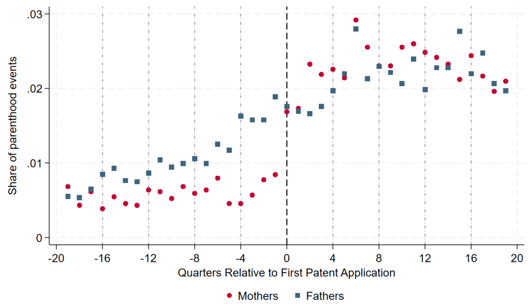


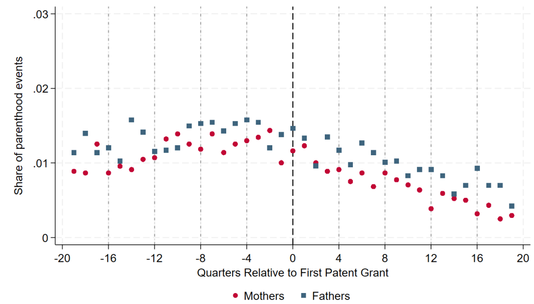
Figure 3 – Innovation and the timing of parenthood

This figure plots the fraction of mothers and fathers having their first child relative to various patenting events. Panel A plots the fraction of parents having their first child relative to the quarter when they filed their first patent application. Panel B plots the fraction of parents relative to the first granted patent. Panel C split up Panel A into applications that are later granted or not. Panel D plots the fraction of parents relative to the first filed patent grant.

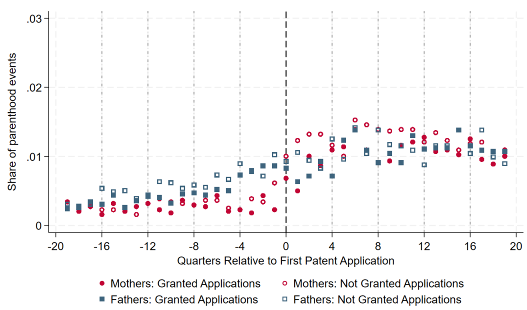
Panel A: Births around first application



Panel B: Births around first grant



Panel C: Births and application quality



Panel D: Births around grant for first application

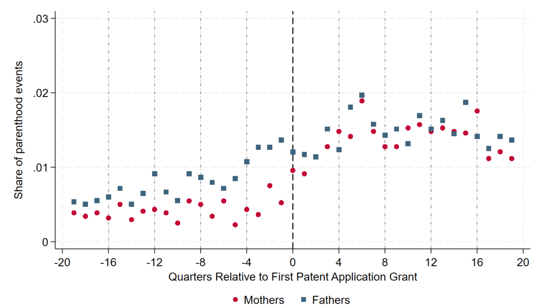
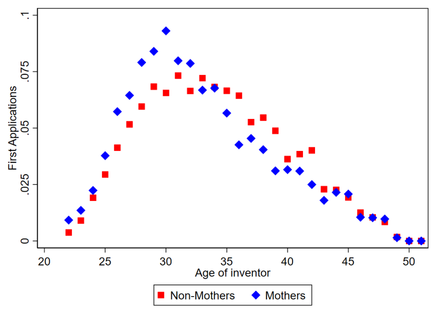


Figure 4 – Entry in innovation over the lifecycle: Parents versus non-parents
This figure depicts the the first innovation output of inventors over their lifetime. Panel A plots the likelihood of filing a patent over inventors' age for mothers and non-mothers. Panel B plots the likelihood of filing a patent over inventors' age for fathers and non-fathers.

Panel A: First career application - women



Panel B: First career application - men

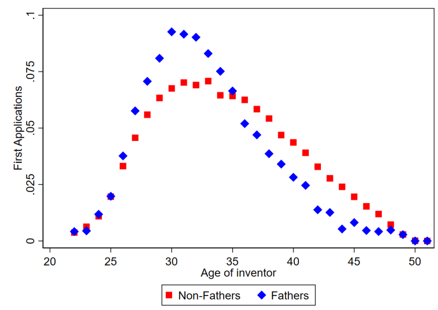


Figure 5 – Childbirth and innovation

This figure plots the impact of motherhood on innovation output following equation 1. On the x-axis is the time in years relative to the birth of the first child. The dependent variables are as follows: Panel A: Application Dummy, equal to one if the inventor files a patent in a given year. Panel B: Grant Dummy, equal to one if a filed patent is eventually granted. Panel C: Number of applications. Panel D: Number of (granted) patents. Panel E: Total Citations, the number of forward citations received within five years of publication. Panel F: Citations per Patent. Event time is measured relative to the year of the first childbirth, with t = −1 omitted as the baseline. All regressions include inventor-by-cohort, cohort-by-age and year fixed effects. Standard errors are clustered at the inventor level. t-statistics are displayed in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively. Variable definitions are in Appendix A. Coefficient estimates are tabulated in Table A3 and Table A4.

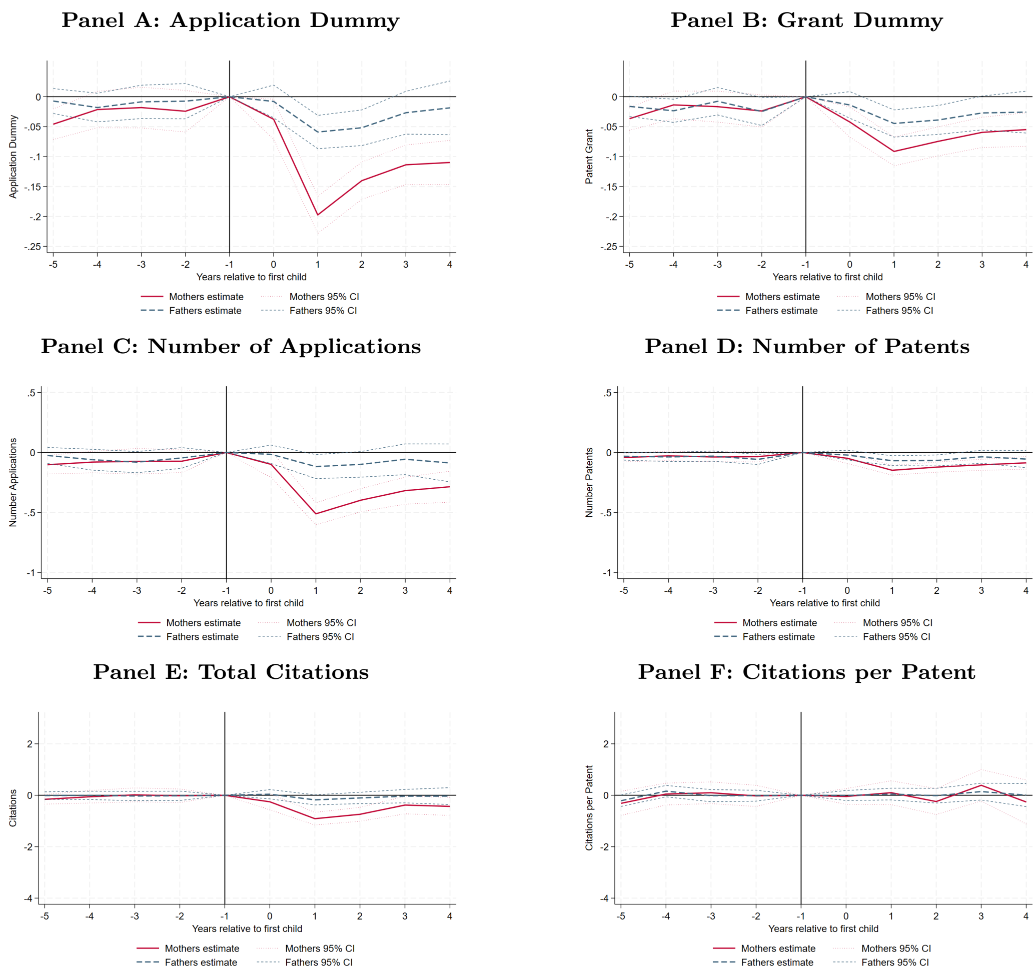
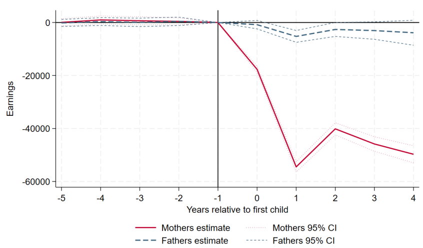


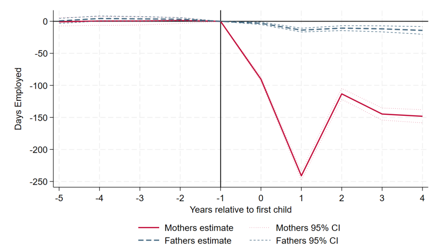
Figure 6 – Childbirth and innovation - labor outcomes

This figure examines the impact of having a child on the career paths of female inventors following equation 1. The dependent variables are as follows. Panel A: Earnings, summed up over all employment spells during the year. Panel B: Days Employed. Panel C: Full Time Dummy defined as equal to one if the inventor works full time. Panel D: Wage, defined as earnings divided by days employed and set to missing if the inventor does not work full time. Event time is measured relative to the year of the first childbirth, with t = −1 omitted as the baseline. All regressions include inventor-by-cohort, cohort-by-age, and year fixed effects. Standard errors are clustered at the inventor level. t-statistics are displayed in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively. Variable definitions are in Appendix A. Coefficient estimates are tabulated in Table A5 and Table A6.

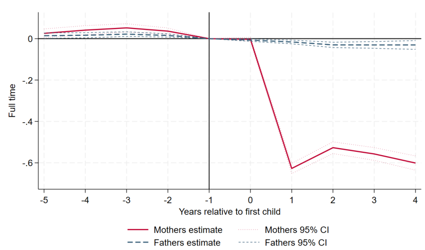
Panel A: Earnings



Panel B: Days employed



Panel C: Full-time employment



Panel D: Daily wage

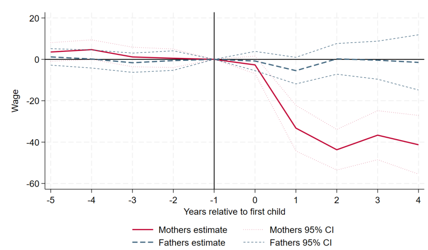
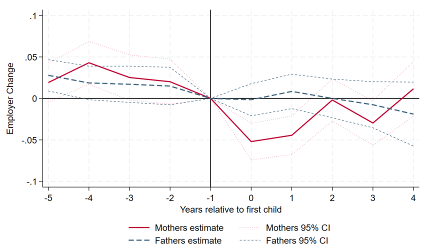


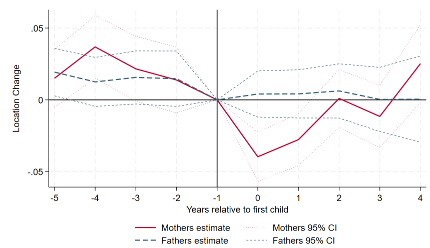
Figure 7 – Childbirth and innovation - Parents' career paths

This figure examines the impact of having a child on the career paths of female inventors following equation 1. The dependent variables are as follows. Panel A: Employer Change, equal to one if the inventor moves to another employer. Panel B: Promotion to Manager, equal to one if the inventor moves into a managerial position. Panel C: Work Dummy equal to one if the inventor is employed. Panel D: Location Change, equal to one if the employer changes her work address defined on a county level. Panel E: Occupation Change, equal to one if the inventor works in another occupation. Event time is measured relative to the year of the first childbirth, with t = −1 omitted as the baseline. All regressions include inventor-by-cohort, cohort-by-age, and year fixed effects. Standard errors are clustered at the inventor level. *t*-statistics are displayed in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively. Variable definitions are in Appendix A. Coefficient estimates are tabulated in Table A5 and Table A6.

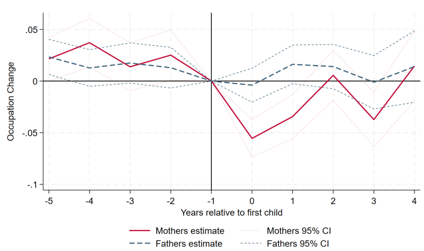
Panel B: Employer Change



Panel C: Location Change



Panel D: Occupation Change



Panel E: Promotion to Manager

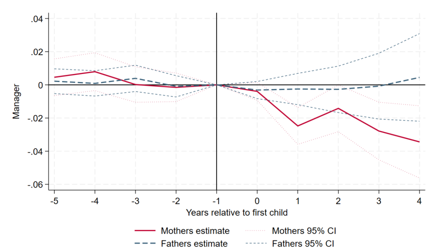


Table 1 – Sample Selection Steps
This table breaks down the main steps that we take to select our sample of female and male inventors who have a child during our sample period.

	All Inventors	**Women**	**Men**	**Used in**
Inventors in INV-BIO ADIAB	152,311	11,634	140,677	
Keep inventors born between 1961 and 1985	96,865	9,421	87,444	
Keep male inventors available in couple database	52,695	9,421	43,274	Figure 1 and 2
Keep inventors with a child	11,136	4,870	6,266	Figure 3
Keep if birth until 2015	10,013	3,747	6,266	
Keep if patent between 1999 and childbirth	9,285	3,090	6,195	Baseline Sample

Table 2 – Summary Statistics - Mothers
This table shows summary statistics of the sample of mothers.

Panel A: Regression Sample

	N	Mean	SD	P5	P25	Median	P75	P95
Application Dummy	114039	0.24	0.43	0.00	0.00	0.00	0.00	1.00
Grant Dummy	114039	0.11	0.32	0.00	0.00	0.00	0.00	1.00
Citations	114039	0.86	3.59	0.00	0.00	0.00	0.00	5.00
Citations per Patent	27144	1.76	2.46	0.00	0.00	1.00	2.25	7.00
Number Applications	114039	0.46	1.34	0.00	0.00	0.00	0.00	2.00
Number Patents	114039	0.16	0.53	0.00	0.00	0.00	0.00	1.00
Earnings	114039	49277.78	35280.47	0.00	25067.00	47617.00	64982.00	112057.00
Work Dummy	114039	0.89	0.31	0.00	1.00	1.00	1.00	1.00
Full Time Dummy	114039	0.77	0.41	0.00	0.86	1.00	1.00	1.00
Manager Dummy	114039	0.05	0.22	0.00	0.00	0.00	0.00	1.00
Employer Change	114039	0.16	0.36	0.00	0.00	0.00	0.00	1.00
Days Employed	114039	298.84	124.73	0.00	275.00	365.00	365.00	366.00
Location Change	114039	0.11	0.31	0.00	0.00	0.00	0.00	1.00
Wage	71201	190.14	86.45	89.51	141.30	169.11	221.76	353.12
Occupation Change	114039	0.14	0.35	0.00	0.00	0.00	0.00	1.00
Age	114039	30.89	3.81	25.00	28.00	31.00	33.00	37.00

Panel B: Mothers One Year Before Birth

	N	Mean	SD	P5	P25	Median	P75	P95
Application Dummy	1853	0.37	0.48	0.00	0.00	0.00	1.00	1.00
Grant Dummy	1853	0.18	0.39	0.00	0.00	0.00	0.00	1.00
Citations	1853	1.38	4.19	0.00	0.00	0.00	0.00	9.00
Citations per Patent	684	1.76	2.46	0.00	0.00	1.00	2.18	6.50
Number Applications	1853	0.75	1.60	0.00	0.00	0.00	1.00	3.00
Number Patents	1853	0.26	0.67	0.00	0.00	0.00	0.00	1.00
Earnings	1853	61951.88	34017.78	15150.00	43098.00	55869.00	75740.00	123501.00
Work Dummy	1853	0.98	0.15	1.00	1.00	1.00	1.00	1.00
Full Time Dummy	1853	0.88	0.29	0.00	0.96	1.00	1.00	1.00
Manager Dummy	1853	0.05	0.22	0.00	0.00	0.00	0.00	0.00
Employer Change	1853	0.14	0.35	0.00	0.00	0.00	0.00	1.00
Days Employed	1853	339.85	71.65	182.00	365.00	365.00	365.00	366.00
Location Change	1853	0.09	0.28	0.00	0.00	0.00	0.00	1.00
Wage	1310	208.54	86.14	127.92	151.22	183.40	242.10	368.92
Occupation Change	1853	0.10	0.30	0.00	0.00	0.00	0.00	1.00
Age	1853	32.26	2.94	27.00	30.00	33.00	34.00	37.00

Table 3 – Summary Statistics - Fathers

This table shows summary statistics of the sample of fathers.

Panel A: Regression sample

	N	Mean	SD	P5	P25	Median	P75	P95
Application Dummy	126096	0.30	0.46	0.00	0.00	0.00	1.00	1.00
Grant Dummy	126096	0.15	0.36	0.00	0.00	0.00	0.00	1.00
Citations	126096	0.86	3.40	0.00	0.00	0.00	0.00	5.00
Citations per Patent	38100	1.31	1.98	0.00	0.00	0.73	2.00	5.00
Number Applications	126096	0.65	1.72	0.00	0.00	0.00	1.00	3.00
Number Patents	126096	0.23	0.69	0.00	0.00	0.00	0.00	1.00
Earnings	126096	75999.42	45152.05	5772.00	50202.00	66235.00	98262.00	156994.00
Work Dummy	126096	0.96	0.20	1.00	1.00	1.00	1.00	1.00
Full Time Dummy	126096	0.92	0.27	0.00	1.00	1.00	1.00	1.00
Manager Dummy	126096	0.06	0.23	0.00	0.00	0.00	0.00	1.00
Employer Change	126096	0.15	0.36	0.00	0.00	0.00	0.00	1.00
Days Employed	126096	335.17	86.75	90.00	365.00	365.00	365.00	366.00
Location Change	126096	0.10	0.30	0.00	0.00	0.00	0.00	1.00
Wage	107182	238.66	114.20	118.44	161.34	206.32	290.93	450.72
Occupation Change	126096	0.14	0.34	0.00	0.00	0.00	0.00	1.00
Age	126096	33.49	3.88	27.00	31.00	33.00	36.00	40.00

Panel B: Fathers One Year Before Birth

	N	Mean	SD	P5	P25	Median	P75	P95
Application Dummy	3205	0.39	0.49	0.00	0.00	0.00	1.00	1.00
Grant Dummy	3205	0.21	0.41	0.00	0.00	0.00	0.00	1.00
Citations	3205	1.08	3.46	0.00	0.00	0.00	0.00	6.00
Citations per Patent	1237	1.30	2.03	0.00	0.00	0.67	1.75	5.00
Number Applications	3205	0.82	1.63	0.00	0.00	0.00	1.00	4.00
Number Patents	3205	0.32	0.80	0.00	0.00	0.00	0.00	2.00
Earnings	3205	85276.71	41751.63	37831.00	57827.00	74313.00	106036.00	160657.00
Work Dummy	3205	0.99	0.10	1.00	1.00	1.00	1.00	1.00
Full Time Dummy	3205	0.97	0.16	0.99	1.00	1.00	1.00	1.00
Manager Dummy	3205	0.05	0.22	0.00	0.00	0.00	0.00	1.00
Employer Change	3205	0.14	0.34	0.00	0.00	0.00	0.00	1.00
Days Employed	3205	352.08	47.43	304.00	365.00	365.00	365.00	366.00
Location Change	3205	0.09	0.29	0.00	0.00	0.00	0.00	1.00
Wage	2907	252.45	110.07	141.31	172.23	224.02	303.13	453.78
Occupation Change	3205	0.09	0.29	0.00	0.00	0.00	0.00	1.00
Age	3205	34.47	3.11	30.00	32.00	34.00	37.00	40.00

Table 4 – Childbirth and innovation - Mothers' earnings

This table reports the results of equation 1. The dependent variables are earnings. Column (1) is identical to our baseline regressions. Column (2) - (4) successively include additional controls and fixed effects as indicated. In column (5), we remove inventors from the sample if they leave their employer after giving birth. In column (6), we remove inventors from the sample if they leave their employer or change occupation. Event time is measured relative to the year of the first childbirth, with t = −1 omitted as the baseline. All regressions include inventor-by-cohort, cohort-by-age, and year fixed effects. Standard errors are clustered at the inventor level. *t*-statistics are displayed in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively. Variable definitions are in Appendix A.

	Earnings					
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment × t = -5	62.56 (0.09)	-256.73 (-0.46)	-277.43 (-0.57)	-281.12 (-0.58)	-248.99 (-0.51)	-223.00 (-0.45)
Treatment × t = -4	973.12 (1.27)	269.94 (0.44)	-127.97 (-0.24)	-109.64 (-0.20)	-112.15 (-0.21)	-111.44 (-0.20)
Treatment × t = -3	659.01 (0.85)	-216.72 (-0.35)	-532.45 (-0.92)	-510.44 (-0.89)	-554.20 (-0.95)	-533.37 (-0.91)
Treatment × t = -2	426.53 (0.63)	-278.48 (-0.47)	-573.73 (-1.01)	-568.35 (-1.00)	-520.42 (-0.91)	-554.35 (-0.97)
Treatment × t = 0	-17667.91*** (-28.61)	-8385.97*** (-14.79)	-8908.53*** (-14.88)	-8947.99*** (-14.95)	-9135.54*** (-14.80)	-8902.01*** (-14.38)
Treatment × t = 1	-54475.44*** (-54.42)	-19533.64*** (-21.84)	-14441.62*** (-15.98)	-14503.03*** (-16.06)	-15035.79*** (-15.30)	-14389.34*** (-14.71)
Treatment × t = 2	-40127.06*** (-34.49)	-19960.47*** (-20.05)	-19173.93*** (-18.42)	-19064.91*** (-18.34)	-19278.48*** (-16.47)	-18997.02*** (-15.48)
Treatment × t = 3	-45834.05*** (-32.87)	-21941.13*** (-18.46)	-20411.71*** (-16.40)	-20196.06*** (-16.22)	-20356.66*** (-13.67)	-20321.37*** (-12.77)
Treatment × t = 4	-49712.37*** (-30.09)	-24737.56*** (-17.02)	-22950.91*** (-14.99)	-22646.51*** (-14.76)	-23893.25*** (-12.38)	-21817.11*** (-10.51)
Full Time Dummy		16100.80*** (33.01)	12368.75*** (24.70)	12470.93*** (24.94)	12532.33*** (23.85)	12312.46*** (23.26)
Tenure		0.27 (1.07)	1.81*** (6.74)	1.69*** (6.28)	1.69*** (6.61)	1.73*** (6.86)
Days Employed		101.89*** (60.00)	95.30*** (49.55)	95.51*** (49.82)	95.64*** (49.66)	95.03*** (49.51)
Cumulative Applications				309.05*** (2.67)	311.15** (2.41)	274.00** (2.12)
Cumulative Citations				27.84 (0.56)	15.14 (0.28)	20.58 (0.39)
Cohort × Inventor FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort × Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Education FE	No	No	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes	Yes	Yes
County FE	No	No	Yes	Yes	Yes	Yes
Patent Technology FE	No	No	Yes	Yes	Yes	Yes
Occupation FE	No	No	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Establishment FE	No	No	Yes	Yes	Yes	Yes
Observations	112,427	112,427	112,127	112,127	103,585	100,111
R-squared	0.68	0.79	0.84	0.84	0.84	0.85

Table 5 – Childbirth and innovation - Fathers' earnings
This table reports the results of equation 1. The dependent variables are earnings. Column (1) is identical to our baseline regressions. Column (2) - (4) successively include additional controls and fixed effects as indicated. In column (5), we remove inventors from the sample if they leave their employer after giving birth. In column (6), we remove inventors from the sample if they leave their employer or change occupation. Event time is measured relative to the year of the first childbirth, with t = −1 omitted as the baseline. All regressions include inventor-by-cohort, cohort-by-age, and year fixed effects. Standard errors are clustered at the inventor level. *t*-statistics are displayed in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively. Variable definitions are in Appendix A.

	Earnings					
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment × t = -5	-154.66	-416.37	-354.86	-378.27	-277.37	-131.99
	(-0.23)	(-0.67)	(-0.61)	(-0.65)	(-0.47)	(-0.22)
Treatment × t = -4	344.73	-413.69	-571.70	-579.77	-462.51	-417.82
	(0.46)	(-0.59)	(-0.87)	(-0.88)	(-0.70)	(-0.63)
Treatment × t = -3	62.10	-680.49	-881.33	-882.23	-869.54	-800.11
	(0.08)	(-0.90)	(-1.19)	(-1.19)	(-1.17)	(-1.07)
Treatment × t = -2	444.97	-140.15	-657.91	-657.50	-624.89	-594.86
	(0.55)	(-0.18)	(-0.84)	(-0.84)	(-0.80)	(-0.76)
Treatment × t = 0	-811.64	-337.49	-102.34	-109.69	143.48	430.58
	(-1.00)	(-0.43)	(-0.13)	(-0.13)	(0.17)	(0.49)
Treatment × t = 1	-5244.23***	-3294.48***	-3018.10***	-3024.31***	-3316.57***	-2729.92**
	(-4.62)	(-3.04)	(-2.69)	(-2.70)	(-2.67)	(-2.15)
Treatment × t = 2	-2616.56*	-888.00	-400.89	-352.67	-378.56	139.94
	(-1.95)	(-0.70)	(-0.31)	(-0.27)	(-0.25)	(0.09)
Treatment × t = 3	-3042.49*	-1191.00	-363.77	-291.01	447.41	2080.01
	(-1.81)	(-0.75)	(-0.22)	(-0.18)	(0.23)	(0.95)
Treatment × t = 4	-3857.14	-1725.64	-1545.88	-1432.34	-1465.21	2868.83
	(-1.60)	(-0.75)	(-0.68)	(-0.63)	(-0.50)	(0.87)
Full Time Dummy		11919.00***	7523.98***	7614.91***	8036.49***	7458.95***
		(13.99)	(8.58)	(8.69)	(9.07)	(8.57)
Tenure		1.25***	4.32***	4.23***	5.55***	5.28***
		(3.76)	(10.32)	(10.13)	(11.58)	(10.94)
Days Employed		128.57***	131.89***	131.95***	126.66***	126.74***
		(47.47)	(38.73)	(38.87)	(37.53)	(37.68)
Cumulative Applications				116.98	74.94	147.69
				(0.72)	(0.46)	(0.90)
Cumulative Citations				121.69**	139.94***	104.82**
				(2.42)	(2.63)	(2.00)
Cohort × Inventor FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort × Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Education FE	No	No	Yes	Yes	Yes	Yes
Industry FE	No	No	Yes	Yes	Yes	Yes
County FE	No	No	Yes	Yes	Yes	Yes
Patent Technology FE	No	No	Yes	Yes	Yes	Yes
Occupation FE	No	No	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Establishment FE	No	No	Yes	Yes	Yes	Yes
Observations	123,908	123,908	123,376	123,376	115,294	111,654
R-squared	0.65	0.70	0.74	0.74	0.74	0.76

APPENDIX

A.1. Variable Definitions

This section provides variable definitions. For more details on the matched employer-employee inventor dataset, we refer to Dorner et al. (2019).

1. *Age* – Inventor age in years.
2. *Application Dummy* – Dummy variable equal to one if the inventor is applying for a patent in a given year. The year is based on the earliest patent filing date within the DOCDB family.
3. *Citations per Patent* – The number of forward citations received per patent. This variable follows the same definition as the variable *Total Citations*, however is defined on a per patent basis and is missing in case the inventor does not file a patent in a given year. The year is based on the earliest patent filing date within the DOCDB family.
4. *Cumulative Applications* – The cumulative number of patent applications for an inventor in a given year. The year is based on the earliest patent filing date within the DOCDB family.
5. *Cumulative Citations* – The cumulative number of citations for each inventor.
6. *Earnings* – The calculated yearly employee's gross wage in Euros. This variable is calculated by summing up over all employment spells. It is calculated from the fixed-period wages reported by the employer and the duration of the (unsplit) original notification period in calendar days. The data is aggregated on a yearly level considering the duration of the employment spell. Wages are deflated to 2015 Euros using the consumer price index for Germany.[13].

[13] The earnings in the IEB are top coded. Overall that affects only about 5 percent of reported employment spells. However, for the population of highly educated it is quantitatively much more important. Earnings at the threshold are imputed according to Stüber et al. (2023)

7. *Employer Change* – A dummy equal to one if the inventor moves to a new establishment.
8. *Full-time Dummy*: A dummy variable equal to one if the inventor works full-time.[14]
9. *Grant Dummy* – Dummy variable equal to one if the inventor is granted a patent in a given year. The year is based on the earliest patent filing date within the DOCDB family.
10. *Location Change* – A dummy equal to one if the inventor moves locations defined as the location of work on a county (Kreis) basis.
11. *Manager Change* – A dummy equal to one if the inventor moves from a non-managerial to a managerial position. Obtained from occupational codes. Managerial occupations are defined as the last three digits of the 1988 occupation classification code equal to 751, 752, or 762.
12. *Number of Applications* – The number of patent applications per inventor in a given year. The year is based on the earliest patent filing date within the DOCDB family.
13. *Number of Patents* – The number of granted patents per inventor in a given year. The year is based on the earliest patent filing date within the DOCDB family.
14. *Occupation Change* – A dummy equal to one if the inventor moves from one occupation to another defined on a 1988 occupational code basis.
15. *Total Citations* – The total number of forward citations received per inventor per year. The year is based on the earliest patent filing date within the DOCDB family. The variable counts all DOCBD (patent family) forward citations received at the European Patent Office within 5 years from the earliest publication date. This approach accounts for truncation bias, as newer patents naturally receive fewer citations than older patents (Lerner and Seru 2021). Due to data protection

[14] The IEB data overreport full-time employment up to 2011. We therefore use the correction procedure developed in Fitzenberger and Seidlitz (2020) to correct for this problem.

reasons, citations are truncated at the 99th percentile of the distribution. The variable is aggregated on an inventor-year level. We see citations as a proxy for the economic quality of patents.[15]

16. *Wage* – The variable wage is defined as earnings divided by days employed. The variable is set to missing if the inventor does not work full time.
17. *Work Dummy* – Dummy equal to one if the inventor is employed.

[15]See for instance Trajtenberg (1990) and Kogan et al. (2017) on how patent citations and the economic value relate to each other.

A.2. Age-Cohort Specification

Our empirical set-up largely follows Melentyeva and Riedel (2025) which compares effects within age cohorts. Inventors entering parenthood at a given age c are compared to a control group who enters parenthood in the following five years, latest in $c+5$. Once they have their first child, control observations exit the control group which decreases in the number of observations as one moves away from the treatment event. This way the last period for which an estimation is possible is when the treatment group is of age $c+4$, i.e. four years after the birth of the child.

The following specification estimates the full dynamics around the time an inventor has her first child, using treated and control inventors five years before having the first child until 4 years afterwards.

$$Y_{ict} = \sum_{c=c_{\min}}^{c_{\max}} \sum_{l=-5,\, l\neq -1}^{4} \beta_{cl} \left[D_{ic} \times \mathbf{1}\{t - A_i = l\} \times \mathbf{1}\{C_{ic} = c\} \right] + \gamma_{ic} + \lambda_{ct} + \lambda_t + \varepsilon_{ict}. \quad (2)$$

where Y_{ict} are outcomes on an inventor-cohort-year level. We use i for each individual inventor, c for cohort, which is defined as the age at first birth, and we use t for the time dimension, in this case on a yearly level. We employ a full set of leads and lags around the time of childbirth for each treatment cohort, captured by the coefficients β_{cl}. $l \in \{-5, -4, -3, -2, 0, 1, 2, 3, 4\}$ denotes event time relative to treatment, with $l = -1$ omitted as the baseline. D_{ic} flags treated units within age-at-birth cohorts c. $\mathbf{1}\{t - A_i = l\}$ are event-time dummies. $\mathbf{1}\{C_{ic} = c\}$ selects the cohort c. We include fully interacted fixed effects and include γ_{ic} which are individual-by-cohort fixed effects, as well as λ_{ct} which are time-by-cohort fixed effects. Standard errors are obtained following Wooldridge (2025) by the delta method using the regression's cluster-robust variance-covariance matrix. A panel bootstrap leads to similar results.

Importantly, we do not use calendar years but center the periods around birth. That means that year 0 ends for the treatment group with the quarter of birth such that this year captures roughly the period of pregnancy. The other periods are defined accordingly. This guarantees that year -1 is not contaminated with anticipation effects, at least not with respect to a concrete treatment time.

We estimate this regression separately for mothers and fathers. We define cohorts for mothers to be starting at age 25 until age 37.[16] For fathers, cohorts are defined from 30 to 42. We do not consider earlier ages, as the number of observations within-cohort is small for earlier ages. We do identify fathers above the mentioned age ranges, however they only serve as controls.

[16]For the age cohorts from age 34 on, estimation is only possible since we extended the maximum age for identification to be 42. That incorporates the risks of including observations as mother who are exiting employment in fact to long term sickness-leave. However, those observations enter only the control group. As the oldest cohort of treatment group is 37, all individuals of the treatment group would be identified with the standard age restriction (age 38) as well (Müller et al., 2022).

Table A1 – Additional Descriptives
This table reports additional descriptives such as team size and the distribution of inventors across patent technologies.

Panel A: Mothers

	N	Mean	SD	P5	P25	Median	P75	P95
Team Size	1642	3.75	2.56	1.00	2.33	3.11	4.55	7.75
Electronics	1853	0.13	0.33	0.00	0.00	0.00	0.00	1.00
Instruments	1853	0.13	0.34	0.00	0.00	0.00	0.00	1.00
Chemistry	1853	0.54	0.50	0.00	0.00	1.00	1.00	1.00
Mechanics	1853	0.16	0.37	0.00	0.00	0.00	0.00	1.00
Other Tech	1853	0.03	0.18	0.00	0.00	0.00	0.00	0.00

Panel B: Fathers

	N	Mean	SD	P5	P25	Median	P75	P95
Team Size	2923	3.04	1.76	1.00	2.00	2.67	4.00	6.03
Electronics	3205	0.21	0.41	0.00	0.00	0.00	0.00	1.00
Instruments	3205	0.14	0.35	0.00	0.00	0.00	0.00	1.00
Chemistry	3205	0.23	0.42	0.00	0.00	0.00	0.00	1.00
Mechanics	3205	0.38	0.48	0.00	0.00	0.00	1.00	1.00
Other Tech	3205	0.05	0.21	0.00	0.00	0.00	0.00	0.00

Panel C: Team Size by Technology - Mothers

	Mean team size	N
Electronics	3.75	208
Instruments	3.55	213
Chemistry	3.91	902
Mechanics	3.56	261
Other Tech	2.95	58

Panel D: Team Size by Technology - Fathers

	Mean team size	N
Electronics	2.84	614
Instruments	2.98	406
Chemistry	3.54	666
Mechanics	2.95	1106
Other Tech	2.31	129

Table A2 – Inventor Occupations
This table lists all occupations with at least 1% of female inventors in the quarter of first patent application, according to KldB 1988. 83 percent of female inventors work in one of the 18 occupations. For male inventors that share is still 79 percent.

Occupations	Women		Men	
	Number	Share	Number	Share
Chemists, chemical engineers	1504	14.1	8918	6.7
Chemical laboratory assistants	1151	10.8	2129	1.6
Scientists n.e.c.	1106	10.4	4225	3.2
Office specialists	595	5.6	4028	3.0
Other engineers	587	5.5	9168	6.8
Electrical engineers	550	5.2	21546	16.1
Mechanical, motor engineers	449	4.2	20581	15.4
University teachers, lecturers at higher (technical) schools	439	4.1	2149	1.6
Other technicians	424	4.0	9390	7.0
Technical draughtspersons	359	3.4	2064	1.5
Chemistry, physics technicians	332	3.1	1303	1.0
Senior government officials	272	2.5	2019	1.5
Data processing specialists	221	2.1	4011	3.0
Biological specialists	218	2.0	228	0.2
Physicists, physics engineers, mathematicians	209	2.0	3731	2.8
Physicians	161	1.5	1060	0.8
Entrepreneurs, managing directors, divisional managers	148	1.4	5471	4.1
Other manufacturing engineers	126	1.2	3104	2.3
All other occupations	1823	16.9	28780	21.4

Table A3 – Childbirth and innovation - Mothers

This table reports event-study estimates of the impact of motherhood on innovation outcomes, following equation 1. Event time is measured relative to the year of the first childbirth, with t = -1 omitted as the baseline. All regressions include inventor-by-cohort, cohort-by-age, and year fixed effects. Standard errors are clustered at the inventor level. *t*-statistics are displayed in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively. Variable definitions are in Appendix A.

	Application Dummy	Grant Dummy	Citations	Citations per Patent	Number Applications	Number Patents
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment × t = -5	-0.05***	-0.04***	-0.16*	-0.31	-0.10***	-0.04**
	(-3.52)	(-3.71)	(-1.65)	(-1.31)	(-2.58)	(-2.33)
Treatment × t = -4	-0.02	-0.01	-0.06	0.05	-0.08*	-0.03
	(-1.38)	(-1.16)	(-0.47)	(0.22)	(-1.75)	(-1.38)
Treatment × t = -3	-0.02	-0.02	0.01	0.10	-0.07	-0.04*
	(-1.05)	(-1.26)	(0.11)	(0.46)	(-1.35)	(-1.81)
Treatment × t = -2	-0.02	-0.02*	-0.02	-0.02	-0.07	-0.03
	(-1.37)	(-1.74)	(-0.14)	(-0.12)	(-1.52)	(-1.55)
Treatment × t = 0	-0.04**	-0.04***	-0.25	-0.05	-0.10*	-0.05**
	(-2.20)	(-3.28)	(-1.61)	(-0.29)	(-1.77)	(-2.23)
Treatment × t = 1	-0.20***	-0.09***	-0.91***	0.10	-0.51***	-0.15***
	(-12.51)	(-7.46)	(-7.26)	(0.43)	(-10.92)	(-7.11)
Treatment × t = 2	-0.14***	-0.07***	-0.74***	-0.24	-0.40***	-0.12***
	(-8.84)	(-6.03)	(-5.36)	(-0.94)	(-8.07)	(-5.64)
Treatment × t = 3	-0.11***	-0.06***	-0.38**	0.39	-0.32***	-0.10***
	(-6.74)	(-4.62)	(-2.19)	(1.25)	(-5.56)	(-4.40)
Treatment × t = 4	-0.11***	-0.05***	-0.43**	-0.26	-0.29***	-0.09***
	(-5.84)	(-3.83)	(-2.40)	(-0.60)	(-4.33)	(-3.21)
Cohort × Inventor FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort × Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	112,427	112,427	112,427	18,176	112,427	112,427
R-squared	0.27	0.24	0.34	0.51	0.36	0.28
Baseline mean	0.31	0.15	1.11	1.77	0.59	0.20

Table A4 – Childbirth and innovation - Fathers

This table reports event-study estimates of the impact of fatherhood on innovation outcomes, following equation 1. Event time is measured relative to the year of the first childbirth, with t = -1 omitted as the baseline. All regressions include inventor-by-cohort, cohort-by-age, and year fixed effects. Standard errors are clustered at the inventor level. *t*-statistics are displayed in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively. Variable definitions are in Appendix A.

	Application Dummy	Grant Dummy	Citations	Citations per Patent	Number Applications	Number Patents
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment × t = -5	-0.01	-0.02*	-0.01	-0.21*	-0.02	-0.03*
	(-0.68)	(-1.87)	(-0.17)	(-1.87)	(-0.73)	(-1.92)
Treatment × t = -4	-0.02	-0.02**	-0.00	0.16	-0.06	-0.04*
	(-1.48)	(-2.38)	(-0.05)	(1.43)	(-1.36)	(-1.92)
Treatment × t = -3	-0.01	-0.01	-0.03	-0.02	-0.08*	-0.03
	(-0.60)	(-0.65)	(-0.31)	(-0.13)	(-1.79)	(-1.41)
Treatment × t = -2	-0.01	-0.02**	-0.02	-0.02	-0.05	-0.06***
	(-0.49)	(-2.07)	(-0.22)	(-0.14)	(-1.04)	(-2.69)
Treatment × t = 0	-0.01	-0.01	0.04	-0.01	-0.02	-0.02
	(-0.57)	(-1.22)	(0.45)	(-0.07)	(-0.39)	(-1.05)
Treatment × t = 1	-0.06***	-0.04***	-0.18*	0.05	-0.12**	-0.07***
	(-4.16)	(-3.86)	(-1.78)	(0.41)	(-2.30)	(-3.25)
Treatment × t = 2	-0.05***	-0.04***	-0.10	-0.02	-0.10*	-0.07***
	(-3.41)	(-3.16)	(-0.92)	(-0.11)	(-1.83)	(-2.84)
Treatment × t = 3	-0.03	-0.03*	-0.03	0.14	-0.06	-0.04
	(-1.46)	(-1.89)	(-0.25)	(0.87)	(-0.87)	(-1.31)
Treatment × t = 4	-0.02	-0.03	-0.03	0.01	-0.09	-0.06
	(-0.81)	(-1.44)	(-0.19)	(0.03)	(-1.08)	(-1.50)
Cohort × Inventor FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort × Age FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	123,908	123,908	123,908	28,825	123,908	123,908
R-squared	0.29	0.27	0.43	0.48	0.46	0.32
Baseline mean	0.36	0.18	1.03	1.33	0.75	0.26

Table A5 – Childbirth and innovation - Mothers' career paths
This table shows the results following equation 1. Event time is measured relative to the year of the first childbirth, with t = −1 omitted as the baseline. All regressions include inventor-by-cohort, cohort-by-age, and year fixed effects. Standard errors are clustered at the inventor level. t-statistics are displayed in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively. Variable definitions are in Appendix A.

	Earnings	Work Dummy	Full Time Dummy	Manager Dummy	Employer Change	Days Employed	Location Change	Wage	Occupation Change
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treatment × t = -5	62.56	0.01	0.03**	0.00	0.02	-0.77	0.02	3.55	0.02**
	(0.09)	(1.39)	(2.36)	(0.81)	(1.60)	(-0.23)	(1.47)	(1.55)	(1.97)
Treatment × t = -4	973.12	0.02*	0.04***	0.01	0.04***	0.53	0.04***	4.70*	0.04***
	(1.27)	(1.90)	(3.73)	(1.36)	(3.26)	(0.15)	(3.31)	(1.95)	(3.11)
Treatment × t = -3	659.01	0.02***	0.05***	0.00	0.03*	0.54	0.02*	1.16	0.01
	(0.85)	(2.99)	(5.11)	(0.04)	(1.82)	(0.17)	(1.87)	(0.48)	(1.17)
Treatment × t = -2	426.53	0.01**	0.04***	-0.00	0.02	1.28	0.01	0.52	0.03**
	(0.63)	(2.35)	(4.80)	(-0.35)	(1.46)	(0.54)	(1.19)	(0.23)	(2.02)
Treatment × t = 0	-17667.91***	0.01	-0.00	-0.00	-0.05***	-90.37***	-0.04***	-2.68	-0.06***
	(-28.61)	(1.16)	(-0.58)	(-1.43)	(-4.62)	(-49.11)	(-4.53)	(-1.24)	(-5.99)
Treatment × t = 1	-54475.44***	-0.45***	-0.63***	-0.02***	-0.04***	-241.07***	-0.03***	-33.23***	-0.03***
	(-54.42)	(-35.95)	(-49.40)	(-4.37)	(-3.74)	(-66.26)	(-2.99)	(-5.89)	(-3.16)
Treatment × t = 2	-40127.06***	-0.22***	-0.53***	-0.01**	-0.00	-113.18***	0.00	-43.69***	0.01
	(-34.49)	(-19.58)	(-36.58)	(-1.98)	(-0.15)	(-26.25)	(0.10)	(-8.74)	(0.45)
Treatment × t = 3	-45834.05***	-0.27***	-0.56***	-0.03***	-0.03**	-144.70***	-0.01	-36.64***	-0.04***
	(-32.87)	(-21.64)	(-35.43)	(-3.14)	(-2.16)	(-30.04)	(-1.04)	(-6.06)	(-2.78)
Treatment × t = 4	-49712.37***	-0.29***	-0.60***	-0.03***	0.01	-148.16***	0.03*	-41.27***	0.01
	(-30.09)	(-21.00)	(-34.11)	(-3.10)	(0.70)	(-28.32)	(1.83)	(-5.71)	(0.85)
Cohort × Inventor FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort × Age FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	112,427	112,427	112,427	112,427	112,427	112,427	112,427	68,769	112,427
R-squared	0.68	0.43	0.54	0.55	0.19	0.51	0.19	0.68	0.22
Baseline mean	55560.23	0.95	0.86	0.05	0.17	323.79	0.12	195.36	0.15

Table A6 – Childbirth and innovation - Fathers' career paths
This table shows the results following equation 1. Event time is measured relative to the year of the first childbirth, with t = −1 omitted as the baseline. All regressions include inventor-by-cohort, cohort-by-age, and year fixed effects. Standard errors are clustered at the inventor level. t-statistics are displayed in parentheses. ***, ** and * represent significance at the 1%, 5%, and 10% level, respectively. Variable definitions are in Appendix A.

	Earnings	Work Dummy	Full Time Dummy	Manager Dummy	Employer Change	Days Employed	Location Change	Wage	Occupation Change
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treatment × t = -5	-154.66	0.01*	0.01**	0.00	0.03***	0.66	0.02**	1.18	0.02***
	(-0.23)	(1.88)	(2.17)	(0.58)	(2.90)	(0.33)	(2.30)	(0.58)	(2.69)
Treatment × t = -4	344.73	0.01	0.02**	0.00	0.02*	4.45**	0.01	0.17	0.01
	(0.46)	(1.56)	(2.57)	(0.23)	(1.81)	(2.22)	(1.44)	(0.08)	(1.40)
Treatment × t = -3	62.10	0.01*	0.02***	0.00	0.02	3.90**	0.02*	-1.63	0.02*
	(0.08)	(1.86)	(3.83)	(0.97)	(1.53)	(2.14)	(1.66)	(-0.69)	(1.76)
Treatment × t = -2	444.97	0.01***	0.02***	-0.00	0.01	3.28***	0.01	-0.59	0.01
	(0.55)	(2.84)	(3.84)	(-0.27)	(1.29)	(2.59)	(1.50)	(-0.25)	(1.29)
Treatment × t = 0	-811.64	-0.01**	-0.01**	-0.00	-0.00	-3.07***	0.00	-0.80	-0.00
	(-1.00)	(-2.56)	(-2.34)	(-1.19)	(-0.16)	(-3.03)	(0.50)	(-0.34)	(-0.47)
Treatment × t = 1	-5244.23***	-0.01***	-0.02***	-0.00	0.01	-13.70***	0.00	-5.45*	0.02*
	(-4.62)	(-4.44)	(-3.51)	(-0.52)	(0.80)	(-9.12)	(0.49)	(-1.67)	(1.69)
Treatment × t = 2	-2616.56*	-0.02***	-0.03***	-0.00	0.00	-10.62***	0.01	0.23	0.01
	(-1.95)	(-5.07)	(-4.62)	(-0.38)	(0.01)	(-5.51)	(0.65)	(0.06)	(1.28)
Treatment × t = 3	-3042.49*	-0.03***	-0.03***	-0.00	-0.01	-11.75***	0.00	-0.41	-0.00
	(-1.81)	(-4.40)	(-3.68)	(-0.08)	(-0.54)	(-4.91)	(0.03)	(-0.09)	(-0.09)
Treatment × t = 4	-3857.14	-0.03***	-0.03***	0.00	-0.02	-14.14***	0.00	-1.47	0.01
	(-1.60)	(-3.87)	(-2.79)	(0.33)	(-0.96)	(-4.62)	(0.03)	(-0.22)	(0.80)
Cohort × Inventor FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort × Age FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	123,908	123,908	123,908	123,908	123,908	123,908	123,908	104,475	123,908
R-squared	0.65	0.42	0.51	0.63	0.20	0.51	0.20	0.60	0.22
Baseline mean	81070.57	0.99	0.96	0.06	0.15	348.63	0.10	243.12	0.14