Social Science Research 135 (2026) 103327



Contents lists available at ScienceDirect

Social Science Research

journal homepage: www.elsevier.com/locate/ssresearch





Educational hypogamy is associated with a smaller child penalty on women's earnings

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ARTICLE INFO

JEL
J12
J13
J16
J22
D10

Keywords:
Child penalty
Hypogamy
Gender earnings gap
Educational assortative mating

ABSTRACT

This study examines how becoming a parent changes the earnings gap between partners, and how that 'child penalty' differs depending on the education level of each partner and the woman's *relative* education within the couple. Using register data on 268,156 Austrian couples who had their first child between 1990 and 2007, we track their earnings before and after childbirth in an event-study framework that uses the *couple* as the unit of analysis. We find that women who are more educated than their partners (*hypogamous* couples) face a smaller penalty than women whose partners have the same or a higher education level (*homogamous* or *hypergamous* couples). Multivariate models that adjust for the different composition of couple types confirm this pattern. A more detailed examination of specific *educational pairings* reveals strong heterogeneity in the size of the child penalty: women with tertiary education in hypogamous unions experience the smallest penalties, while those in hypergamous unions with tertiary-educated partners face the largest. Supplementary analyses indicate that the smaller penalties for tertiary-educated women in hypogamous unions do not reflect a selection of low-earning men into these partnerships.

1. Introduction

Parenthood triggers an abrupt divergence in the career trajectories of women and men. While mothers experience a sizable and often persistent reduction in labor income after the birth of a first child, fathers' earnings remain largely unchanged (Kleven et al., 2019b). This gender divergence — known as the 'child penalty' on women's earnings relative to those of men — is recognized as a central driver of the persistent gender pay gap (Cortés and Pan, 2023; Cukrowska-Torzewska and Lovasz, 2020). Kleven et al. (2019b) introduced an event-study design to estimate the long-run child penalty, which has become the standard approach for quantifying the effect of parenthood on gender earnings disparities (Andresen and Nix, 2022; Cortés and Pan, 2023; Kleven et al., 2020). This *harmonized* framework centers on the birth of the first child and allows researchers to compare the size of child penalties across geographical regions and population groups.

Comparative research shows that the magnitude of average child penalties varies substantially across countries and regions, highlighting the role of family policies, labor market structures, and cultural norms in shaping the child penalty (Kleven, 2022; Kleven

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https://doi.org/10.1016/j.ssresearch.2026.103327
Received 6 February 2025; Received in revised form 13 February 2026; Accepted 18 February 2026
Available online 25 February 2026
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et al., 2019a; Musick et al., 2020; Rellstab, 2024). By contrast, far less is known about how child penalties vary *within* countries — particularly by women's relative status within households. The evidence to date is mixed. Some studies suggest that the size of child penalties is largely unrelated to women's education or their relative economic status within the couple (Kleven, 2022; Kleven et al., 2018, 2021). Others find that women who outrank their partners in education or earnings[1] incur smaller penalties than women with partners of equal or higher status (Angelov et al., 2016; Artmann et al., 2022; Klesment and Van Bavel, 2017). In short, we still lack clear evidence on how child penalties vary across social groups and couple types.

This study addresses that gap. Using large-scale data on heterosexual couples from administrative registers, we examine how child penalties vary with each partner's level of education and with women's *relative* status within the couple. This research is important as it contributes to a better understanding of how intra-couple dynamics shape gendered employment decisions. More broadly, it sheds light on how women's educational advances relative to men — and the growing share of *hypogamous* couples in which the woman has a higher level of education than her partner (De Hauw et al., 2017; Van Bavel, 2012) — may affect the evolution of the gender earnings gap. Analyzing partners' relative earnings trajectories across the family-life course in the societal context of rising educational hypogamy is crucial for understanding broader issues of gender inequality, i.e. how women's *relative status* within the couple shapes gender earnings inequalities, especially after becoming parents, and consequently, gender relations within families and in society at large.

While classic studies on the 'motherhood penalty' (Budig and England, 2001) compare the earnings of mothers with those of childless women or analyze women's earnings before and after childbirth (e.g., Cukrowska-Torzewska and Matysiak, 2020; England et al., 2016; Gangl and Ziefle, 2009; Mari and Cutuli, 2021), research on the 'child penalty' shifts the focus to how parenthood affects women's economic standing *relative* to men's. Research on the child penalty can further be divided into studies that examine how the earnings of average women evolve relative to those of average men around the time of childbearing—without matching *individuals* to their partners (e.g., Kleven et al., 2019b), and those that shift to *couples* as the unit of analysis to examine how childbearing affects within-couple earnings inequality (Dotti Sani, 2015; Musick et al., 2020, 2022; Nylin et al., 2021; Cheng and Zhou, 2024). This study contributes to the latter strand of research, examining how the arrival of a first child affects women's relative economic standing within families.

We present evidence from Austria based on the analysis of register data on 268,156 first births between 1990 and 2007, matched with information on the characteristics of both parents, including their annual earnings from five years before to ten years after the birth. Results from both classic event-study approaches and multivariate regression analyses show that educational hypogamy mitigates the size of the child penalty, especially among women with tertiary education. This advantage cannot be explained by parents' age at first birth, fertility differentials, parents' educational attainment levels, or the selection of low-earning men into hypogamous couples. Overall, our findings imply that the growing prevalence of educational hypogamy — documented in many countries across North and Latin America, Europe, and Asia (Esteve et al., 2016; Lee, 2025; Van Bavel et al., 2018; Wang, 2025) — may be conducive to greater gender equality within couples, at least with respect to partners' relative economic power.

2. Theoretical expectations

This study examines heterogeneity in the magnitude of the *child penalty*, defined as the long-run reduction in women's earnings *relative* to men's that follows the transition to parenthood. Specifically, we test whether women's *relative* education within couples moderates the child penalty, net of partners' absolute educational attainment. A woman's higher education per se — regardless of her partner's characteristics — may be linked to smaller penalties through its association with stronger career orientations and better jobs that provide the means to outsource childcare and domestic tasks (Steiber et al., 2016). At the same time, women's higher education increases their opportunity costs of time spent out of the labor force or of working part-time (Bütikofer et al., 2018; Goldin, 2014), potentially increasing the child penalty (England et al., 2016). In any case, the role of the woman's education per se is *not* the focus of this study (see Deming, 2022, p. 5 for a recent review).[2] Instead, we examine whether a woman's position *relative* to her partner exerts an *independent* influence on the child penalty, net of other socio-demographic characteristics, including partners' educational attainment levels. This is an important research question that helps us better understand how status disparities between partners shape the gender-specific economic consequences of parenthood — a central driver of the gender earnings gap.

The available evidence on how partners' pre-birth educational pairings shape the child penalty is scarce and remains inconclusive (Angelov et al., 2016; Artmann et al., 2022; Klesment and Van Bavel, 2017; Kleven et al., 2018). Moreover, previous studies have not attempted to disentangle the effects of partners' *levels* of education from the effects of educational *disparities* within couples, nor have they considered the role played by selection into specific unions. This study addresses these research gaps. Given its growing empirical relevance, we focus specifically on *educational* hypogamy to examine how educational disparities within couples moderate the child penalty. In what follows, we outline our theoretical expectations of how hypogamous pairings may moderate the child penalty, net of absolute education levels.

[1] Some of these studies rely on pre-birth education to measure women's status relative to their partners (Angelov et al., 2016; Artmann et al., 2022; Kleven et al., 2018), while in other studies (or as an additional predictor in the aforementioned studies), the relative earning potential of the partners has been used (Artmann et al., 2022; Kleven et al., 2021).

[2] The review argues that evidence about the role of women's educational attainment in shaping the penalty is contradictory. Some studies found that penalties were higher at higher levels of education, whereas the bulk of studies found an association of higher education with smaller penalties, especially at higher ages at first birth (Doren, 2019).

2.1. Hypogamy and gender equality

Hypogamous couples — in which the woman's education exceeds her partner's — are likely to incur a smaller child penalty than homogamous or hypergamous couples for a set of interrelated reasons: *Relative resources* theory posits that the partner with greater resources enjoys stronger bargaining power over the allocation of time and tasks within the couple (Blood and Wolfe, 1960; Blumberg and Coleman, 1989). In hypogamous unions, women's higher relative education (and associated earnings potential) raises their outside options and threat points, and therefore enhances their *bargaining power* in the relationship, enabling them to negotiate a more balanced division of labor and career opportunities between partners (Lundberg and Pollak, 1996; Evertsson and Nermo, 2007; Van Bavel et al., 2018). This mechanism complements Becker's specialization model: the woman's higher relative education and earning potential imply higher relative opportunity costs for her time spent on childcare or domestic tasks (Becker, 1993). In hypogamous couples, women's comparative advantage in domestic work and childcare relative to their partners hence diminishes, making their traditional specialization in unpaid household labor economically less compelling. This can incentivize a more equal division of labor within the couple. Moreover, the resource advantage of women in hypogamous couples extends beyond economic resources: Education can confer cultural capital and negotiation skills that further strengthen women's intra-household bargaining power (Dribe and Nystedt, 2013). Together, these factors can help maintain women's labor-market attachment after childbirth and dampen the child penalty in hypogamous couples.

Notably, a more equal division of labor among hypogamous couples may also arise from economic constraints: When the less educated partner — the man in this case — is underemployed or earns substantially less, the family depends more on the woman's income. This configuration can prompt women in hypogamous couples to return to work sooner after childbirth and to work longer hours, resulting in a more equal division of paid work and a smaller child penalty (cf. England, 2010; Steiber et al., 2016 on financial necessity among women with less-educated partners).

In addition to economic mechanisms, women in hypogamous unions may incur smaller child penalties for attitudinal reasons. For instance, hypogamous couples may be more likely to hold progressive attitudes towards gender roles (Steiber and Siegert, 2026; Trimarchi, 2022). Men in hypogamous unions may be more supportive of their partner's careers and more willing to share domestic chores and childcare, thereby buffering the impact of parenthood on their partner. Moreover, hypogamous couples may have fewer children (Nitsche et al., 2018, 2020; Trimarchi and Van Bavel, 2020). Fewer births imply fewer career interruptions for women and thus smaller long-term child penalties (Miller, 2011; Taniguchi, 1999).

Based on all these rationales, we propose a hypothesis of *hypogamy advantage*: Women in educationally hypogamous unions incur a smaller child penalty than those in homogamous or hypergamous unions, net of other socio-demographic factors such as the partners' educational attainment levels or age at first birth (H1a).

2.2. Hypogamy and gender display

There are also reasons why women in hypogamous unions might *not* incur smaller child penalties. Even among couples who appear 'modern' in terms of the woman's relative education, traditional gender-role norms may persist (Bertrand et al., 2015) and be reproduced by 'doing gender' (West and Zimmerman, 1987). If men feel under normative pressure to remain the primary earner in hypogamous unions, they may resist taking on more domestic work, leaving their highly skilled partner to shoulder most childcare despite her high earning potential. When women's dominant status in hypogamous couples clashes with traditional gender roles, the resulting tension may trigger behaviors of 'gender display' (Brines, 1994) that increase women's housework burden (Bittman et al., 2003) and hence exacerbate the child penalty for women. For example, women in hypogamous unions — especially when they hold a substantial educational advantage relative to their partners — may deliberately scale back paid work and increase their engagement in domestic and care activities to compensate for this 'gender deviance' (Grunow et al., 2012; Syrda, 2023). By keeping her earnings below her partner's, the hypogamous couple can avoid challenging the male-breadwinner norm (Bertrand et al., 2015).

Based on these rationales, we propose a competing hypothesis of *hypogamy backlash*: Women in educationally hypogamous unions do *not* enjoy a smaller child penalty than those in homogamous or hypergamous unions — they may even face a larger penalty, all else equal, when persistent gender norms prompt a reduction in women's labor market participation to offset the perceived gender deviance (H1b).

The literature offers no clear consensus on the relative explanatory power of the two theoretical perspectives underlying H1a and the alternative H1b (Gupta, 2007; Syrda, 2023). To assess which of the hypotheses is better supported by the data, we examine the association of educational hypogamy with the size of the child penalty using four distinct analytical strategies (see Section 4 for details).

2.3. Hypogamy vs. relative income

The mechanisms posited in H1a and H1b rest on the idea that a woman's higher education relative to her partner's translates into a wage advantage. Consequently, women in hypogamous unions may either gain bargaining power within the couple or experience pressure to reduce the deviance between traditional gender norms and their strong economic status within the couple. However, in labor markets such as Austria's, persistent gender wage gaps (Böheim et al., 2013) can diminish the economic leverage associated with educational hypogamy (Steiber and Siegert, 2026). In contexts, where educational hypogamy does not translate into wage hypogamy among many couples (Chudnovskaya and Kashyap, 2020), the relative-earnings-based mechanisms underlying H1a and H1b may not materialize.

Despite this limitation of education-based measures of relative status within the couple, we focus on *education* as the core measure of partners' status in this study, because it has important advantages over wage-based metrics. First of all, education is more than just a measure of economic power; higher education is also associated with social and cultural capital and plausibly stronger negotiating skills (Dribe and Nystedt, 2013). Second, while education may not be the ideal measure of earning potential — as women with the same education are often in lower-paid occupations than men — pre-birth earnings are not a valid alternative, because many couples have their first child before their earning potential is revealed through current wages, especially those on higher educational trajectories. Prior efforts to gauge partners' relative earnings potential prior to childbirth (e.g. Artmann et al., 2022) have had to rely on strong counterfactual assumptions, e.g., that in the absence of children, women would have had similar earnings trajectories to men.[3] For all of these reasons, we consider *relative education* the preferable pre-childbirth measure of intra-couple status differentials: it captures both economic and non-economic dimensions of status and applies equally to those not currently in the labor force.

2.4. Selection into hypogamy

Research on the dynamics of sorting into hypogamous couples is scarce,[4] and the literature builds on varying and countervailing assumptions (Steiber and Siegert, 2026 for a review). Depending on which selection mechanism is most salient, sorting into hypogamous unions can plausibly mitigate or magnify the child penalty.

On the one hand, several potential selection mechanisms imply that hypogamous unions may be associated with a *smaller* child penalty. First, it could be argued that career-oriented women and men with gender egalitarian values are disproportionally likely to form hypogamous unions (Trimarchi, 2022). Such couples tend to divide paid and unpaid work more equally, cushioning the mother's post-birth earnings loss. Second, hypogamous unions may be associated with a smaller child penalty because men with low earning potential are disproportionally likely to enter into such unions (Chudnovskaya and Kashyap, 2020). For instance, it has been argued that highly educated women face constraints in the mate market that may lead them to settle for partners with lower income potential (Corti and Scherer, 2021).

On the other hand, dynamics of positive *assortative mating* may lead to non-random selection into hypogamous unions that imply an association of hypogamy with a *larger* child penalty. For instance, highly-educated women who nevertheless favor traditional gender roles may seek out hypogamous unions with less educated men—who likewise tend to hold more traditional views on gender roles (Steiber and Siegert, 2026) — thereby achieving value congruence in the couple. Alternatively, but also from an assortative mating perspective, it could be argued that highly-educated women seek partners who match their own socio-economic standing and earning potential (Becker, 1973; Mare, 1991), even if those men are formally less educated. Accordingly, we may expect men in hypogamous unions to have earnings that exceed what their educational attainment level would predict. If hypogamous unions are positively selected on men with a high-income potential, given their level of education, this would diminish any predicted selection-based hypogamy advantages in terms of a smaller child penalty on women's *relative* economic status in the couple.

While we cannot test all of the proposed selection mechanisms with register data (i.e. those based on attitudes and preferences), our analysis proceeds in two stages. First, we establish whether educational hypogamy is associated with a larger or a smaller child penalty (adjudicating between H1a and H1b). Second, we assess how far the observed association of hypogamy with the size of the child penalty can be explained by selection based on men's earnings.

2.5. The Austrian context

Relative to the Nordic countries, Austria exhibits a larger child penalty, reflecting policy and cultural environments that are less supportive of maternal employment (Kleven, Landais, Posch et al., 2019). Over the period relevant to this study, Austria's parental leave system was generous in terms of leave duration and job protection — features shown to depress maternal employment (OECD, 2007)[5] — but offered only flat-rate compensation (Thenner, 1999). Low wage replacement rates, together with a large gender earnings gap (Böheim et al., 2013), discouraged fathers from taking leave (Lalive and Zweimüller, 2009), while the flat-rate design also made extended leave economically unattractive for highly educated women[6] who face high opportunity costs. Nonetheless, prevailing norms — skepticism toward institutional childcare and strong expectations of maternal care for young children — have been shown to encourage women across social strata, including the highly educated, to take long leaves after childbirth and to re-enter employment on a part-time basis (Steiber et al., 2016). Childcare provision reinforced these choices. While publicly subsidized preschool (age 3+) is

[3] A more credible approach has been prosed by Almås et al. (2023) who used information on parental socioeconomic status to predict the earning potential of individuals who are still too young to show their full earning potential. We do not have information on parental characteristics in our data.

[4] But see Almås et al. (2023) for a study on selection into hypergamy.

[5] Mothers are entitled to eight weeks of maternity leave with full wage replacement before and directly after childbirth. During the early 1990s, this was followed by up to two years of job-protected parental leave available to either parent but overwhelmingly claimed by mothers. A 1996 reform introduced a *non-transferable* six-month leave period for fathers, effectively reducing the maximum leave available to mothers to 18 months, but take-up among fathers remained low (Lalive and Zweimüller, 2009). In 2002, the duration of parental leave was again extended, so that one parent could take leave until the child was 30 months old, after which the other parent could claim another six months. Empirical evidence suggests that this change depressed maternal employment rates (OECD, 2007).

[6] The level of wage replacement has increased for higher-earning women in more recent years.

widely used, nursery places are scarce, enrollment under age three was below five percent in 2005 (Eurostat[7]), and opening hours often fall short of supporting dual full-time work. Accordingly, despite high overall female labor-force participation, most mothers — including the highly educated — work part-time even as children grow older (Berghammer, 2014; Riederer and Berghammer, 2020).

Against this backdrop, we expect to find comparatively large average child penalties in Austria also in the present study, despite the low fertility rate, which has fallen to around 1.4 in the mid-1990s (OECD, 2024). However, the policy context may moderate the effect of women's relative education within couples on the child penalty. Women in educationally hypogamous unions may experience a smaller penalty than equally educated women in homogamous unions if household finances rely more on her potential earnings. In such cases, the high opportunity costs of extended leave and part-time work in the Austrian context may encourage an earlier return and longer hours, particularly among highly educated women in hypogamous couples. That said, this hypothesized hypogamy advantage may be attenuated in the Austrian context, where traditional expectations of maternal childcare remain strong across educational strata — unless educationally hypogamous unions are selectively formed by less gender traditional partners (as outlined in section 2.4).

3. Data and measurement

3.1. Data sources and sample

This study uses data derived from the Austrian Social Security Data Set (ASSD) (Zweimüller et al., 2009), which combines information on all births in Austria between 1990 and 2007 with the pre- and post-birth employment and earnings trajectories of the children's parents. The ASSD is a matched employer-employee dataset derived from Austrian social security records and combined with information from tax authorities (pay slips), marriage and divorce registers. It includes all private sector employees, but excludes civil servants and farmers, and covers approximately 85% of the Austrian labor force. The recorded annual earnings pertain to gross wages from employment, excluding transfers such as unemployment and parental leave benefits. This focus on market income is appropriate for studying child penalties, which reflect the gendered adaptation of labor market behavior following childbirth.

The analytical sample includes all parental couples[8] who resided in Austria and had their first child in the period 1990-2007. For a couple to be included in the sample, it is necessary that both parents of the child can be identified in the data, have Austrian citizenship,[9] and valid records of employment status and annual earnings for every year from five years before the birth event until eleven years afterward (balanced panel). A limitation of the data is that while it covers all earnings from dependent employment, we lack information on income from self-employment. We thus exclude couples who derive some or all their income from self-employment. We restrict both parents' ages at first birth to between 20 and 45 years, ensuring they remain of working age throughout the observation period. A detailed breakdown of observations lost to each sample restriction is provided in Annex Table A1. Our final sample comprises 268,156 couples experiencing a first birth — around 4.3 million couple-year observations.

3.2. Data setup and measures

Following the classic Kleven approach (Kleven et al., 2019b), we set up an event study around the birth of the first child and estimate child penalties in terms of *gross labor earnings* — excluding any transfer income — and retaining zero earnings during periods of non-participation. However, unlike Kleven and colleagues, who index *event time t* in terms of calendar years relative to the year of childbirth, our event studies are constructed around the *exact* date of the birth, with earnings measured for 12-month intervals around that date. This approach avoids using as a pre-birth earnings-benchmark a period — the 12 months preceding the birth — that is typically already affected by income losses during mandatory maternity leave. To estimate long-run child penalties, *event time* t runs from -5 to $+10$, with t_{10} referring to the child's eleventh year of life.

As earnings data are reported on a calendar-year basis, we calculate weighted annual earnings for each event-time interval according to the relative proportion of the two calendar years that fall within the interval. To illustrate, if a child is born on June 1, 2000, earnings at event time t_{-1} refer to the period between June 1, 1999 and May 31, 2000, calculated as 7/12 of 1999 earnings and 5/12 of 2000 earnings. We address two common issues in administrative earnings records. First, earnings data are truncated below the *marginal employment threshold* — a limit that defines the maximum earnings an employee can receive from a job while still being considered marginally employed. We impute these earnings based on the legally defined annual thresholds rather than recording them as zero.[10] Second, earnings are right-censored (top-coded) at the *maximum contribution base*.[11] To ensure our results are robust, we

[7] Eurostat, ilc_caindformal, extracted: 14 July 2025.

[8] As in Kleven, Landais, Sogaard 2019, we define 'couples' as the two persons registered as the child's parents, regardless of their marital status or living arrangements. We identify the mother's first birth, which may not be the father's first child (as in Kleven et al., 2019b). However, given our age restriction for parents at first birth (ages 20 to 45)—it is highly likely also to be the father's first child.

[9] For Austrian citizens the educational information in the register data is more reliable and comparable. Low out-migration rates among citizens also ensure more complete earnings and demographic histories over the observation period.

[10] In 2015, used as the reference period for inflation adjustment in this study, the marginal employment threshold in Austria was €415.72 per month. This threshold is periodically adjusted to reflect changes in wage levels and economic conditions. For 2024, this threshold was €520.00 per month.

[11] Contributions only need to be paid up to the *maximum contribution base. A*bove this threshold, earnings are right censored in the ASSD (around €4650 in 2015; and around €6060 Ero per month in 2024).

apply the same top-coding correction procedure as Kleven et al. (2020).[12]

We use different approaches to estimate child penalties on women's earnings relative to those of men. The outcome variables in these approaches are all based on the earnings measure just described but used in different ways (see Section 4 for details).

Educational attainment is measured at the time of the first birth. It is defined at four levels: (1) compulsory education, (2) vocational qualification (apprenticeship training or vocational school not leading to a tertiary-education entrance qualification), (3) tertiary-education entrance qualification ('Matura'), and (4) tertiary education. At the couple level, we use a categorical measure of the educational gap between the partners, distinguishing three *couple types*: homogamous couples (where the partners have the same level of education), hypergamous couples (where the man has the higher level of education), and hypogamous couples (where the woman has the higher level of education). In our sample, 60.6% of couples are homogamous, 19.5% are hypergamous, and 19.9% are hypogamous. Moreover, we use a compound measure that combines the partners' educational levels into 16 *educational pairings*.

4. Analytical strategy

Building on the literature and proposing new approaches, this study examines child penalties — i.e., the effect of childbearing on women's earnings *relative* to those of men — employing four analytical strategies. First, we implement the classic event-study framework of Kleven et al. (2019b) to *compare* average fathers' with average mothers' annual earnings trajectories around the birth of the first child. In this setup, each parent is treated as an independent unit—rather than being matched to their actual partner (Section 4.1 for detail).

Second, we set up a couple-level event study (Section 4.2 for detail) to trace women's average share of the partners' joint earnings around the birth of the first child (Angelov et al., 2016; Musick et al., 2020). In both event-study specifications, we stratify the sample of parental couples described in Section 3.1 by *couple type* to assess heterogeneity in the magnitude of the child penalty, i.e. to test whether the penalty varies between homogamous, hypogamous, and hypergamous couples.

Third, we propose a novel approach that starts with computing the child penalty for *each* couple as the change in the woman's share of the couple's joint earnings between two years before birth (t_{-2}) and ten years after (t_{10}). This child penalty metric is then used as the dependent variable in (cross-sectional) linear regression analysis, allowing for a flexible exploration of the factors shaping the child penalty. The predictor of central interest is again the *couple type*, while we control for the year of birth and parents' other socio-demographic characteristics.

Fourth, we refine this multivariate regression approach to separate the effect of the educational *difference* between the partners (i.e. couple type) from the effects of partners' educational *levels* on the child penalty. Using diagonal reference models (Sobel, 1981), we can examine whether educational hypogamy itself—net of partners' educational levels—affects the size of the child penalty.

These four approaches are explained in more detail in Sections 4.1-4.4. Across all of them, our goal is to model women's earnings *relative* to those of their partners; with an analytical focus on how the penalty varies by couple type.

4.1. Individual event study

Kleven et al. (2019b) established a methodology to study the impact of children on the career trajectories of parents using an event-study approach that exploits the sharp change in labor market outcomes after the birth of the first child for mothers relative to fathers to estimate the so-called child penalty. This approach is based on separate regressions for women and men where Y denotes the annual gross earnings (including zeros for the non-employed) for individual i of gender g in year s and at event time t:

$$Y_{ist}^{g} = \sum_{j \neq -2} \alpha_j^{g} * \boldsymbol{I}[j = t] + \sum_{k} \beta_k^{g} * \boldsymbol{I}[k = age_{is}] + \sum_{y} \gamma_y^{g} * \boldsymbol{I}[y = s] + \nu_{ist}^{g} \quad (1)$$

The regressions include a full set of event time dummies (first term on the right-hand side), age dummies to control for life-cycle trends (second term), and year dummies to control for time trends such as wage inflation and business cycles (third term).[13]

The child penalty estimate is derived in two steps. First, we estimate the earnings effect of childbearing separately for men and women and convert the estimated level effects into percentages using the event time coefficients for each gender α_t^g and the predicted outcomes without the event time effects Y_{ist}^g in the following way: $P_t^g = \alpha_t^g / E\left[Y_{ist}^g | t\right]$. In a second step, the child penalty P_t is defined as the percentage by which women fall behind men due to children.[14] The child penalty P_{t10} represents the proportionate reduction in women's earnings *relative* to men's due to the birth of the first child, when the child is in its eleventh year of life. This long-term penalty

[12] The share of top-coded men at t10 is 6.7%, and 0.5% for women. The pattern of results reported in this study remains unchanged when the top-coding correction is applied. We report the results without this correction, as it can bias estimated differences between couple types if top-coded individuals in hypogamous unions have higher/lower average earnings than their counterparts in other couple types.

[13] Our specification differs from that of Kleven et al., who organize the data according to calendar years and omit the event time dummy t_{-1} to measure the impact of children relative to the calendar year just before the first birth. We instead organize the data around the exact date of the birth and omit the event time dummy t_{-2} to measure the impact of children relative to a 12-month period before the birth that is not yet affected by the eight weeks of mandatory maternity leave in t_{-1}.

[14] $P_t = \left(\alpha_t^m - \alpha_t^f\right) / E\left[Y_{ist}^w | t\right]$, where α_t^m and α_t^f are the event time coefficients for men and women, respectively, and $E\left[Y_{ist}^w | t\right]$ is the predicted outcome for women absent the effect of children.

captures the effects of all children born in the observation window.

This estimation framework is quasi-experimental because — after controlling for life-cycle trends and aggregate time trends, it treats the exact timing of a birth as an unanticipated shock to a woman's labor market trajectory. The assumption is that, accounting for age and calendar time, the residual timing of birth is independent of other determinants of labor market outcomes, like the earnings trajectories before the birth (Kleven et al., 2021). The basic identifying assumption is that in the absence of a child, a woman's labor-market trajectory would have continued smoothly and parallel to the man's trajectory. If this assumption can be maintained, the steep fall in women's earnings at first birth can be interpreted as a causal effect of childbearing. This implies that women are not changing the level of investment in their careers in anticipation of motherhood. If they lower their investment already before t_{-1}, e.g., switching to lower paid occupations that are more easily compatible with childrearing, this will show in their pre-birth earnings trends and result in a lower, conservative estimate of their penalty.

4.2. Couple-based event study

While the approach proposed by Kleven et al. (2019a,b) compares average female to average male earnings trajectories, irrespective of who is in a couple with whom (no matching of partners), in our second approach the unit of observation is the couple (Angelov et al., 2016; Musick et al., 2020). We combine information on both partners to derive a measure of the woman's share of the couple's joint earnings at each event time t_i. The following regression is run at the couple level:

$$S_{cst} = \sum_{j \neq -2} \alpha_j * \boldsymbol{I}[j = t] + \sum_{k} \beta_k * \boldsymbol{I}[k = motherage_{cs}] + \sum_{\gamma} \gamma_\gamma * \boldsymbol{I}[\gamma = s] + \nu_{cst} \quad (2)$$

The outcome S_{cst} measures the woman's share of the earnings in couple c, in year s and at event time t. The regression includes dummies for event time (first term on the right-hand side), mother's age (second term) and year (third term). We omit the event dummy at t_{-2}. The long-run penalty P_{t10} measures the percentage by which the woman's share of earnings has fallen at t_{10} relative to t_{-2}. As we use a balanced panel and thus the composition of our sample does not change over time, the regressions do not include couple fixed effects.

To analyze heterogeneity in the magnitude of the child penalty between homo-, hyper- and hypogamous couples, we follow prior studies and use sample splits to compare average penalties across subgroups of the population (e.g., Angelov et al., 2016; Artmann et al., 2022; Kleven, 2022; Kleven et al., 2019a). That is, we estimate regressions (1) and (2) separately for each of the three *couple types*. Since this type of heterogeneity analysis across socio-demographic groups remains descriptive, we complement the event-study approach with a multivariate framework that allows going beyond descriptive comparisons and to explore the specific factors contributing to the variability in child penalties across groups.

4.3. Multivariate linear regression

In the multivariate approach, the dependent variable P_c is calculated for *each* couple as the change in the woman's share of couple earnings between t_{10} and t_{-2}. The mean is a negative value (measured in percentage points) and pertains to the long-term change in the woman's earnings share between the pre-birth period t_{-2} and the time when the first child is between ten and eleven years old. P_c is modelled in an ordinary-least-squares (OLS) framework,

$$P_c = \beta_0 + \beta_1 * level_educ_{f|m} + \beta_2 * rel_educ_c + \gamma * X_c + u_c \quad (3)$$

where $level_educ_{f|m}$ stands for the level of parental education (either the father's or mother's) in couple c and rel_educ_c denotes relative education in couple c, measured using the *couple types* defined by the educational gap between partners: homogamy, hypergamy and hypogamy. Due to the linear dependency of relative education on the two partners' educational levels, it is not statistically meaningful to include the educational level of the father and the mother as well as the couple type as covariates in the standard OLS context (perfect collinearity). For this reason, we include either mother's (model 1) or father's education (model 2) along with rel_educ_c in the models.

4.4. Diagonal reference models

To estimate the effect of rel_educ_c on the child penalty, over and above both partners' level of education, we employ diagonal reference models (DRM) that originate from the literature on social mobility effects (Sobel, 1981) and have been applied to estimate heterogamy effects in couples in prior studies (Chan and Ermisch, 2015; Eeckhaut et al., 2013; Steiber and Siegert, 2026). Essentially, we use DRM with the aim to isolate the *partial association* of hypogamy with the size of the child penalty that is left once we control for both partners' educational attainment levels.

DRM provide a solution to this task, by setting the educationally homogamous couples as the 'pure types' who serve as the relevant comparison groups for women and men — at the same level of education — in educationally heterogamous couples. The outcomes of heterogamous couples are estimated to lie between the averages of the two reference couple types, with two weight parameters that reflect heterogamous couples' resemblance to homogamous couples at the man's and at the woman's level of education. Formally, the DRM is estimated as follows:

$$P_{fmc} = p^{*}\mu_{ff} + (1-p)^{*}\mu_{mm} + \sum \beta_x {}^{*} rel_educ_{fmx} + \sum \beta_\omega {}^{*} X_{fm\omega} + e_{fmc} \quad (4)$$

P_{fmc} is defined as the child penalty of couple c in cell *fm* in a contingency table of the father's education *f* by the mother's education *m*. The estimated diagonal effects (μ_{11}, μ_{22}, μ_{33}, μ_{44}) refer to the educational gradient for homogamous couples. The outcome for educationally mixed couples is modelled as the weighted sum of the two means in homogamous couples at the father's (μ_{ff}) and mother's level of education (μ_{mm}). The weights, represented by the non-linear product terms p (weight of *her* education) and $1-p$ (weight of *his* education), are constrained to sum to one and to be non-negative. They indicate the relative strength of the influence of his and her education. In the extreme case when $p = 1$, only mother's education matters. In this case the DRM is equivalent to an OLS model that includes mother's but not father's education as a control. Conversely, when $p = 0$ only father's education matters. Accounting for partners' education through non-linear terms allows for the additional estimation of *relative education* effects, by adding dummy variables for hypogamy and hypergamy as covariates X to the model. We compare DRM with varying weight specifications (p varying from 0 to 1 on increments of 0.25) and assess how these modify the estimated effects of relative education. We use the DRM Stata package (Kaiser, 2018).

All models, the OLS and DRM control for the child's year of birth and district fixed effects (99 regions in Austria). Additional covariates are added to subsequent models in a stepwise manner. The second model adjusts for differences across couple types in age and partnership status at first birth. In the third specification, we test whether differences across couple types reflect differential fertility.

4.5. Specific educational pairings

In addition to estimating child-penalty differences across three broad *couple types*, we also run OLS models using a finely grained composite indicator for every specific educational pairing. This disaggregation allows us to examine variation that the coarse categories — especially the internally diverse group of hypogamous unions —would otherwise conceal, thereby yielding a more nuanced picture of how hypogamy shapes the penalty. As shown in Annex Table A3, not all 16 theoretically possible pairings occur frequently enough to be analytically meaningful.[15] For this reason, five pairing types, each representing no more than 1% of the sample (and together less than 2.5%), are excluded from this analysis. The modal group are homogamous couples with two vocationally educated partners, accounting for 44.4% of all unions.

4.6. Sorting into hypogamous couples

To investigate whether hypogamous unions are negatively selected on male earnings, as posited in the literature and outlined in Section 2.4, we conduct a sorting test: We compare the earnings profiles of *observed* hypogamous couples with those of *randomly constructed* hypogamous couples (counterfactuals). For each woman in a hypogamous relationship, we randomly draw a different male partner from the pool of men who share the actual partner's educational level (e.g., tertiary-educated women whose partner has a vocational degree are matched to another man with this level of education). Moreover, we condition the random matches on the calendar year of the birth (i.e. observed and random couples had their child in the same year) so that observed and random couples face the same macroeconomic environment.

5. Results

5.1. Descriptive statistics

Table 1 presents descriptive statistics for the sample of analysis (N = 268,156 births, mothers and fathers) disaggregated by couple type: homogamous, hypergamous, and hypogamous. The three groups show a similar mean age at first birth (around 26-27 years for women; 29-30 years for men) and similar shares of couples have a second child within ten years of the first birth (around 69-71%). While hypogamous couples are less likely to be married at the time of the first birth (47.7%) than first parents overall (51.9%); among those who were married at first birth, the risk of divorce within the next ten years is similar for all couple types. While the majority of children born to homogamous couples (63%) and hypergamous couples (57%) were born in the 1990s, the children born to hypogamous couples were more likely born in the 2000s (56%), reflecting the trend of rising shares of hypogamous couples over time.

5.2. Description of earnings trajectories

Fig. 1 traces inflation-adjusted earnings from five years before (t_{-5}) to ten years after birth (t_{10}). Male earnings (blue) rise steadily throughout and show no discernible break at childbirth, regardless of couple type. In contrast, female earnings (red) decline sharply at birth and only partially recover by t_{10}. The decline starts at t_{-1}, due to mandatory maternity leave in the 12-month period preceding

[15] In a mere 0.5% of the couples, both partners have only compulsory education. Couples in which the mother has compulsory education, and the father a high-school or tertiary degree represent 0.4% of the sample. The pairing, where the father has compulsory education and the mother a higher education than him (vocational, high school, or tertiary), overall represents only 1.5% of the sample.

Table 1
Description of sample for analysis.

	Total	homogamous	hypergamous	hypogamous
Mother's characteristics				
Age at first birth	26.4	26.3	26.6	26.3
Second birth up until t_{10}	69.9%	69.9%	69.0%	70.9%
Annual earnings in EUR at t_{-2} [a]	22,387	22,032	22,246	23,607
Annual earnings in EUR at t_{10} [a]	14,359	13,773	12,369	18,098
Father's characteristics				
Age at first birth	29.0	28.9	28.7	29.6
Annual earnings in EUR at t_{-2} [a]	27,543	27,241	28,114	27,905
Annual earnings in EUR at t_{10} [a]	38,045	37,426	41,366	36,668
Couple characteristics				
Share of her earnings t_{-2}	46.6%	46.4%	47.3%	46.4%
Share of her earnings t_{10}	28.3%	27.6%	25.1%	33.8%
Child penalty ($t_{10} - t_{-2}$) [b]	−18.3 pp	−18.8 pp	−22.2 pp	−12.6 pp
Married at first birth	51.9%	53.4%	51.6%	47.7%
Divorced at t_{10} [c]	13.4%	13.4%	12.3%	14.6%
Birth cohort 1990 - 1999	58.1%	63.3%	56.6%	43.9%
Birth cohort 2000 - 2007	41.9%	36.7%	43.4%	56.2%
Observations	268,156	162,446	52,375	53,335

Notes: The table reports characteristics at the individual level and the couple level (means or %).
[a] Annual earnings include zeros and are adjusted for inflation (using the CPI with base year 2015).
[b] This child penalty is computed for each couple (in percentage points). It is computed by subtracting the woman's share of the couple's earnings at t_{-2} from her share at t_{10}.
[c] Conditional on being married at first birth. The divorce register is available up to 2006; hence this value is based on couples who experienced the birth up to 1996 (N = 66,329).

birth. While average male and female pre-birth earnings are similar across couple types in t_{-2}, post-birth trajectories diverge: Male earnings grow fastest in hypergamous couples, whereas female earnings recover most in hypogamous couples. The green line charts women's share of partners' combined earnings. Two years before birth this share amounts to 46-47 percent in all couple types but drops to 25 percent in hypergamous, 28 percent in homogamous, and 34 percent in hypogamous couples (see also Table 1).

The decline in earnings between t_{-2} and t_{10} among women, but not men, reflects stable or — in homogamous and hypergamous couples — increasing employment rates among fathers, whereas women's employment rates fall by 20 percentage points (pp) in homogamous, 24pp in hypergamous and 16pp in hypogamous couples. Over the same period, women's part-time rates increased from around 14 percent to about 72 percent, with only small differences across couple types (Annex Table A2).

5.3. Event studies

The individual-level event studies show a similar general pattern for the three couple types (Fig. 2): Whereas men's earnings are not affected by fatherhood, women's average market income drops by almost 100% between t_{-2} and t_0. Subsequently, between t_0 and t_{10}, women's earnings gradually recover to around half of what they earned before birth. In *all* three couple types, men record flat earnings trajectories that are unaffected by parenthood, whereas women experience substantial losses. However, in line with H1a, the child penalty at t_{10} — that is, the birth-related reduction in women's earnings *relative* to men's — is smaller in hypogamous (43%) than in homogamous (45%) or hypergamous couples (51%).

The small pre-trends Fig. 2 visible in [16] may indicate anticipatory effects for women in hypogamous couples who tend to have less work experience at the time of the first birth at t_0 (Annex Table A2) than other women and are likely to invest in their careers in the years preceding motherhood. However, many of these women complete tertiary education and enter the graduate job market in these years and may experience wage growth prior to t_0 for reasons that are unrelated to childbearing.

The couple-level event studies show that women's share of the couple's earnings drops by around 40 percentage points (pp) between t_{-2} and t_{10} in all three couple types (Fig. 3). While the female earnings share in all three groups recovers somewhat after this low point, the recovery is steepest for women in hypogamous couples. Women in hypogamous couples lose 20 pp of their earnings share between t_{-2} and t_{10} — about 4-5 pp less than women in homogamous or hypergamous couples.[17] The penalty for all three groups is substantially larger than what has been found in the United States (10 pp for births in the 2000s, cf. Musick et al., 2022) but comparable with what has been found for the U.K. and Germany (Musick et al., 2020).

The analysis shown in the Annex (Fig. B1), that stratifies the sample by the number of children up to t_{10}, shows a consistent pattern.

[16] Pre-trends are a common finding in event studies estimating child penalties (Andresen and Nix, 2022) and not a concern for a causal interpretation of the results (Artmann et al., 2022).
[17] In the main analysis, we follow Musick et al. (2020) and control for mother's age. The results do not change when we control for father's age instead or for both parents' age.

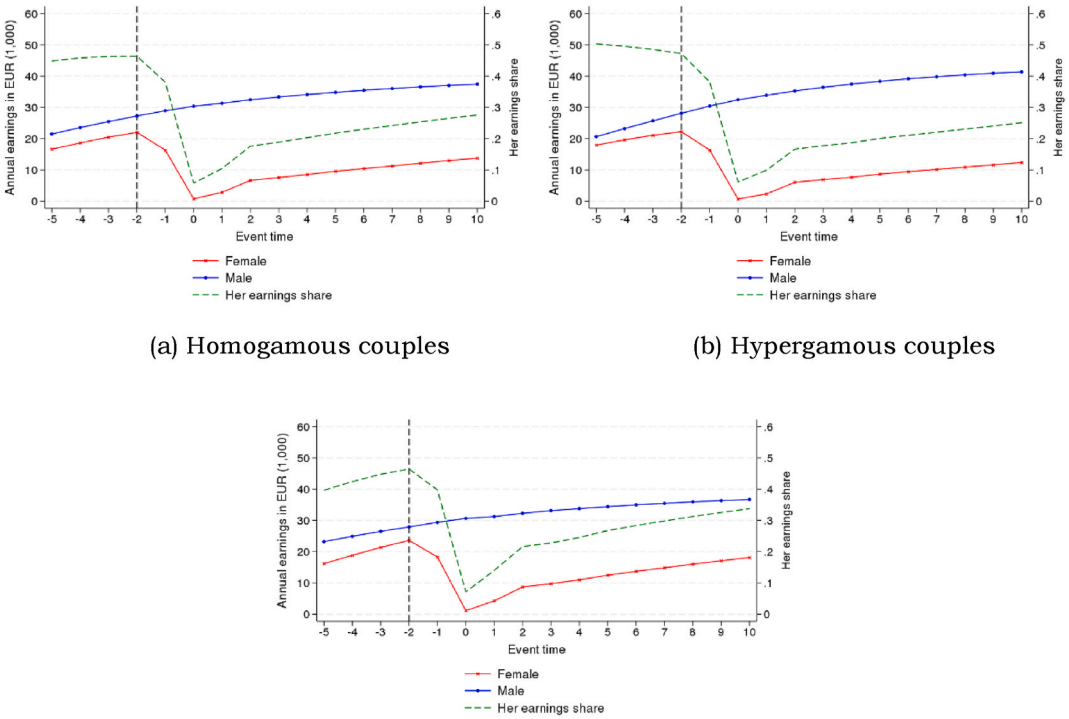


Fig. 1. Male and female earnings trajectories and the woman's share of couple earnings
Notes: Average annual earnings are adjusted for inflation (using CPI with base year 2015). Note that women's average earnings share at t_i (green) is not equivalent to her average earnings at t_i (red) divided by couple's average joint earnings at t_i (sum of blue and red).

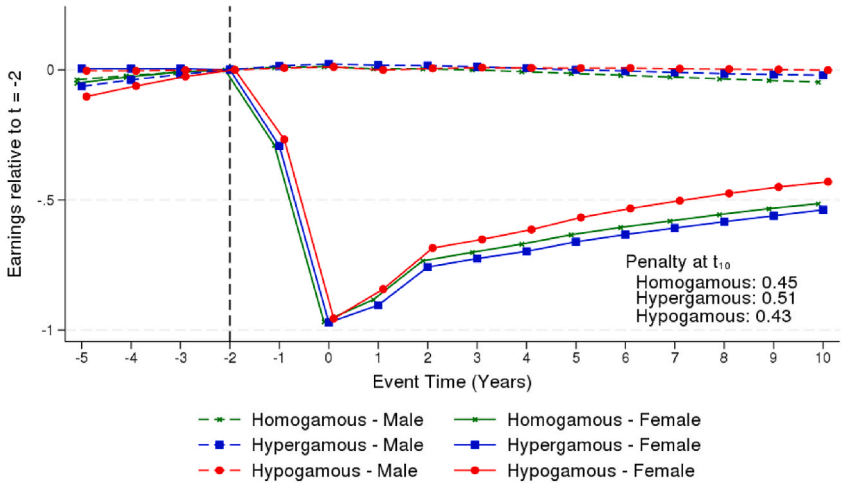


Fig. 2. Child penalty in annual earnings at the *individual* level, by couple type
Notes: The figure shows event time coefficients estimated from Eq. (1) as a percentage of the counterfactual outcome absent children. It shows the magnitude of child penalties for three sub-samples (homo-, hyper-, and hypogamous couples).

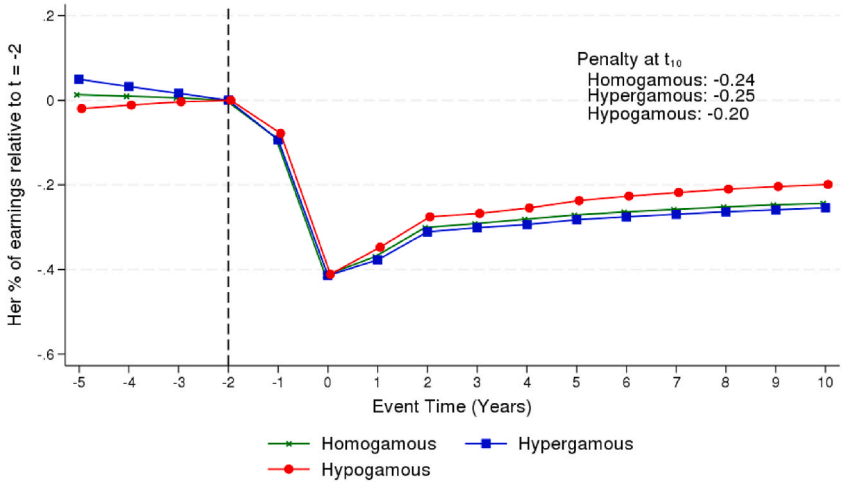


Fig. 3. Child penalty in annual earnings at the *couple* level, by couple type
Notes: The figure shows event time coefficients estimated from Eq. (2). It shows the size of child penalties in relative annual earnings for three subsamples (homo-, hyper-, and hypogamous couples). Penalty estimates remain identical when we include dummies for the man's age.

As expected, women who have borne more children face a larger child penalty, but the penalty remains the smallest for hypogamous women regardless of the number of births.

5.4. Linear regression analyses and diagonal reference models

The couple-level event studies (Fig. 3) adjust for age and time trends within each subsample of couples, but do not account for compositional differences between the *couple types*, for instance in terms of the age gap between partners, the marital status of the couple, and most importantly, partners' educational attainment levels. For example, the lower penalty for women in hypogamous unions may simply be due to their partners' lower average education instead of a direct effect of their hypogamy status. To assess such compositional effects, and to assess the mediating role of subsequent fertility, we run a series of OLS and DRM models estimating the effect of *relative* education (i.e., couple type) on the child penalty, while controlling for the *level* of education and other variables (Table 2).

The child penalty is estimated as a negative number with an average of about −18 pp, i.e. the change in the woman's average share of the couple's earnings between t_{-2} and t_{10}. Negative coefficients indicate an increase in the size of the penalty relative to the reference group, whereas positive coefficients indicate a smaller child penalty.

The first set of OLS models, which control for the year of birth and the *level* of education of the mother (Table 2, model 1) or father (model 2), show that compared to homogamy, hypogamy reduces the penalty (by about 5 and 6 pp), while hypergamy increases it (by 3 and 5pp). Hence, the difference in the magnitude of the penalty between hypergamous and hypogamous couples is estimated at around 8-11 pp. Importantly, these hypergamy and hypogamy effects remain consistent—and of the same size—in the DRM that control for *both* partners' educational levels using non-linear terms — regardless of the weight specification (models 3-5). Varying the DRM weight for women's education p from 1 to 0 (across models) has negligible impact on the estimates of hypogamy effects. This indicates that, at the specific education levels forming the *observed* heterogamous pairings in our data, the 'her-education' and 'his-education' reference profiles yield similar benchmarks — so sliding the reference between them barely changes the benchmark against which heterogamous couples are compared.[18] Importantly, the hypogamy and hypergamy effects remain of similar size across all p, demonstrating that our conclusions do not hinge on the particular choice of p. Overall, the results therefore suggest that educational hypogamy is associated with a smaller child penalty and that this association is distinct from—and robust to—the separate influences of his and her education.

Moreover, this pattern of results remains when we additionally control for the year of birth, mother's age at first birth, the age

[18] For intuition: for the heterogamous pairings we observe, the two reference endpoints—the benchmarks indexed by *her* education and by *his* education—are at similar levels (both high for hypogamy, and both low for hypergamy). As a result, sliding the reference between them barely moves the benchmark, and thus the estimated hypogamy/hypergamy effects remain similar. Note that in the DRM the reference for a hypogamous couple is a convex combination of the fitted values from the (1) "her-education" margin and the (2) "his-education" margin. Our estimates show that higher '*her* education' raises women's earnings share (positive slope), while higher '*his* education' lowers it (negative slope). For hypogamy (she higher, he lower), this yields two high endpoints, whereas for hypergamy (he higher, she lower) both endpoints are low. Consequently, the benchmark changes very little.

Table 2
Change in her relative earnings from t_{-2} to t_{10}.

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	DRM	DRM	DRM
	her education	his education	weighted	weighted	weighted
Compulsory	0.056***	−0.005	0.063***	0.065***	0.032***
	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)
High school	−0.025***	0.000	−0.014***	−0.024***	−0.004*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Tertiary	0.020***	−0.031***	0.002	0.015***	−0.017***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Hypergamous	−0.047***	−0.031***	−0.042***	−0.045***	−0.036***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Hypogamous	0.059***	0.047***	0.052***	0.056***	0.049***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Year of birth	0.005***	0.004***	0.004***	0.005***	0.004***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Weight *p*	1.00	0.00	0.50	0.75	0.25
AIC	65,685	66,511	66,492	66,056	66,693
Observations	268,156	268,156	268,156	268,156	268,156
	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	DRM	DRM	DRM
	her education	his education	weighted	weighted	weighted
Compulsory	0.049***	−0.018***	0.050***	0.055***	0.017*
	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)
High school	−0.021***	0.011***	−0.005**	−0.018***	0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Tertiary	0.023***	−0.032***	0.001	0.017***	−0.019***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Hypergamous	−0.042***	−0.031***	−0.038***	−0.041***	−0.034***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Hypogamous	0.052***	0.044***	0.046***	0.050***	0.044***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Year of birth	0.004***	0.003***	0.004***	0.004***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Mothers' age	0.002***	0.003***	0.003***	0.002***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	0.000
Age difference	0.008***	0.008***	0.008***	0.008***	0.008***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Married at t_o	−0.003***	−0.005***	−0.004**	−0.003*	−0.004**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Weight *p*	1.00	0.00	0.50	0.75	0.25
AIC	62,707	63,178	63,526	63,135	63,543
Observations	268,156	268,156	268,156	268,156	268,156

Notes: Change in her relative earnings from t_{-2} to t_{10} regressed on the education of the mother (M1 & M6) or father (M2 & M7) and relative education (couple types). Reference groups: vocational degree and homogamy. Age difference defined as father's minus mother's age. DRM with different weight specifications. Educational level effects in the DRM pertain to homogamous couples. All models include district fixed effects. Standard errors in parentheses. Mean (SD) of outcome: 0.18 (0.28). ***$p < 0.001$.

difference between the partners, and the marital status of the couple (models 6-10). Associations with smaller penalties are shown for a higher maternal age at first birth,[19] a larger age gap between the partners (the father being older), and non-marital unions. The year of birth has a negative effect, indicating that the size of the child penalty has declined over time, which aligns with findings from other countries (Musick et al., 2022; Nylin et al., 2021).

Although not the central interest of this analysis, it is worthwhile reporting the effects of the partners' educational *levels* that are controlled for in the regressions. Linear models that include both partners' educational levels as predictors, but not relative education (Annex Table C1) show a mitigating effect of her education: Compared to women with medium education (reference group), the child penalty is smaller if the woman has a tertiary degree (+12 pp). The educational level attained by the man, by contrast, has an aggravating effect, with larger penalties observed for women with tertiary-educated male partners (−11 pp). Controlled for these educational level effects, our main findings (Table 2) show an independent effect of *relative* education that supports hypothesis H1a:

[19] As shown in Annex Table C3, once we control for the birth of additional children, this effect changes its sign, i.e., that the mitigating effect of higher age is driven by lower subsequent fertility.

Educational hypogamy is associated with a smaller child penalty compared to the other two couple types. The size of the hypogamy advantage is robust to different model specifications: The difference in the size of the penalty between hypergamous and hypogamous couples is estimated at around 8-11 pp in both the linear OLS models and the DRM.

In summary, the observation from the event studies that hypogamous women tend to experience a smaller child penalty holds in the multivariate setup and cannot be explained by differences between couple types in terms of the timing of births or the age composition of partners. Coefficients for hypogamy effects are only slightly reduced once we add these controls. Moreover, hypogamy has been shown to have an effect that persists when we control for women's and men's level of education. Those in hypogamous couples consistently show a smaller child penalty. In a next step, we examine more detailed educational pairings to investigate if this hypogamy advantage holds for all subtypes of couples in which the woman is more educated than the man or if it is constrained to certain types of educational hypogamy.

5.5. Educational pairings

The educational pairings reveal far more diversity than the coarse classification into three couple types shown in Table 1. As Annex Tables A3-A5 demonstrate, the mean age at first birth among mothers is broadly similar across the three couple types (26.3–26.6 years), yet within homogamous couples it spans from 25.9 to 29.1 years, depending on the partners' educational levels. Heterogamous unions in which one partner holds tertiary credentials likewise record higher-than-average maternal ages at first birth. Fathers' ages also vary more across detailed educational pairings than across the more coarsely defined couple types. Furthermore, also the likelihood of a subsequent birth within ten years after the first birth differs markedly by educational pairing, with highly educated couples showing the greatest propensity for parity progression. Given this pronounced heterogeneity across fine-grained pairings, it is hardly surprising that the magnitude of the child-penalty likewise varies more across specific pairings than across the three broad couple types, as Fig. 4 illustrates.

Fig. 4 shows the estimates of two OLS models that regress the child penalty on the pairings. The models use the large group of homogamous couples, where both the mother and father have vocational degrees (medium education), as the reference (44.4% of couples). Negative (positive) estimates indicate a larger (smaller) penalty compared to the reference group (in percentage points). The baseline model includes year of birth and district fixed effects, mother's age at first birth, the age difference between the partners, and the marital status (estimates shown as crosses). In the second model, we add a dummy for whether the mother had another child by t_{10} (estimates shown as squares). Full models are shown in the Annex Table C3.

Among *homogamous* couples (green) the penalty varies only slightly by educational level. According to model 1, the three homogamous pairings differ by only 0.3 pp, implying that educational attainment has little bearing on the size of the penalty within this group. After we control for the fact that more-educated homogamous couples are more likely to have additional children by t_{10} (model 2), tertiary-educated mothers show a 3 pp smaller penalty than the homogamous reference group.

Hypergamous couples (blue) are more heterogeneous. Two pairings stand out with particularly large penalties: couples where the father has a tertiary education, and the mother either a vocational degree (+10 pp in model 1) or a high-school degree (+9 pp). Adjusting for fertility progression (model 2) does not change this pattern: the two pairings with tertiary-educated fathers record substantially higher penalties (+9 pp and +7 pp, respectively) compared to the reference group. Next to these hypergamous parings with particularly large penalties, two hypergamous pairings show penalties close to the overall average: unions in which the man holds a high-school or vocational degree and the woman's education is one level lower.

Finally, variation is largest among *hypogamous* couples (red): While women with a vocational qualification or a high-school degree show penalties close to the average, two hypogamous pairings stand out with the smallest penalties: tertiary-educated women partnered with men holding a high-school degree or a vocational degree incur penalties that are 8 pp and 11 pp lower, respectively. Once we control for parity progression (model 2), these premiums increase to 10 pp and 12 pp, respectively.

In summary, examining specific educational pairings — instead of aggregated couple types — reveals larger disparities in the child penalty. The sharpest contrast appears in unions where one partner has a tertiary degree and the other a vocational degree: Model 2 predicts a penalty of just 7 pp for hypogamous couples (tertiary-educated woman) but a much larger 28 pp for the mirror hypergamous pairing (tertiary-educated man) — and therefore a gap of roughly 22 pp between these two pairings.

5.6. Sorting into hypogamous couples

As outlined in Section 2.4, the literature suggests that hypogamous unions may be negatively selected on low and stagnant male earnings (Chudnovskaya and Kashyap, 2020). If this holds true in the Austrian context, it raises the question of whether the comparatively *small* penalties observed for *tertiary-educated women* in hypogamous couples (Fig. 4) are the result of such selection processes. For the other types of hypogamous unions, where the mother has medium levels of education, we do not find a sizeable hypogamy advantage (i.e. a smaller than average penalty).

To investigate this question, we examine whether the hypogamous unions with the smallest child penalties — those with a *tertiary educated* woman — are selected on *male* earnings, conducting the sorting exercise described in Section 4.6. That is, we randomly match tertiary-educated women in hypogamous couples with other men from a pool of men who share the same level of education as the woman's actual partner and who had their child in the same year. Subsequently, we compare the earnings trajectories of the *observed* and *random* hypogamous couples (Fig. 5).

Panel (a) of Fig. 5 shows that men's earnings trajectories are somewhat higher in observed than random hypogamous couples, indicating modest positive selection on male earnings. This is consistent with the assortative mating perspective: Highly educated

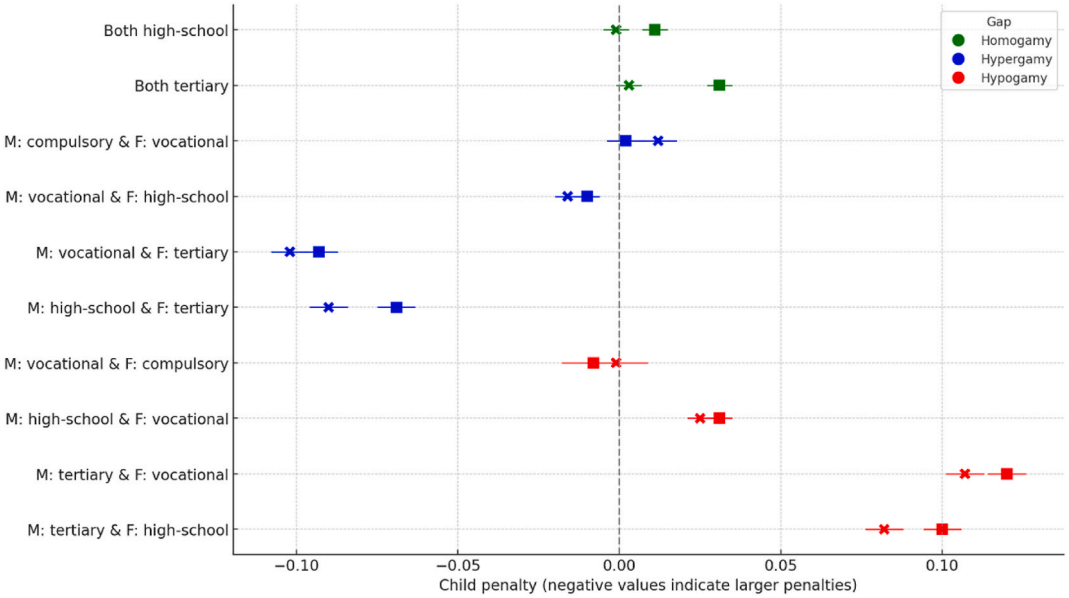


Fig. 4. Child penalty at the couple-level, by educational pairing

Notes: The coefficient plot shows estimates (and their 95% CI) from a regression of the change in her relative earnings from t_{-2} to t_{10} on educational pairings plus controls. All effects are relative to homogamous couples where both partners have vocational education with an average penalty of −20 pp (Annex Table C2). Five pairing types are excluded as they represent only a small fraction of all couples: both compulsory, M: compulsory & F: high-school, M: compulsory & F: tertiary, F: compulsory & M: high-school, F: compulsory & M: high-school.

Model 1, represented by the crosses, controls for year and district fixed effects, marital status, mother's age at t_0 and the age difference between partners.

Model 2, represented by squares, additionally includes a control for additional children up until t_{10}.

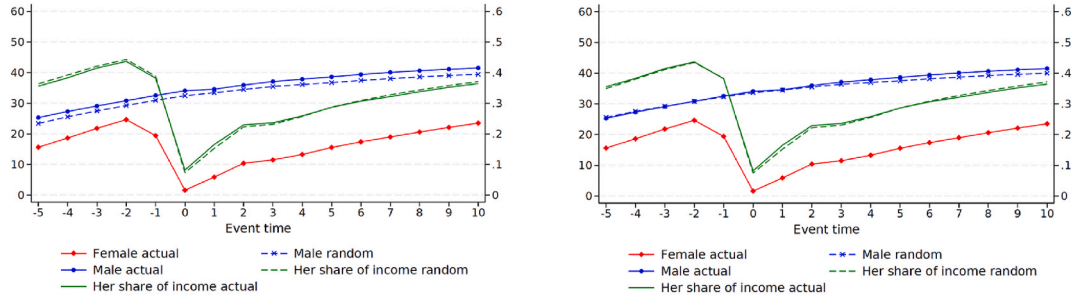
women tend to partner and have children with men whose earnings potential exceeds the average for their education level. Since the higher earnings of men in the observed couples may arise due to non-random sorting on age — men in observed hypogamous unions tend to be older than similarly educated men in other unions (cf. Annex Table A5) — we repeat the analysis with age-standardized earnings (panel b). This analysis no longer shows any selectivity on men's pre-birth earnings and earnings trajectories for observed couples that are only marginally steeper. Crucially, the woman's share of couple earnings (green) is virtually identical for observed and random hypogamous couples. Consequently, the couple-level child penalty is the same for observed and random couples. We therefore conclude that our penalty estimates for tertiary-educated women in hypogamous unions are *not* biased downwards due to selection on low or stagnant male earnings.

6. Discussion

This study contributes to research on the long-term consequences of parenthood for gender inequality within heterosexual couples. It examined how *gender earnings inequality* within couples changes due to parenthood. This question matters for both scholarship and policy because the child-related earnings disruption for mothers —but not fathers—is a key driver of the persistent gender pay gap. Documenting how—and in which couples—parenthood widens within-couple earning inequality helps to identify the mechanisms that sustain gender inequality beyond the early childrearing period. Yet, knowledge about which mothers bear the largest child penalties, and how this is shaped by gender dynamics in partnerships is still limited. To address this gap, we investigated how the penalty varies by partners' *relative status* before the first birth, measured through their relative educational attainment. In particular, we asked whether the woman's relative status within the couple moderates the degree to which parenthood shifts her relative economic standing within the couple.

Using register data on 268,156 Austrian couples whose first child was born between 1990 and 2007, we employed various analytical strategies to test whether the child penalty depends on a woman's education relative to her partner's. This included event-study designs based on individual and couple-level data as well as multivariate regression analysis. Our findings are consistent across these strategies: we found the smallest child penalties for women in *hypogamous* couples (the woman is more educated than her partner) and the largest for women in *hypergamous* couples (the man has the high level of education); with women in *homogamous* couples (partners share the same level of education) falling in-between.

Employing a flexible multivariate regression framework with the couple-level child penalty—calculated separately for *each* couple—as the outcome, we tested whether hypogamy moderates the penalty, net of partners' educational attainment levels and other



(a) Not controlled for age (b) Age standardized

Fig. 5. Earning trajectories of observed and random hypogamous couples.
Notes: Average female and male earnings trajectories and her share of couple's income from t_{-5} to t_{10} for *observed/actual* and *random* couples (N = 16,427 in each group). Annual earnings are adjusted for inflation (using CPI with base year 2015). Random couples are obtained by randomly assigning male partners to tertiary educated females, conditional on the level of women's actual partner's education and the year of childbirth. Panel (a) includes earnings that are affected by age trends; panel (b) is based on age standardized earnings (i.e. earnings in random couples weighted by the share of the age (single years) in the observed couples in each t_i). The average age of men among observed couples is 30.3 years; and 28.8 years among random couples.

couple characteristics. Across all specifications, hypogamy was consistently associated with smaller child penalties. This included diagonal reference models (DRM) showing that educational hypogamy is still associated with a smaller child penalty once we control for *each* partner's level of education using a non-linear specification. Models, like the DRM, that are able to disentangle heterogamy effects from educational level effects, are an important tool for research on the implication of educational assortative mating. Their application in the present study allowed us to ascertain that educational hypogamy in couples mitigates the child penalty, for reasons that are *unrelated* to educational attainment per se.

Our event-study window follows parents' earnings up to ten years after childbirth and partly overlaps with the Great Recession period. Our event studies account for this macroeconomic shock through year fixed effects, which absorb economy-wide shocks common to all couples in a given year, and by assigning zero earnings to the non-employed, thereby avoiding concerns about recession-related employment selectivity. However, recession effects may have been heterogeneous by gender and education—and thus by couple type. In our stratified (Kleven-style) approach, we estimate models separately by gender and couple type and include year fixed effects within each stratum, allowing time/recession effects to differ across groups. For our multivariate approach, we further assess this possibility in robustness checks by interacting partners' education and couple type with alternative recession-exposure indicators. These analyses are provided in Annex D and suggest that recession exposure can modestly shift magnitudes particularly around fathers' education—with hypogamy advantages (i.e., smaller child penalties) being about one percentage point smaller for couples affected by the recession—but does not change the main pattern of findings: among couples affected by the recession, women in hypogamous couples continue to experience smaller child penalties than homogamous couples, while hypergamous couples remain the most disadvantaged. This supports the robustness of our main conclusions to differential recession exposure across groups.

Our finding that hypogamy mitigates the child penalty also held up after adjusting for key socio-demographic differences between couples—partners' ages, marital status, and subsequent fertility. Importantly, however, a pairing-level decomposition revealed that the *hypogamy advantage* is concentrated among tertiary-educated women, whereas women with medium education in hypogamous unions exhibit no sizeable advantage relative to their counterparts in homogamous unions.

Why do hypogamous women incur smaller penalties? That child penalties are smaller for highly educated women whose male partners have lower education than they do can carry theoretical implications for how we understand household behavior and gendered labor-market outcomes after parenthood. Our findings align with relative resources theory (Blood and Wolfe, 1960), economic bargaining models (Lundberg and Pollak, 1996) and Becker's specialization model (Becker, 1993) insofar as in hypogamous couples—where the man does *not* hold an earnings advantage—women are less likely to specialize in domestic work and childcare after the first birth and therefore suffer smaller income losses relative to their partner. Yet, since we found men's earnings to be unaffected by fatherhood, the *hypogamy premium* cannot be attributed to men scaling back on paid work (e.g., to take on a larger share of childcare) when their partner has a higher earning potential. Hypogamous couples do not divide market work more equally since the men in such unions do not reduce their working hours or earnings when they become fathers. Instead, we contend that hypogamous couples outsource a larger share of childcare and domestic tasks than their homogamous counterparts, enabling a better conciliation of the woman's employment with parenthood. This accords with evidence from prior research showing that men in hypogamous unions tend to be more supportive of maternal employment—at least normatively, if not in terms of practical help with childcare or domestic work (Steiber and Siegert, 2026). A further possibility is that women in hypogamous unions sort into better, more child-friendly jobs, which we can however not test with the data at hand.

The findings of this study point to theoretical accounts in which child penalties arise from — and vary with — intra-household gender dynamics, rather than reflecting only the separate resources of mothers or fathers (Gupta, 2007). We find that women's absolute as well as

their relative education is associated with a smaller child penalty. However, this study cannot pinpoint the underlying mechanisms. Although we made advances over previous research, by isolating the partial association of educational hypogamy with a smaller child penalty from the impact of parents' educational attainment, our analysis cannot establish causality (Steiber and Siegert, 2026). Due to limited knowledge on which women and men select into hypogamous unions, it is an interesting avenue for future research to examine how women in hypogamous unions reduce their child penalty, to what extent bargaining with their partners about the outsourcing of some of the domestic work and childcare plays a role and to what extent selection into family-friendly jobs plays into this association.

That said, this study is among the first to theoretically and empirically address selection into hypogamous unions as a core mechanism. We presented a sorting analysis that compared observed hypogamous couples with randomly matched counterfactuals, which showed no evidence that the hypogamy advantage arises merely due to the selection of men with low earning potential into hypogamous unions (Chudnovskaya and Kashyap, 2020). We conclude that the smaller penalty for hypogamous women cannot be explained either by selective pairing with low-earning men or by differences in fertility behavior.

Observing smaller penalties for hypogamous women underscores that the cost of motherhood is not the same for all women—rather, it emerges from a nexus of selection into specific unions, bargaining within the household, and changing gender norms. That the hypogamy advantage manifests chiefly among tertiary-educated women further indicates that intra-household dynamics and selection processes intersect with partners' educational attainment levels. At the broader economic level, our findings indicate that average child penalties might shrink as the prevalence of hypogamy rises—particularly at higher educational levels.

Our study has some limitations. In Austria, most mothers work part-time for many years, regardless of their education (Riederer and Berghammer, 2020), as also shown in the descriptive statistics in this study. However, based on Austrian register data, that only offer a crude indicator of part-time work with a 35-h threshold, we cannot establish differences across couple types regarding the average number of working hours in part-time jobs. Moreover, we cannot investigate child penalties on hourly wages and how these vary across couple types. Future research is called to investigate sorting into hypogamous unions in more detail, including normative factors. It would be important to investigate to what extent the hypogamy premium and the observation that it is largely confined to tertiary-educated women is driven by the selection of certain women and men into these unions. While we provide some evidence that sorting does not drive lower child penalties in hypogamous couples, future research could explore this further by modeling the selection into such unions directly. Moreover, future work is called to investigate the role of relative economic power within the couple before childbearing, to complement our analysis of relative education. Simple pre-birth earnings measures are not ideal for this purpose as such early-career earnings do not capture earning potential or lifetime earnings prospects for young parents. But research using intergenerational data on parental earnings—or other instruments for relative earnings capacity—could illuminate how partners' relative economic power before parenthood shapes the child penalty.

CRediT authorship contribution statement

Nadia Steiber: Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Data curation, Conceptualization. **Lara Lebedinski:** Methodology, Formal analysis. **Bernd Liedl:** Formal analysis. **Rudolf Winter-Ebmer:** Writing – review & editing, Methodology, Data curation, Conceptualization.

Acknowledgements

For helpful discussions and comments, we would like to thank Bernt Bratsberg, Martin Halla, Vegard Skirbekk and Andrea Weber as well as seminar participants at ESPE Beograd, University of Vienna and Oslo and seminar participants at the European Population Conference 2024 in Edinburgh.

This research was funded by the Austrian Science Fund FWF [DOI: 10.55776/P35136].

Annex.

A Sample description

Our initial sample has 644,659 observations of first births and parental couples (Table A1). We remove births with an unknown father (41,483) and exclude couples without information on the mother's or father's education (11,835). Subsequently, we lose 64,615 observations due to the restriction on parental age and 98,247 observations once we exclude couples without Austrian citizenship. Finally, when we drop couples where either the mother or the father has at least one missing wage between t_{-5} and t_{10} (fully balanced panel), we lose 157,899 observations. The missing wages are largely due to the unavailability of income data for the self-employed. Of the 157,899 observations that we lose when restricting to a balanced panel, 130,789 are due to individuals being self-employed in at least one period.

Table A1
Sample restrictions and sample size

Initial sample	644,659	100%
Father unknown	41,483	6.43%
No education data on mother or father	11,835	1.84%
Age restriction	64,615	10.02%
Citizenship restriction	98,247	15.24%
Balanced sample restriction	157,899	24.49%
Final sample	268,165	41.60%

Notes: This table shows the number of observations dropped due to each of the restrictions imposed on the sample. The balanced sample restriction required that both mother and father have valid annual earnings in all 16 periods (t_{-5} to t_{10}).

Table A2
Description of sample for analysis

	Total	homogamous	hypergamous	hypogamous
Mother's characteristics				
Work experience before birth in yrs	7.7	8.0	8.5	6.3
Maternity leave in days	633	624	643	649
Employment rate at t_{-2}	90.3%	90.9%	90.9%	87.9%
Employment rate at t_{10}	70.5%	70.9%	67.4%	72.2%
Part-time rate at t_{-2}	14.2%	14.3%	13.2%	14.6%
Part-time rate at t_{10}	72.1%	72.5%	73.8%	69.0%
Father's characteristics				
Work experience before birth in yrs	9.8	9.9	8.2	10.7
Employment rate at t_{-2}	87.2%	87.8%	84.5%	88.1%
Employment rate at t_{10}	89.7%	90.1%	90.1%	87.9%
Part-time rate at t_{-2}	5.9%	6.2%	6.3%	5.0%
Part-time rate at t_{10}	6.0%	5.8%	6.0%	7.1%
Observations	268,156	162,446	52,375	53,335

Notes: Women on maternity leave are counted as employed. The part-time rate is defined as the percentage of part-time or marginal employment (<35 h per week) among those employed. Note that due to data limitations, at t_{-2}, this information is for the birth years 2003-2007 and at t_{10}, for the birth years 1991-2002 (sample sizes vary with employment rates at ti).

Table A3
Descriptive statistics for educational pairings – couple characteristics

	No of observations	Sample share in %	Child penalty t_{10}-t_{-2} in pp *	Married at t_0	Divorced at t_{10} **	Birth cohort 1990s	Birth cohort 2000s	Second birth until t_{10}
Homogamous	**162,446**	**60.6%**	**−0.19**	**53.4%**	**13.4%**	**63.3%**	**36.7%**	**69.9%**
Compulsory	1386	0.5%	−0.17	46.1%	13.0%	82.1%	17.9%	57.0%
Vocational	119,071	44.4%	−0.20	52.3%	13.8%	72.0%	28.0%	67.8%
High school	22,638	8.4%	−0.17	53.2%	13.9%	33.6%	66.4%	75.4%
Tertiary	19,351	7.2%	−0.15	60.7%	9.0%	42.8%	57.2%	77.1%
Hypergamous	**52,375**	**19.5%**	**−0.22**	**51.6%**	**12.3%**	**56.6%**	**43.4%**	**69.0%**
M: com & F: voc	11,991	4.5%	−0.20	51.2%	11.8%	84.7%	15.3%	60.2%
M: com & F: hi	764	0.3%	−0.19	48.0%	13.8%	60.0%	40.1%	57.1%
M: com & F: tert	283	0.1%	−0.27	43.5%	10.0%	59.7%	40.3%	55.1%
M: voc & F: hi	23,752	8.9%	−0.21	49.5%	13.9%	44.8%	55.2%	71.7%
M: voc & F: tert	6934	2.6%	−0.29	52.0%	11.0%	60.3%	39.7%	68.3%
M: hi & F: tert	8651	3.2%	−0.25	58.3%	11.0%	46.6%	53.4%	75.5%
Hypogamous	**53,335**	**19.9%**	**−0.13**	**47.7%**	**14.6%**	**43.9%**	**56.2%**	**70.9%**
M: voc & F: com	3020	1.1%	−0.19	33.3%	15.5%	71.9%	28.2%	59.5%
M: hi & F: com	665	0.3%	−0.10	30.5%	21.7%	43.3%	56.7%	58.1%
M: tert & F: com	288	0.1%	−0.01	26.4%	38.5%	45.8%	54.2%	58.0%
M: hi & F: voc	32,935	12.3%	−0.15	47.9%	14.7%	42.4%	57.6%	71.5%
M: tert & F: voc	8543	3.2%	−0.06	47.8%	14.0%	45.8%	54.3%	71.3%
M: tert & F: hi	7884	2.9%	−0.08	54.3%	13.1%	36.9%	63.1%	73.9%

Notes: The table reports characteristics at the couple level. * This child penalty is computed for each couple and is based on the woman's share of the couple's earnings at t_{-2} and at t_{10}. ** This is conditional on being married at t0. Birth cohort refers to the years of childbirth.

Table A4
Descriptive statistics – mothers' characteristics

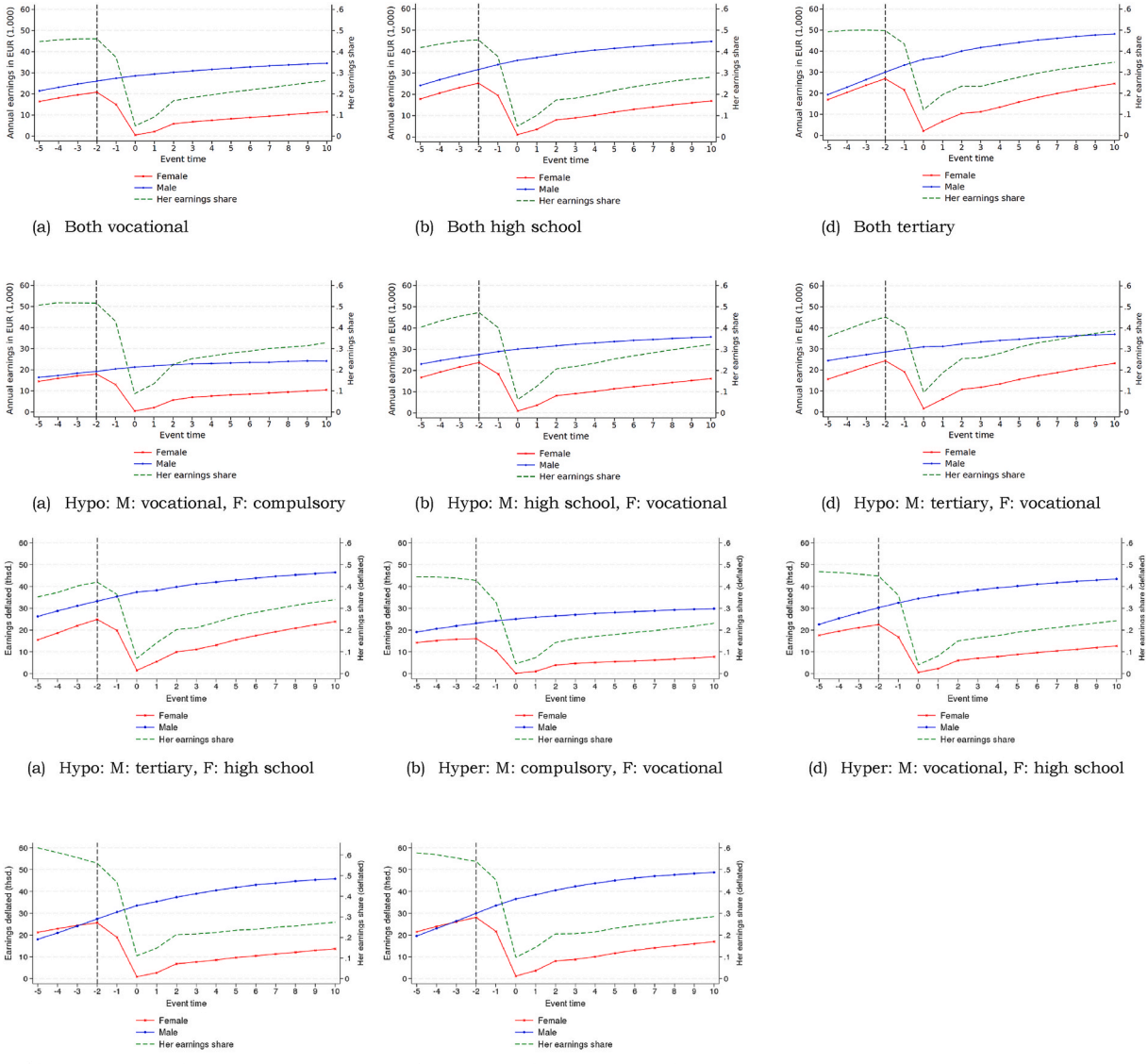
	Annual earnings in EUR at t_{-2}*	Annual earnings in EUR at t_{10}*	Age at first birth	Work experience before birth in yrs	Duration of maternity leave	Part-time rate in t_{-2} **	Part-time rate in t_{10} **
Homogamous	**22,032**	**13,773**	**26.3**	**8.0**	**624**	**14.3%**	**72.5%**
Compulsory	13,817	6392	27.2	7.6	597	27.2%	63.4%
Vocational	20,746	11,526	25.9	8.7	614	12.9%	73.9%
High school	25,162	16,856	26.0	6.7	681	11.7%	74.4%
Tertiary	26,874	24,524	29.1	5.3	625	21.7%	61.1%
Hypergamous	**22,246**	**12,369**	**26.6**	**8.5**	**643**	**13.2%**	**73.8%**
M: com & F: voc	16,068	7776	26.3	8.4	598	18.7%	68.9%
M: com & F: hi	16,999	8607	26.5	7.9	639	19.1%	68.7%
M: com & F: tert	16,491	9590	28.5	8.0	643	13.6%	71.3%
M: voc & F: hi	22,489	12,763	25.8	8.5	668	13.2%	76.2%
M: voc & F: tert	25,621	13,711	28.0	10.0	629	13.3%	76.2%
M: hi & F: tert	28,086	17,000	28.0	7.6	646	11.8%	73.6%
Hypogamous	**23,607**	**18,098**	**26.3**	**6.3**	**649**	**14.6%**	**69.0%**
M: voc & F: com	17,990	10,468	26.1	8.3	617	17.8%	67.5%
M: hi & F: com	20,224	15,671	26.0	6.2	658	15.7%	65.3%
M: tert & F: com	18,997	23,446	28.6	5.0	620	31.4%	56.2%
M: hi & F: voc	23,734	16,118	25.7	6.5	657	12.0%	72.7%
M: tert & F: voc	24,342	23,131	27.6	5.5	629	18.0%	61.5%
M: tert & F: hi	24,883	23,848	27.8	5.2	646	20.4%	62.4%

Notes: The table reports characteristics at the individual level. * Annual earnings include zeros and are adjusted for inflation (using CPI with base year 2015). **Part-time rate defined as the percentage of part-time work including marginal employment (<35 h per week) versus full-time work among those employed. Note that at t-2, this information is available for the birth years 2003-2007and at t10, for the birth years 1991-2002 (sample sizes varying with employment rates at event times).

Table A5
Descriptive statistics – fathers' characteristics

	Annual earnings in EUR at t_{-2}*	Annual earnings in EUR at t_{10}*	Age at first birth	Work experience before birth in yrs+
Homogamous	**27,241**	**37,426**	**28.9**	**9.9**
Compulsory	18,704	21,937	31.2	9.7
Vocational	26,074	34,485	28.7	10.9
High school	31,551	44,695	28.0	8.6
Tertiary	29,992	48,132	31.2	5.9
Hypergamous	**28,114**	**41,366**	**28.7**	**8.2**
M: com & F: voc	23,121	29,783	28.9	10.7
M: com & F: hi	28,156	39,167	27.7	8.1
M: com & F: tert	20,144	37,863	31.0	5.4
M: voc & F: hi	30,250	43,384	27.5	8.3
M: voc & F: tert	27,396	45,782	30.2	6.0
M: hi & F: tert	30,002	48,649	30.5	6.1
Hypogamous	**27,905**	**36,668**	**29.6**	**10.7**
M: voc & F: com	19,213	24,131	30.5	9.2
M: hi & F: com	19,463	23,596	31.1	8.3
M: tert & F: com	19,517	24,285	32.7	7.8
M: hi& F: voc	27,499	35,785	29.1	11.1
M: tert & F: voc	28,529	36,9741	30.6	11.9
M: tert & F: hi	33,268	46,423	29.9	9.0

Notes: The table reports characteristics at the individual level. * Annual earnings include zeros and are adjusted for inflation (using CPI with base year 2015). Part-time rates omitted for fathers (see Table A3 for mothers) due to very low levels at both time points.



(a) Both vocational (b) Both high school (d) Both tertiary

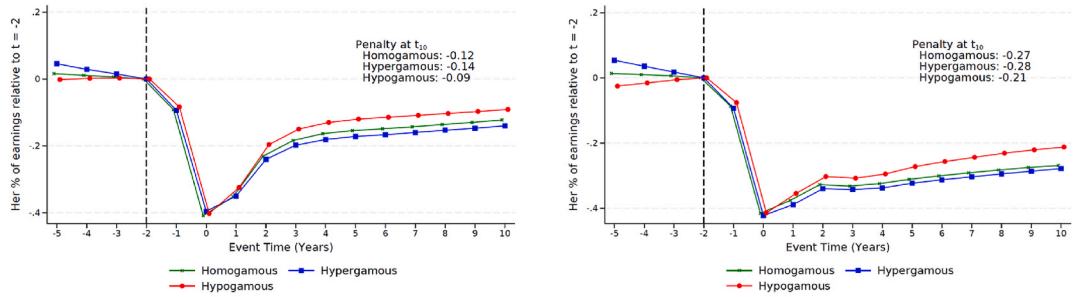
(a) Hypo: M: vocational, F: compulsory (b) Hypo: M: high school, F: vocational (d) Hypo: M: tertiary, F: vocational

(a) Hypo: M: tertiary, F: high school (b) Hyper: M: compulsory, F: vocational (d) Hyper: M: vocational, F: high school

(f) Hyper: M: vocational, F: tertiary (g) Hyper: M: high-school, F: tertiary

Fig. A1. Descriptive graphs of male and female earnings trajectories, by educational pairing.
Notes: Annual earnings are adjusted for inflation (using CPI with base year 2015). The woman's mean earnings share at t_i (green) is not equivalent to her share of the average couple's joint earnings at t_i (sum of blue and red.

B Event Studies



(a) One child (b) Two or more children

Fig. B1. Heterogeneity in the child penalty by number of children
Notes: Child penalty in relative earnings at the *couple* level, by couple type and for couples with one child (a) and more than one child up until t_{10} (b). The figure shows event time coefficients estimated from Eq. (2).

Decomposition analysis. Our main outcome Y in Eq. (1) are annual earnings. To examine the extent to which child penalties arise from changes in participation or daily wages, we use as other outcomes the 'number of days worked in t_i' and 'mean earnings per day worked'.[20] The latter decrease if parents shift to part-time work or if their hourly wages decline. As Austrian registers do not record working hours, the two mechanisms cannot be disentangled. Figure B2 shows that the smaller penalty for women in hypogamous unions is due to both a greater number of days worked after the birth (panel a) and higher daily earnings (panel b). However, in all couple types, recovery of mothers' earnings is more strongly driven by participation (days worked) than daily wages, reflecting high rates of prolonged part-time work among Austrian mothers at *all* levels of education (Berghammer, 2014).

[20] Note that in the years immediately after the birth, when most women are on leave, the sample for the analysis of daily earnings is strongly selected; we therefore abstain from interpreting the change of her share in daily earnings in the years immediately after the birth.

A similar decomposition analysis at the couple-level shows that women's *share* of days employed at t_i increases steadily between the birth and t_{10} (panel c); with the steepest recovery observed for hypogamous women. The trajectory of the woman's share of daily earnings (panel d) by contrast, is notably flat for all three couple types, reflecting long-term part-time work which reduces daily earnings due to reduced hours per day and may also hamper wage growth (Paul, 2016).

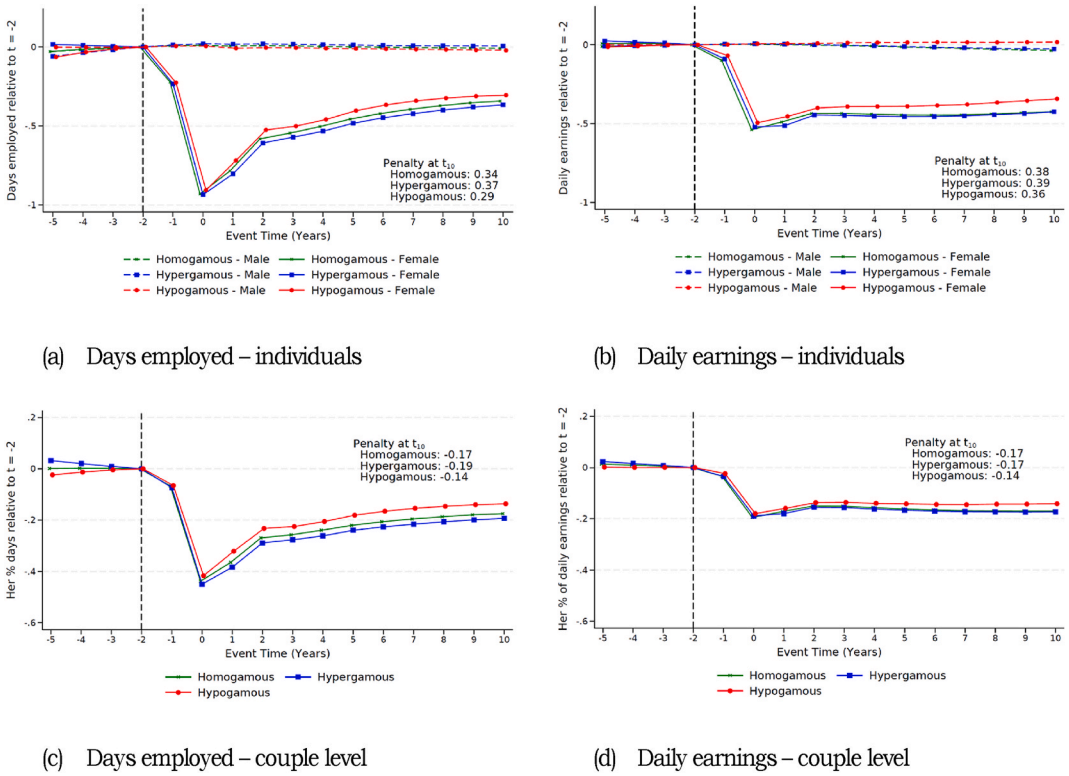


Fig. B2. Decomposition of the child penalty in annual earnings

Notes: The figures show estimates of the child penalty at the individual level according to Eq. (1) decomposed into annual days employed (a) and daily earnings calculated by dividing annual earnings by the number of days worked in the year (b). Moreover, the figures show the child penalty at the couple-level according to Eq. (2) decomposed into the woman's share of annual days worked (c) and the woman's share of average daily earnings (d), which are calculated only for couples in which parents are employed in each t_i. Given low participation, the female sample is highly selective at t_0 and t_1.

C Multivariate regression analysis

Table C1
Change in her relative earnings from t_{-2} to t_{10}

	(1)	(2)
Mothers' education		
Compulsory	0.014***	0.003
	(0.002)	(0.002)
High school	0.024***	0.028***
	(0.001)	(0.001)
Tertiary	0.111***	0.121***
	(0.002)	(0.002)
Fathers' education		
Compulsory	0.020***	0.000
	(0.004)	(0.004)
High school	−0.031***	−0.014***
	(0.001)	(0.001)
Tertiary	−0.109***	−0.092***

(*continued on next page*)

Table C1 (*continued*)

	(1)	(2)
	(0.002)	(0.002)
Year of birth	0.004***	0.004***
	(0.000)	(0.000)
Mothers' age		−0.001***
		(0.000)
Age difference		0.008***
		(0.000)
Married at t_o		0.003**
		(0.001)
2nd child up to t_{10}		−0.117***
		(0.001)
Observations	268,156	268,156

Notes: Results from regressions (OLS) of the change in her relative earnings from t_{-2} to t_{10} (mean of outcome: 0.18) on the education of the mother and the father, including district fixed effects. Age difference defined as father's minus mother's age. Reference group: vocational degree. Standard errors in parentheses. ***p < 0.001, **p < 0.01.

Table C2
Average child penalty Pc, by educational pairing

	M: Compulsory	M: Vocational	M: High school	M: Tertiary
F: Compulsory	−0.17 (0.5%)	−0.19 (1.1%)	−0.10 (0.3%)	−0.01 (0.1%)
F: Vocational	−0.20 (4.5%)	−0.20 (44.4%)	−0.15 (12.3%)	−0.06 (3.2%)
F: High school	−0.19 (0.3%)	−0.21 (8.9%)	−0.17 (8.4%)	−0.08 (2.9%)
F: Tertiary	−0.27 (0.1%)	−0.29 (2.6%)	−0.25 (3.2%)	−0.15 (7.2%)

Notes: For all possible combinations of the father's (F) and mother's (M) education (16 pairings), this table reports the average penalty Pc according to Eq. (3) (in pp) and the sample share of the pairing (in %).

Table C3
Model with educational pairings

	(1)	(2)
Homogamous: both vocational	Ref	Ref
Homogamous: both high school	−0.001	0.011***
	(0.002)	(0.002)
Homogamous: both tertiary	0.003	0.031***
	(0.002)	(0.002)
Hypergamous: M: compulsory & F: vocational	0.012***	0.002
	(0.003)	(0.003)
Hypergamous: M: vocational & F: high school	−0.016***	−0.010***
	(0.002)	(0.002)
Hypergamous: M: vocational & F: tertiary	−0.102***	−0.093***
	(0.003)	(0.003)
Hypergamous: M: high school & F: tertiary	−0.090***	−0.069***
	(0.003)	(0.003)
Hypogamous: M: vocational & F: compulsory	−0.001	−0.008
	(0.005)	(0.005)
Hypogamous: M: high school & F: vocational	0.025***	0.031***
	(0.002)	(0.002)
Hypogamous: M: tertiary & F: vocational	0.107***	0.120***
	(0.003)	(0.003)
Hypogamous: M: tertiary & F: high school	0.082***	0.100***
	(0.003)	(0.003)
Married at first birth	−0.004***	0.003**
	(0.001)	(0.001)
Mother's age first birth	0.003***	−0.001***
	(0.000)	(0.000)
Age difference between partners	0.008***	0.008***
	(0.000)	(0.000)
Second birth up until t_{10}		−0.117***
		(0.001)
Constant	−0.276***	−0.114***
	(0.004)	(0.004)
Observations	268,156	268,156
R-squared	0.056	0.089

Notes: This table shows estimation results from a regression of change in her relative earnings from t_{10} - t_{-2} (mean of outcome −0.18) on educational pairings, controlled for birth year and district fixed effects. Model also includes a dummy if parents were married at childbirth, mother's age at first childbirth and the age difference between partners, defined as father's minus mother's age. In model 2, we add a dummy capturing whether the mother had another child up until t10. The coefficients for five pairings are not shown due to small size ($\leq$ 1% of all couples): (1) homogamous: both compulsory, (2) hypergamous: M: compulsory & F: high school; (3) hypergamous: M: compulsory & F: tertiary; (4) hypogamous: M: high school & F: compulsory; (5) Hypogamous: M: tertiary & F: compulsory. Standard errors in parentheses. ***p < 0.001, **p < 0.01.

D Robustness to recession analysis

Reflecting the potential impact of the Great Recession on the education-specific earnings trajectories of women and men and by implications for our results on changes in women's relative earnings within couples due to childbirth, we conducted an additional robustness analysis. *Recession exposure* of couples experiencing first birth in the years 1990-2007 was defined using two different specifications. First, we defined recession exposure as experiencing childbirth in 2006/07—being affected by the recession early after childbirth; and second, we defined recession exposure as being affected by the recession at any time between t1 and t10. In Tables D1 and D2, these two different specifications of recession exposure were interacted with education and the couple type.

Across Tables D1 and D2, accounting for recession exposure does not overturn our main conclusions but shows some heterogeneity. In Table D1, the level of education of each parent interacts with recession exposure: the typically larger penalty when the father has tertiary education is attenuated (positive tertiary × recession interaction in panel B), whereas the usual "protective" association of women's tertiary education is weaker under recession exposure (negative tertiary × recession interaction in panel A). In Table D2, this moderation is restricted to fathers' education, while mothers' education shows no recession differential (interactions close to zero and insignificant).

Importantly, the gradients for the different couples types persist: recession exposure slightly reduces the penalty for homogamous couples (≈0.8–1.5 pp in Table D1; ≈0.7–0.9 pp in Table D2); hypogamous women continue to have a sizeable advantage of about 5–6 pp outside recessions that is modestly smaller among recession-affected couples (≈1.1–1.4 pp in Table D1; ≈0.7 pp in Table D2), and hypergamous couples remain disadvantaged, with the recession interaction varying by specification. Overall, we conclude that the recession adjustments change magnitudes at the margin, not the ranking: among couples affected by the recession, women in hypogamous couples still experience a smaller penalty (by 4-6 pp) than those in homogamous couples. And the largest penalties are estimated for women in hypergamous couples.

We thus conclude that our results are robust to recession exposure and may be moderated by business cycle effects.

Table D1
Change in her relative earnings from t_{-2} to t_{10}

Education	(1)	(2)	(3)	(4)
	A Mother's education		B Father's education	
Compulsory	0.056***	0.057***	−0.005	−0.008*
High school	−0.025***	−0.024***	0.000	0.000
Tertiary	0.020***	0.022***	−0.031***	−0.033***
Compulsory x recession		0.010		0.044**
High school x recession		−0.009		0.000
Tertiary x recession		−0.016**		0.015**
Couple type				
Hypergamous	−0.047***	−0.050***	−0.031***	−0.032***
Hypogamous	0.059***	0.060***	0.047***	0.049***
Hyper x recession		0.013**		0.004
Hypo x recession		−0.011*		−0.014**
Recession	no	0.015***	no	0.008*
Year of birth (cont.)	0.005***	0.004***	0.004***	0.004***
Observations	268,156	268,156	268,156	268,156

Notes: Recession is defined as having been affected by recession early after childbirth (childbirth in 2006/2007). Results from regressions (OLS) of the change in her relative earnings from t_{-2} to t_{10} on the education of the mother or the father, and the couple type. All models include district fixed effects. Reference group: vocational degree. For comparison, see Models 1 and 2 in Table 2. ***p < 0.001, **p < 0.01.

Table D2
Change in her relative earnings from t_{-2} to t_{10}

Education	(1)	(2)	(3)	(4)
	A Mother's education		B Father's education	
Compulsory	0.056***	0.062***	−0.005	−0.015**
High school	−0.025***	−0.024***	0.000	−0.009***
Tertiary	0.020***	0.022***	−0.031***	−0.047***
Compulsory x recession		−0.004		0.022**
High school x recession		−0.000		0.016***
Tertiary x recession		−0.003		0.026***
Couple type				
Hypergamous	−0.047***	−0.056***	−0.031***	−0.024***
Hypogamous	0.059***	0.063***	0.047***	0.053***
Hyper x recession		0.014***		−0.013***
Hypo x recession		−0.007		−0.007*
Recession	no	0.009***	no	0.007**
Year of birth (cont.)	0.005***	0.004***	0.004***	0.003***
Observations	268,156	268,156	268,156	268,156

Notes: Recession is defined as having been affected by recession in t1 or later. Results from regressions (OLS) of the change in her relative earnings from t_{-2} to t_{10} on the education of the mother or the father, and the couple type. All models include district fixed effects. Reference group: vocational degree. For comparison, see Models 1 and 2 in Table 2. ***p < 0.001, **p < 0.01.

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