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Abstract

This study contributes to the literature on how parenthood affects the within-couple gender earnings gap. It examines how this 'child penalty' on women's earnings varies with the education level of both partners and the woman's *relative* education within the couple. Using Austrian register data on 268,156 heterosexual couples who entered parenthood between 1990 and 2007, and an event study design that uses the *couple* as the unit of analysis, we examine the heterogeneity in the magnitude of the child penalty. Our stratified analyses show that the average child penalty is smaller for women in *hypogamous* couples, where she is more educated than her partner, than for women in *homogamous* or *hypergamous* unions, where the male partner is equally or more educated. These results are confirmed by multivariate regressions that control for compositional effects and disentangle the effects of partners' level of education from the impact of the woman's relative education within the couple. Furthermore, examining detailed educational pairings, rather than lumping couples into three broad types, reveals a larger variation in the size of the child penalty: tertiary-educated women in hypogamous unions incur substantially smaller penalties compared to all other educational pairings, while women in hypergamous unions with a tertiary-educated man face particularly large penalties. Supplementary analyses suggest that the reduced child penalties for tertiary-educated women in hypogamous unions do not reflect a selection of men with low earning potential into this union type.

Keywords: Child penalty, hypogamy, gender earnings gap.
JEL: J12, J13, J16, J22, D10

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1 Introduction

Parenthood triggers an abrupt divergence in the career trajectories of women and men. The substantial and often persistent decline in mothers' earnings contrasts sharply with the largely unaffected earnings trajectories of fathers (Kleven, Landais, and Søgaard 2019). This phenomenon, commonly referred to as the 'child penalty' on women's earnings, is recognized as one of the main drivers of the gender pay gap (Cortés and Pan 2023; Cukrowska-Torzewska and Lovasz 2020). Kleven et al. (2019) proposed an *event study design* to analyze this divergence, i.e., to estimate the long-term earnings penalty incurred by women relative to men following the birth of the first child, a framework that has since been widely adopted in subsequent research exploring the causal effects of parenthood on gender earnings disparities (Andresen and Nix 2022; Cortés and Pan 2023; Kleven et al. 2020). Such research has demonstrated that the magnitude of the child penalty varies significantly across countries and regions (Kleven 2022; Musick et al. 2020; Rellstab 2024), highlighting the role of family policies, labor market structures, and cultural norms in shaping the child penalty, but there remains a notable gap in our understanding how child penalties vary within countries according to couples' socioeconomic status.

Some studies suggest that women with a higher education and socioeconomic status[1] than their partner (i.e., hypogamous couples) may experience a smaller child penalty, due to the woman's greater bargaining power in the couple or greater means to buy childcare services (Angelov et al. 2016; Artmann et al. 2022; Klesment and Van Bavel 2017) compared to women in homogamous or hypergamous couples, where the male partner has an equal or higher status. However, the evidence is mixed, with some research suggesting that women's *relative* education or *relative* earning potential does not substantially affect the size of the child penalty (Kleven et al. 2018, 2021). Overall, research on the variation in the size of the child penalty across socioeconomic strata and couple types remains limited. This study addresses this gap by examining the heterogeneity of the child penalty among heterosexual couples in Austria, with a specific focus on the role of education and the effects of educational assortative mating on the magnitude of the child penalty. Through this research, we aim to deepen our understanding of the intra-couple dynamics that contribute to the gender earnings gap.

Unlike the extensive body of literature on the 'motherhood penalty' (Budig and England 2001), which estimates the economic impact of childbearing on women by comparing mothers with childless women or by analyzing 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' instead shifts the focus on how childbearing 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, Landais, and Søgaard 2019), and those that shift to *couples* as the relevant unit of analysis to examine how childbearing affects within-couple earnings inequality (Cheng and Zhou 2024; Dotti Sani 2015; Musick et al. 2020, 2022; Nylin et al. 2021). This study contributes to the latter strand of research by examining the child penalty at the couple level, focusing on how childbearing affects within-couple earnings inequality and thereby sheds light on the dynamics of relative economic

[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).

status and gender relations *within* families.

Moreover, this study advances the literature on child penalties by integrating it with emerging research on the implications of the reversal of the gender gap in education (Esteve et al. 2016) for the gender division of labor within couples (see Steiber and Siegert 2024 for an overview). The reversed gender gap in education has given rise to a growing share of heterosexual couples in which the woman holds a higher level of education than her partner—referred to as *hypogamous* couples (De Hauw et al. 2017; Van Bavel 2012). To effectively assess the impact of educational hypogamy on the evolution of gender earnings inequality as couples become parents, it is crucial to use data that link women with their actual partners. This *couple-level perspective* requires going beyond analyzing the size of the penalty solely by women's educational attainment (De Quinto et al. 2021; Doren 2019) to also examine the role of their partner's education and the impact of *relative* education within the couple. Women's relative education serves as an important indicator of their relative human capital and earning potential within the couple and can provide insight into the mechanisms that contribute to the child penalty. Addressing differences in the evolution of partners' relative earnings over the family-life course and situating this analysis within the broader societal context of rising educational hypogamy in heterosexual couples, is crucial for understanding broader issues of gender inequality, i.e. how women's relative status within the couple, particularly in relation to parenthood, shapes gender earnings inequalities and consequently gender relations within families and in society at large.

We present evidence from Austria, utilizing register data on 268,156 couples who entered parenthood between 1990 and 2007, and applying various event study designs to examine how absolute and relative education contribute to heterogeneity in the magnitude of the long-term child penalty on women's earnings. Following the methodology proposed by Kleven et al. (2019), we find that eleven years after the first child is born, women's earnings fall behind men's by around 47%. Moving to the couple as the unit of analysis (Musick et al. 2020), this translates into an average reduction in the woman's share of the couple's earnings of around 18 percentage points. Both approaches show significant variation in the child penalty across couple types, with smaller penalties incurred by women in hypogamous unions.

While such descriptive evidence is in line with prior research, this study aims to contribute to our understanding of the reasons for why the size of the child penalty varies across couple types. To this end, we develop a flexible analytical design for couple-level data that allows us to control for compositional effects (e.g. in the timing of childbearing) and to disentangle the effects of partners' *level* of educational from the effect of the woman's *relative* education. Our findings show that educational hypogamy has a mitigating effect on the size of the child penalty, and this effect operates independently of both partners' educational attainment. Our penalty estimates continue to be smallest for hypogamous women also when we control for the mother's age, year of birth, and subsequent fertility. The register data on the near universe of all first birth in the observation period furthermore allow us to reveal substantial heterogeneity in the size of the child penalty within the broadly defined group of *hypogamous* unions, whereby significantly smaller penalties in hypogamous unions are found primarily for women with tertiary education. Finally, comparisons of observed with random couples suggest that this mitigating effect of hypogamy on the child penalty is not due to a mere selection of low earning men into hypogamous couples, as has been suggested in the Swedish case (Chudnovskaya and Kashyap 2020). Overall, this study provides evidence that educational hypogamy is associated with a smaller child penalty and therefore that the societal trend of rising educational hypogamy may be conducive to gender equality within couples at least in terms of

relative economic power. The remainder of this paper is structured as follows. Section 2 provides an overview of our theoretical expectations on the effects of education and hypogamy on the child penalty. Section 3 describes our data, the analytical setup and econometric specifications, and the country context. Section 4 presents the results. Section 5 concludes. Supplementary information is available in the Annex.

2 Theoretical expectations

Hypogamous couples, where the woman has a higher level of education than the man, could be expected to incur a smaller child penalty for several reasons: The woman's higher education implies a higher earning potential, which increases opportunity costs of female household production (Becker 1993, substitution effect). This could incentivize a more equitable division of market work and encourage fathers to take a more active role in childcare, potentially reducing the career penalties for mothers. In these couples, women have less of a comparative advantage in domestic work and childcare (Becker 1985). Similarly, women who have attained a higher level of education than their partners may have greater bargaining power in the relationship, enabling them to negotiate for a more balanced distribution of childcare and career opportunities (Evertsson and Nermo 2007; Lundberg and Pollak 1996; Van Bavel et al. 2018). This can also help to maintain women's labor market attachment and reduce child penalties. The woman's higher education can improve women's bargaining power not only through higher earnings, but also through higher cultural capital and better negotiation skills (Dribe and Nystedt 2013). Notably, the same behavioral outcome — a more equal division of labor — may also result from economic constraints: If the less educated partner (the man) is underemployed or has significantly lower wages, the family may rely heavily on the woman's income. This situation could necessitate women in hypogamous couples to re-enter the labor market sooner after childbirth and to work longer hours, leading to a more equal division of paid work and a smaller penalty (Steiber et al. 2016).

Apart from economic factors, women in hypogamous unions may experience smaller penalties for attitudinal or demographic reasons. Hypogamous couples may be more likely to hold progressive attitudes towards gender roles (Steiber and Siegert 2024; Trimarchi 2022). Fathers may be more supportive of their partner's career aspirations or more willing to share domestic responsibilities, thereby mitigating the impact of children on women's careers. Moreover, hypogamous couples may delay starting families and have fewer children (Nitsche et al. 2018, 2020; Trimarchi and Van Bavel 2020), which would reduce the potential career penalties for women (Miller 2011; Taniguchi 1999) and in particular their long-terms penalties as additional children amplify the costs of motherhood.

There is also reason to expect that women in hypogamous couples do not incur smaller penalties. Even in these 'modern couples', traditional gender norms may persist (Bertrand et al. 2015). If the man feels normative pressure to be the primary breadwinner, he may be reluctant to take on more domestic responsibilities, leaving the major burden of childcare on the woman, despite her higher earning potential. Hypogamous couples may experience stress when the woman's higher educational status clashes with traditional gender roles, and this tension may lead to behaviors ("gender display", cf. Brines 1994) that exacerbate the child penalty for the woman (Bittman et al. 2003). For example, hypogamous women with a substantially higher socioeconomic status than her partner's, may try to compensate for this 'gender deviance' by increasing the woman's engagement in domestic and care activities and reducing her labor market participation and career investments (Grunow et al. 2012; Syrda 2023). This behavior helps avoiding a situation in which she earns more than

him (Bertrand et al. 2015).

Selection into hypogamous unions may also amplify the penalty: Instead of assuming that hypogamous couples hold particularly progressive attitudes towards gender roles, it is also conceivable that it is rather women with traditional views on gender relations who prefer a male partner with less education and similar views on desirable gender roles (Steiber and Siegert 2024). Such value-congruent couples may prefer women's specialization in household production, regardless of a comparative advantage. Moreover, hypogamous unions have been argued to be negatively selected on household income (Chudnovskaya and Kashyap 2020), implying that they are lower-income couples with fewer financial resources to invest in childcare services, which may aggravate the burden on mothers and their child penalties.

In sum, while women in educationally hypogamous couples may experience a lower child penalty for reasons having to do with comparative advantages, relative power, or progressive attitudes, they may also face higher penalties due to persistent gender norms, status inconsistency stress leading to 'gender display', and a lack of resources. The actual impact is likely to depend on the mechanisms of selection into hypogamous couples, which are still poorly understood (Steiber and Siegert 2024).

This study goes beyond previous work in that it seeks to theoretically and empirically disentangle the impact of women's and men's level of education — that is associated with their resources and attitudes — from the impact of the woman's *relative* education — which affects her bargaining power in the couple, irrespective of her level of education, and may create normative pressures. From a theoretical point of view (Section 4 for methodological considerations), a higher level of education on the part of the woman per se — regardless of her partner's characteristics — may be associated with a smaller penalty through preferences (career orientation) and resources (means to outsource domestic tasks and childcare). But it may also be associated with a larger penalty, because more skilled workers enjoy greater returns to experience and effort, and therefore time-out for childcare has more severe implications for women's careers if they are more highly skilled (Bütikofer et al. 2018; England et al. 2016). Similarly, part-time work and changes to more flexible jobs that allow for a reconciliation of work and parental roles during periods of childrearing, also lead to larger wage penalties for more educated women (Goldin 2014). Highly educated women furthermore tend to partner with equally highly educated men (homogamy) who are resourceful and may have characteristics such as supportive attitudes that can help mitigate the child penalty (Steiber et al. 2016). However, there are an increasing number of highly educated women entering partnerships with men who are less educated than them (hypogamy). It is an open empirical question if homogamy does more to help highly educated women avoid a large child penalty (e.g., via higher joint resources, more supportive partners) than hypogamy (e.g., through bargaining, negotiation, comparative advantage). It is likely to depend on the specific combination of the man's and the woman's education in the couple and the size of the educational gap between the partners (Cheng and Zhou 2024). The available evidence is scarce and mixed (Angelov et al. 2016; Artmann et al. 2022; Klesment and Van Bavel 2017; Kleven et al. 2018, 2021) and does not disaggregate the broad and heterogeneous group of hypogamous couples. Moreover, prior studies have not attempted to disentangle the effects of the partners' level of education from the effects of educational differences in the couple, or to account for selection into unions. This study contributes to these research gaps. We investigate whether educational hypogamy is an independent mitigating factor for the child penalty.

3 Data and institutional background

3.1 Data

The data used in this study are 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-birth and post-birth employment and earnings trajectories of the children's parents. The ASSD is a matched employer-employee dataset from Austrian social security records, combined with information from tax authorities (pay slips), marriage and divorce registers. It includes all private sector employees, but excludes civil servants and farmers, overall covering approximately 85% of the Austrian labor force. The recorded annual earnings pertain to gross wages from employment, excluding transfers such as unemployment benefits or maternity and parental leave benefits. This focus on market incomes is appropriate for the study of child penalties, which reflect the gendered adaptation of labor market behavior following childbirth.

3.2 Sample of couples and data structure

The sample for the analysis is constructed as follows: It comprises all parental couples[2] who resided in Austria and who experienced the birth of their first child in the period 1990-2007. For a couple to be included in the sample, it is necessary that both the mother and father can be identified in the data and that the annual earnings of both partners are observed in each year between five years before and 11 years after the birth. A limitation of the data is that we observe all earnings from dependent employment but lack information on income from self-employment. As a result, couples that derive part or all their income from self-employment are excluded from the sample. Age at first birth is restricted to 20-45 years for mothers and fathers, who are therefore of working age throughout the observation period. The sample excludes parents without Austrian citizenship.[3] Details on the number of observations lost due to specific sample restrictions can be found in the Annex. Our core estimation sample consists of 268,156 observations of births and parental couples – or around 4.3 million couple-year observations.

Following Kleven and colleagues (Kleven, Landais, and Søgaard 2019; Kleven, Landais, Posch, et al. 2019), for the event study, we use a long and balanced panel of first fathers and mothers with valid information on employment status and earnings in each calendar year during a 16-year observation period around the first birth. However, deviating from Kleven et al., who index event time t in terms of calendar years relative to the year of childbirth, our event study is constructed around the exact date of the first birth and the earnings data are organized into 12-month periods around the first birth, so that for a couple whose first child was born on 1 June 2000, the income at event time t_{-1} refers to the period between 1 June 1999 and May 31 2000. Event time t runs from -5 to +10. Accordingly, t_{10} refers to the eleventh year of the child's life.

[2] As in Kleven et al. (2019) couples comprise two persons who are identified as the parents of the child observed in the data, irrespective of their co-residence or marital status. The child is the first child borne by the mother, for some fathers it may not be the first one (as in Kleven, Landais, Posch, et al. 2019). Restricting the age to 20-45 at first birth reduces the chance that for the father it is not the first one.
[3] For Austrian citizens the educational information in the register data is more reliable and comparable. Moreover, due to comparatively low risks of out-migration among citizens, data are more complete.

3.3 Measures

We estimate child penalties in annual gross labor earnings, excluding transfer income. The variable is specified in levels to allow keeping zero earnings during periods of non-participation in the data. As the data are indexed in 12-month intervals relative to the exact date of birth, while the earnings data are provided annually for calendar years, the weighted annual earnings are calculated according to the proportion of two calendar years within the event times. To illustrate, for parents whose first child is born on 1 June 2000, earnings at event time t_{-1} refer to the period between 1 June 1999 and 31 May 2000, and are a weighted average of the earnings in 1999 (7/12) and in 2000 (5/12). Earnings data are truncated below the marginal employment threshold, i.e. a limit that defines the maximum earnings an employee can receive from a job while still being considered marginally employed.[4] Earnings from such employment are imputed. Moreover, earnings are right-censored (top-coded) at the maximum contribution base.[5] We test the robustness of results, applying the top-coding correction used by Kleven, Landais, Posch et al. (2019).[6]

To decompose the child penalty, we investigate as additional outcomes, the number of days worked in a year (i.e. 12-month periods t_i) and mean daily earnings on the days worked, which decrease if parents shift to part-time work or due to reduced hourly wages after childbirth. The latter cannot be identified directly, as Austrian register data lack information on working hours.

Educational attainment is a time-invariant variable measured at the time of the birth. It is defined at four levels: (1) compulsory education, (2) vocational degree (apprenticeship training or school-based vocational training that does not lead to a tertiary education entrance qualification, (3) high school completed with a qualification for entrance into tertiary education ('Matura'), and (4) tertiary education. We use two measures of education at the couple level, first, a compound measure that combines the partners' education into 16 *educational pairings* and second, a categorical difference measure of the *educational gap* between the partners. The latter differentiates between three couple types; homogamous couples, where the partners have the same level of education, hypergamous couples, where the man has the higher education, and hypogamous couples, where the woman has the higher education. In our sample 60.6% of couples are homogamous, 19.5% are hypergamous and 19.9% are hypogamous.

Table 1 presents descriptive statistics for the sample, disaggregated by couple type: homogamous, hypergamous, and hypogamous. The three groups have a similar mean age at first birth (around 26-27 years for women and 29-30 years for men) and a similar proportion of couples have a second child within 10 years of the first birth (around 69-71%). The proportion of couples who were married at the time of the first birth is slightly lower among hypogamous couples (47.7%) than the overall average (51.9%). However, among those who were married at first birth, the risk of divorce within ten years of the first birth is similar for the three groups. The majority of children born to homogamous (63%) and hypergamous (57%) couples were born in

[4] In our reference period 2015, the marginal employment threshold in Austria was €415.72 per month. This threshold is adjusted periodically to reflect changes in wage levels and economic conditions. For 2024, the marginal employment threshold was €520.00 per month.

[5] Contributions only need to be paid up to the *maximum contribution base*, based on which social security contributions are calculated and above which earnings are right censored in the ASSD (around 4,650 Euro in 2015; and around 6,060 Euro per month in 2024).

[6] The share of top-coded men at t10 is 6.7% and the one of women 0.5%. The pattern of results reported in this study remain unchanged when using this correction. We decided to report results without the 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.

the 1990s, whereas the children born to hypogamous couples were more likely to be born in the 2000s (56%), reflecting the trend towards an increasing share of hypogamous couples over time.

Table 1: Description of sample for the analysis

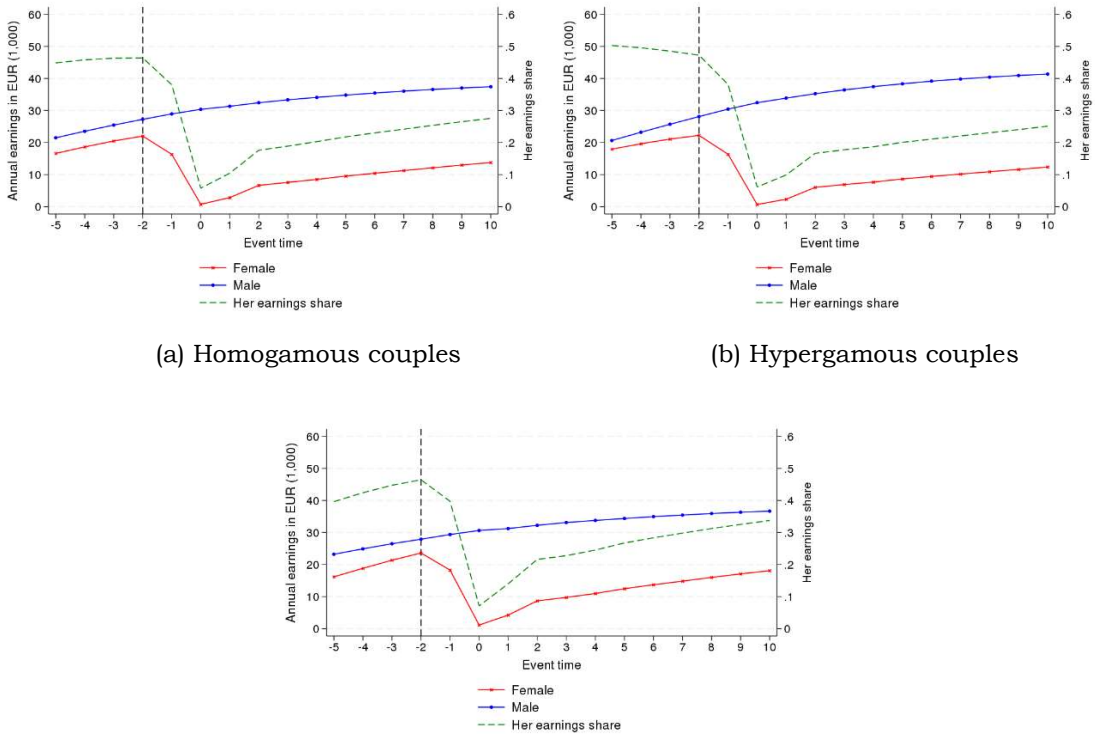
	Total	homogamous	hypergamous	hypogamous
Mother's characteristics				
Age at first birth	26.4	26.3	26.6	26.3
Annual earnings in EUR at t_{-2}*	22,387	22,032	22,246	23,607
Annual earnings in EUR at t_{10}*	14,359	13,773	12,369	18,098
Work experience before birth in yrs	7.7	8.0	8.5	6.3
Maternity leave in 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%
Second birth up until t_{10}	69.9%	69.9%	69.0%	70.9%
Father's characteristics				
Age at first birth	29.0	28.9	28.7	29.6
Annual earnings in EUR at t_{-2}*	27,543	27,241	28,114	27,905
Annual earnings in EUR at t_{10}*	38,045	37,426	41,366	36,668
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%
Couple characteristics				
Child penalty (t_{10}– t_{-2}) +	-18 pp	-19 pp	-22 pp	-13 pp
Married at first birth	51.9%	53.4%	51.6%	47.7%
Divorced at t_{10}++	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 and the couple level.
* Annual earnings include zeros and are adjusted for inflation (using CPI with base year 2015).
** This pertains to a rate of individuals who are employed (incl. maternity leave) versus those who are not.
***Defined as the percentage of part-time work including marginal employment (<35 hours 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 t_{10}, for the birth years 1991-2002 (sample sizes varying with employment rates at event times).
+ 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}. It is computed by subtracting the woman's share in t_{-2} from her share in t_{10}.
++ Conditional on being married at first birth. The divorce register is available until 2006; hence this value is based on couples that experienced birth up to 1996 (N=66,329).

Fig. 1 displays inflation adjusted annual earnings trajectories from t_{-5} to t_{10} for women and men, whereby t_0 denotes the 12-month period following the birth and t_{-1} the 12-month period preceding the birth, when female earnings (red line) already fall behind those in t_{-2} due to pre-birth maternity leave. Male earnings (blue line) show a steady upward trend in all three couple types. In contrast, the female earnings trajectories show a sharp decline at birth and a slow and only partial recovery until t_{10} for women in all couple-types (see also Table 1). While male and female pre-birth earnings are comparable across the three groups, male earnings increase most in hypergamous couples, whereas female earnings recover most in hypogamous couples. The green line illustrates the share of the combined earnings

of both partners earned by the woman. In all three couple types, the female shares of earnings range between 40% and 50% before the birth and drop by about 14 to 22 percentage points between t_{-2} and t_{10} (Fig. 1 and Table 1).

Table 1 shows how these declines in women's annual earnings around the first birth are related to participation and hours worked. While men's employment rates remain stable (hypogamous) or increase slightly (homogamous and hypergamous) between t_{-2} and t_{-10}, women's employment rates fall in all three couple types (by 20pp for homogamous, 24pp for hypergamous and 16pp for hypogamous women). Over the same period, women's part-time rates increase on average from around 14% to around 58%, and the differences in this regard between women from different couple types are remarkably small (see Table 1). At t_{10}, around 73%-74% of homogamous and hypergamous mothers work part-time and around 69% of hypogamous mothers.



(a) Homogamous couples

(b) Hypergamous couples

(c) Hypogamous couples

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 the woman's average earnings share at t_i (green) is not equivalent to her average earnings at t_i (red) divided by couple's joint earnings at t_i (sum of blue and red).

3.4 The Austrian context

The child penalty tends to be smaller in the Nordic countries, plausibly due to policy frameworks and cultural norms that are supportive of maternal employment, whereas larger penalties are observed in continental European countries such as Austria and Germany, where policies and societal attitudes are less conducive to gender equality (Kleven, Landais, Posch, et al. 2019).

In Austria, traditional gender norms are prevalent, and the institutional set-up constrains maternal employment while offering long parental leave options (Steiber et al. 2016). Mothers are entitled to eight weeks of maternity leave with full wage replacement before and immediately after childbirth. In the early 1990s, parents could subsequently (i.e. after maternity leave) take parental leave until the child's second birthday with full job protection. Mothers or fathers could take this leave, but in practice, it was mainly used by mothers. The 1996 reform of parental leave introduced a mandatory period of six months for fathers, which was forfeited if not used, essentially curtailing parental leave for mothers to 18 months, while the take-up by fathers remained low (Lalive and Zweimüller 2009). In 2002, a universal childcare allowance independent of previous employment was introduced and parental leave duration was extended again. Now, one parent could take leave until the child was 30 months old, after which the second parent could claim another six months. This reform has depressed employment rates of mothers with children aged 18-30 months (OECD 2007). Overall, in the period most relevant to this study, the Austrian parental leave system was generous in terms of duration and job protection but offered modest financial compensation (Thenner 1999). Parental leave benefits were based on a flat-rate system with a low level of wage replacement and thus high opportunity costs for women with high earning potential.[7] This encouraged many mothers to take long leaves and given the comparatively high gender gap in earnings in Austria (Böheim et al. 2013), fathers not to take any leave. The leave system is less attractive for higher-earning women; however, social attitudes in Austria, which tend to be unfavorable towards maternal employment, skeptical of institutional care, and resolutely in favor of maternal care when children are young, are reflected in long parental leaves taken by women from all social strata (Steiber et al. 2016).

Women's labor force participation rate is generally high when children reach school age, but most mothers, including those with higher education, continue to work part-time as children grow up (Berghammer 2014; Riederer and Berghammer 2020).[8] While there is extensive provision of highly subsidized public pre-school facilities for children from the age of three, nursery places are scarce. In 2010, only 12.5% of children under the age of three were enrolled in formal childcare. Moreover, the opening hours of both nurseries and kindergartens are often insufficient to support the full-time employment of both parents. Such incompatibility between labor force participation and parenting has furthermore been shown to affect fertility behavior in Austria (Prskawetz and Zagaglia 2005). Despite a prevailing two-child norm, fertility has declined to below the replacement level with a total fertility rate of 1.4 in the period 1995-2010 (OECD 2024).

[7] In later years, wage replacement has been improved for higher-earning women.

[8] The employment rate for partnered mothers with children under 15 was around 70% in the mid-2000s (OECD 2024). However, among employed mothers, 66% work less than 35 hours per week (around 55% among employed mothers with tertiary education), indicating a high prevalence of part-time work (Statistik Austria 2011).

4 Analytical approach

The data are analyzed using four distinct approaches. First, we employ the classic event study design for estimating child penalties, as proposed by Kleven, Landais, and Søgaard (2019), in which the units of analysis are individual women and men as part of parental couples. Notably, in this approach, women and men are not matched to their partners but are instead analyzed as individual entities. Second, taking a couple perspective, we employ an event study approach that uses data on actual couples (Musick et al. 2020) — with the woman's share of couple's joint earnings as the dependent variable — as opposed to running separate regressions for women and men as in Kleven et al. In both approaches, samples are stratified by couple type to test whether hypergamous and hypogamous couples differ from their homogamous counterparts in terms of the size of the child penalty. Third, we run linear regression models with a couple-level estimate of the child penalty (i.e., the woman's share of a couple's joint income at t_{10} compared to t_{-2}) as the dependent variable, allowing for a flexible exploration of the determinants of the size of the child penalty. The primary predictor of interest is partners' relative education measured, first, using the difference measure (i.e., couple types defined based on the *educational gap* between the partners) and, second, using the composite measure (*educational pairings*), controlling for the year of birth, parents' age, and other compositional effects. Fourth, we apply diagonal reference models (Sobel 1981) that can disentangle the effects of partners' level of education from the effects of the educational difference between the partners on the size of the child penalty.

4.1 Event study methodology

The seminal research by Kleven, Landais, and Søgaard (2019) established a methodology to study the impact of children on the career trajectories of mothers and fathers 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:

$$Y_{ist}^{g} = \sum_{j \neq -2} a_j^g * \boldsymbol{I}[j = t] + \sum_k \beta_k^g * \boldsymbol{I}[k = age_{is}] + \sum_y \gamma_y^g * \boldsymbol{I}[y = s] + v_{ist}^g \qquad (1)$$

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). 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}.

The child penalty estimate is derived in two steps. First, we estimate the 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: $P_t^g = \alpha_t^g \; / \; E\left[Y_{ist}^g \mid t\right]$. In a second step, the child penalty P_t is defined as the percentage by which women fall behind men due to children: $P_t = (a_t^m - a_t^f) \; / \; E[\, Y_{ist}^w \mid t\,]$, where a_t^m

and a_t^f are the event time coefficients for men and women, respectively, and $E[\,Y_{ist}^w \mid t\,]$ is the predicted outcome for women absent the effect of children. The child penalty Pt_{10} 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 quasi-experimental approach provides an estimate of the causal effect of parenthood, based on the assumption that the event, i.e. the timing of childbirth, is not affected by the outcome, i.e. the earnings trajectories before the birth (Kleven, Landais, and Søgaard 2019). This implies that women are not changing the level of investment in their careers already in anticipation of motherhood. If they lower their investment already before t_0, i.e. switching to lower paid occupations that are more easily compatible with childrearing, this will show in their pre-birth trends in earnings and result in a lower, conservative estimate of their penalty. Longer term penalties capture the effects of all children born in the observation window.

Our main outcome Y in regression (1) are annual earnings. To examine whether effects on earnings arise from changes in the number of days worked or from changes in earnings per day (the ASSD data does not contain information on the hours worked), we use as other outcomes in regression (1) the 'number of days worked in t_i' and 'mean earnings per day worked'. To analyze heterogeneity in the magnitude of the child penalty between homo-, hyper- and hypogamous couples, we estimate regression (1) separately for each of the three groups.

While the approach proposed by Kleven et al. (2019) compares average female to average male earnings trajectories, irrespective of who is in a couple with whom (no matching of partners), our second event study approach uses data on actual couples (Angelov et al. 2016; Musick et al. 2020). In this approach, we use couple-level data that combine information on both partners to derive a measure of the woman's relative earnings in the couple. Hence, the unit of observation is the couple, and the outcome of interest is 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:

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

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 event time dummies (first term on the right-hand side), mother's age dummies (second term) and year dummies (third term). We omit the event dummy at t_{-2}. The long-run child penalty Pt_{10} 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 therefore the composition of our sample does not change over time, the regressions do not include couple fixed effects. The impact of time-invariant couple characteristics such as their educational pairing at the time of birth are investigated in a multivariate framework outlined in 4.2.

A limitation of event study approaches is that the analysis of heterogeneity in the size of the child penalty across socio-demographic groups remains largely descriptive. Prior studies, for instance, have used sample splits to compare average child penalties across educational groups or across geographical units (e.g., Angelov et al. 2016; Artmann et al. 2022; Kleven 2022; Kleven, Landais, Posch, et al. 2019). In this study, we follow a similar approach to establish differences in the average child penalty across three sub-samples: homogamous, hypergamous, and hypogamous couples. We then move on to a multivariate framework that allows us to go beyond descriptive comparisons and to explore the the specific factors contributing to the variability in child penalties across groups.

4.2 Multivariate models of the child penalty

In the multivariate approach, the dependent variable P_c is calculated for each couple as the difference in the woman's share of couple earnings between period t_{10} and period t_{-2}. The mean is a negative value (average of -18 percentage points, see Table 1) 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. First, P_c is modelled in an ordinary least squares 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 compound measure (couple types: homogamy, hypergamy and hypogamy). Due to the linear dependency of relative education in the couple on the two partners' educational levels, in the standard OLS context, it is not possible to include the educational level of the father and the mother as well as the couple type. For this reason, we include either mother's (model 1) or father's education (model 2) along with rel_educ_c in the models. However, if we want to estimate the independent effect of rel_educ_c on the child penalty, over and above both partners' level of education, we need to employ non-linear 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 2024). Such a DRM sets the educationally homogamous couples as the influential 'pure types' who are the relevant comparison groups for women and men at the same level of education. They serve as the diagonal referents for educationally hypogamous (and hypergamous) couples who can be found above (below) the diagonal in Table 2.

Table 2: Average child penalty Pc and sample share (%), 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: The table shows all combinations of the father's (F) and the mother's (M) education and for each of these pairings, the average child penalty (in pp), and the empirical relevance of the pairing (% of sample).

The DRM estimates the outcome for hypo- and hypergamous couples as a function of the values in the diagonal cells, with two weight parameters that reflect heterogamous couples' resemblance to homogamous couples at the man's and the woman's level of education. The outcomes of heterogamous couples are estimated to lie between the averages of the two reference couple types. Formally, the DRM is estimated as follows:

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

The outcome 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 level of education (μ_{ff}) and at the mother's level of education (μ_{mm}). The weights are represented by the non-linear product terms p (weight of her education) and $1-p$ (weight of his education) which 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 and in this case the DRM is equivalent to the OLS model 1 that includes mother's but not father's education as a control. Conversely, when $p = 0$ only father's education matters, equivalent to OLS model 2. Accounting for his and her education through non-linear terms allows for the additional estimation of *relative education* effects, by adding dummy variables indicating hypogamy and hypergamy as covariates X to the model. We compare DRM models 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 the 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. To control for differences in the age and partnership status across couple types, in the second model we add mother's age at first birth, the age difference between the partners, and the couple's marital status at first birth. To test if differences across couple types derive from differential fertility behavior in the observation window, in the third model we add a dummy indicating whether the mother had additional children within eleven years after first birth.

5 Main results

5.1 Event studies

Fig. 2 shows our estimates from the event study approach proposed by Kleven et al. (2019) for three different samples: homo-, hyper-, and hypogamous couples (separate regressions for women and men and for each sample). We can see that the average earnings trajectories of women and men start diverging at t_{-1} because mothers are on mandatory maternity leave in the eight weeks preceding the birth. At t_0, i.e. the first year of the child's life, when most women are on parental leave (zero market income), women's earnings drop by almost 100%. Women's earnings only gradually recover between t_0 and t_{10} to around half of what they earned in t_{-2}. Men, by contrast, show flat earnings trajectories that are not affected by the birth. The average child penalty at t_{10} in women's earnings relative to men's is 47% (total of all three couple types, not shown). For all three couple types, men's earnings trajectories are flat, whereas women experience considerable penalties. However, compared to the overall average of 47%, the child penalty at t_{10} is larger for hypergamous couples (51%) and smaller for hypogamous couples (43%).

Fig. 3 presents our estimates of the child penalty in terms of the woman's share of the couple's earnings for the three groups, showing that the woman's share of the couple's earnings drops by around 40 percentage points (pp) between t_{-2} and t_{10} for all three couple types. While the female earnings share recovers somewhat after this low point in all three groups, the recovery is steepest for women in hypogamous couples. Overall, 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. 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).

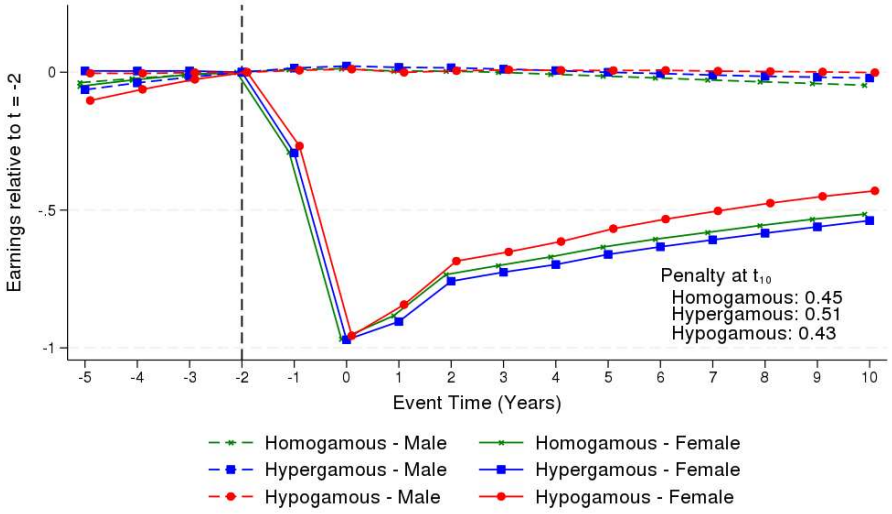


Fig. 2. Child penalty in annual earnings at the *individual* level, by couple type.
Notes: The figure shows event time coefficients estimated from Eq. 1 as a percentage of the counterfactual outcome absent children as outlined in Section 4.1, following the methodology proposed by Kleven et al. (2019). It shows the magnitude of child penalties for three sub-samples (homo-, hyper-, and hypogamous couples).

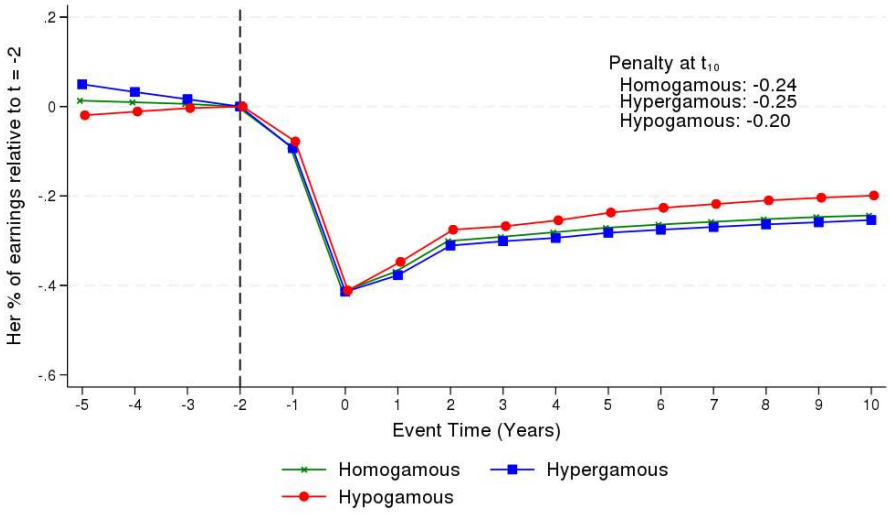


Fig. 3. Child penalty in annual earnings at the *couple* level, by couple type.
Notes: The figure shows event time coefficients estimated from Eq. 2 based on couple-level data. It shows the size of child penalties in relative annual earnings for three sub-samples (homo-, hyper-, and hypogamous couples).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

The small pre-trends visible in Fig. 2 are a common finding in research that uses event study frameworks to estimate child penalties (Andresen and Nix 2022) and not a concern for a causal interpretation of the results (Artmann et al. 2022). They may indicate anticipatory effects for hypogamous women who 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 this reason that is unrelated to childbearing.

To explore the implications of multiple children, we replicated the event study at the couple level in subsamples that conditioned on fertility progression. The child penalty was around x percentage points higher for those with more than one child. The analyses shown in the Annex (Fig. A1), which stratify the sample by the number of children up to t_{10}, reveal a consistent pattern. 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.

The results of the decomposition analysis (Fig. A2 in the Annex) show that the smaller child penalty for women in hypogamous unions than for those in hyper- or homogamous unions is due to both their stronger attachment to the labor market after the birth (in terms of days worked per year, panel a) and their higher average earnings per day worked (panel b). The greater loss in daily earnings for women in hyper and homogamous unions is due to fewer hours worked per day (i.e., part-time work) and/or a stronger motherhood penalty on hourly earnings. Although we do not have information on hourly wages, based on a crude part-time indicator in the register data that sets the full-time threshold at 35 hours per week, we can show that hypogamous women experience a slightly less steep increase in part-time rates between t_{-2} and t_{10} than women in the other union types (Table 1). As full-time work is associated with greater human capital accumulation and consequently wage growth (Paul 2016), this may mitigate the motherhood penalty on hourly wages for hypogamous women. However, for all three couple types, recovery of mothers' annual earnings is more strongly driven by participation than daily earnings, reflecting the high rates of part-time work among mothers at *all* levels of education (Berghammer 2014; Riederer and Berghammer 2020).[9] Moving to the couple-level analysis, we see that the woman's *share* of days employed at t_i increases steadily between the birth and t_{10} (panel c); with the steepest recovery — relative to their partners — observed for hypogamous women. Also, in terms of the woman's *share* of daily earnings when both partners work (panel d), we observe the smallest loss for hypogamous mothers. The trajectory of daily earnings is notably flat for all three couple types[10], which is plausibly due to long-term part-time work which may hamper wage growth.

The analyses so far have examined heterogeneity in the size of the child penalty across couple types, using stratified samples and event study designs that adjust (only) for age patterns and time trends in earnings (Fig 2 and Fig. 3). In a next step, we use a multivariate regression design to examine the factors that contribute to the smaller child penalty for hypogamous women.

[9] The employment rate for partnered mothers with children under 15 was around 70% in the mid-2000s (OECD 2024). However, among employed mothers, 66% work less than 35 hours per week—55% among employed mothers with tertiary education, indicating a high prevalence of part-time work at all levels of education (Statistik Austria 2011).

[10] Note that in the years 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 after the birth.

5.2 Regression analyses

The event studies for the stratified couples (Fig. 3) adjust for age and time trends[11], but do not control for compositional differences between the couple types (sub-samples) in terms of, for example, the age difference between partners, the marital status of the couple, and most importantly, partners' *level* of education. For instance, the lower penalty for women in hypogamous unions may be due to the lower average education of their partners compared to homogamous couples at their level of education and/or to direct effects of their hypogamy status. Similarly, women in hypergamous unions may face greater penalties because of the higher education of their partners compared to homogamous couples at their own level of education, or because of a direct hypergamy effect. Furthermore, there may be differences between the couple types in the timing of fertility over the life course. To assess such compositional effects, we run a series of OLS and DRM models estimating the effect of *relative* education (i.e. couple type) on the size of the child penalty, while controlling for the *level* of education (Table 3).

The child penalty is estimated as a negative number with an average of -18 pp, i.e. the change in the woman's average share of the couple's earnings between t_{-2} and t_{10}. Thus, negative estimates indicate an increase in the size of the penalty relative to the reference group, whereas positive estimates indicate a smaller child penalty. The OLS models, which control for the year of birth and the *level* of education of the mother (model 1) or father (model 2), show positive effects of hypogamy (5 and 6 pp), indicating a smaller child penalty for this couple type than for homogamous couples, whereas hypergamy is associated with a larger penalty (3 and 5 pp). Notably, these hypergamy and hypogamy effects remain consistent in the DRM that control for his and her level of education *simultaneously* using non-linear terms (models 3-5).

Note, that *level* effects of education in the DRM pertain to homogamous couples and are smaller compared to the effects of relative education. To better understand the effect of education per se, supplementary linear models that include *level* effects of education, but not relative education, are provided in the Annex (Table A5). They show a mitigating effect of the woman's education: Compared to women with medium levels of education (vocational degrees as reference group), the child penalty is smaller if the woman has a tertiary degree (+12.1 pp). The education attained by the man, by contrast, has an aggravating effect, with larger penalties observed for women with tertiary-educated male partners (-10.9 pp) than those with vocational degrees. Controlled for these education effects, our findings show an independent effect of *relative* education: 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 nonlinear DRM (regardless of the weight specification). Notably, this pattern of results remains when we control for the year of birth, mother's age at first birth, the age 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[12], 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). Fig. A4 in the Annex show that this trend was linear from 1995 onwards.

In summary, the observation from the event studies that hypogamous women

[11] 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.

[12] As can be seen from Table A6 in the Annex, 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.

tend to experience a smaller child penalty also holds in the multivariate setup and cannot be explained by compositional effects 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.

Table 3: Change in her relative earnings from t_{-2} to t_{10}

	(1) OLS her education	(2) OLS his education	(3) DRM weighted	(4) DRM weighted	(5) DRM 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) OLS her education	(7) OLS his education	(8) DRM weighted	(9) DRM weighted	(10) DRM 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 (all models). Reference groups: vocational degree and homogamy. Age difference defined as father's minus mother's age. DRM with different weight specifications. All models include district fixed effects. Standard errors in parentheses. Mean (SD) of outcome: -0.18 (0.28). *** p<0.001.

5.3 Educational pairings

The large-scale register data permit a more detailed examination of the specific educational pairings that fall under the three types of couples. As shown in Table 2, not all 16 possible pairings are empirically relevant.[13] For this reason, five pairing types, each accounting for only up to 1% of the sample (and less than 2.5% of the sample in total), are excluded from the following analysis.

The educational pairings show much more variation in the age at first birth and in subsequent fertility (Annex Tables A2-A4) than the broad categorization into hypo-, hyper- and homogamous couples (Table 1). For example, while women in all three couple types have a similar average age at first birth of around 26.3-26.6 years, this varies between 25.9 years in homogamous couples with vocational degrees and 29.1 years in homogamous couples with tertiary education. In heterogamous couples with one tertiary-educated partner, the average age of first mothers is also higher (around 28 years) than in the modal group of vocationally trained homogamous couples. Similarly, fathers' average age at first birth is similar in all couple types (around 28.7-29.6 years) but varies between 27.5 and 31.2 years between specific pairings. There is also more variation in the likelihood of a subsequent birth up by t_{10} between educational pairings than between couple types, with higher odds among more highly educated couples (Annex Tables A2-A4).

In terms of the size of the child penalty, there is also greater heterogeneity between the educational pairings than the couple types, as illustrated in Fig. 4 that shows the estimates of two OLS models that regress the pairings on the child penalty. The models use the large group of homogamous couples, where both the mother and the father have medium education (i.e., vocational degrees), as the reference (44.4% of couples). Negative (positive) estimates indicate a larger (smaller) penalty compared to the reference group (in pp). 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 a 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 A6.

The estimates in Fig. 4 show that within the group of *homogamous* couples, the variation in the size of the penalty by education level is modest (shown in green). According to Model 1, homogamous couples differ by only 0.3 percentage points, suggesting that educational attainment has a limited impact on the magnitude of the penalty within this group. Once we control for the fact that more educated homogamous couples are more likely to have additional children by t_{10} than the reference group (Model 2), homogamous tertiary educated women show a 3.1 pp smaller penalty. Within *hypergamous* couples (shown in blue), variation in the size of the penalty is more pronounced. Two pairings stand out with elevated penalties: couples where the father has a tertiary education, and the mother has a vocational degree (+10.2 pp in Model 1) and couples with a tertiary educated father and a mother with a high-school degree (+9.0 pp). When we control for fertility progression in Model 2, these penalties are reduced but remain substantial at +9.3 pp and +6.9 pp. Notably, two of the hypergamous pairings show average penalties: men with high-school or vocational degrees whose female partners' education is one level lower. Finally, the variation in the size of the penalty is greatest within *hypogamous* couples: While hypogamous mothers with a vocational qualification (0.0 pp) or a high-school

[13] 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 has a high-school or tertiary degree represent 0.4% of the sample. The constellation, where the father has compulsory education and the mother has a higher education than him (vocational, high school, or tertiary), overall represents only 1.5% of the sample.

education (+2.5 pp in Model 1) do not enjoy a sizeable premium compared to the reference group, two hypogamous pairings stand out with the smallest penalties: The Child penalties for tertiary-educated women partnered with men holding a high-school degree or a vocational degree is 8.2 pp and 10.7 pp smaller, respectively. Once we control for the likelihood of having an additional child by t_{10}, these premiums increase to 10.0 pp and 12.0 pp, respectively.

A detailed examination of educational pairings, rather than the aggregated couple types, has revealed a great deal of heterogeneity in the size of the penalty: In unions, where one of the partners has a tertiary degree and the other one is medium educated (vocational degree), there is a difference of around 22 pp in the size of the penalty between the hypogamous and the hypergamous types. Based on Model 2, the predicted penalties for the two couple types are 28.4 pp and 7.1 pp, respectively.

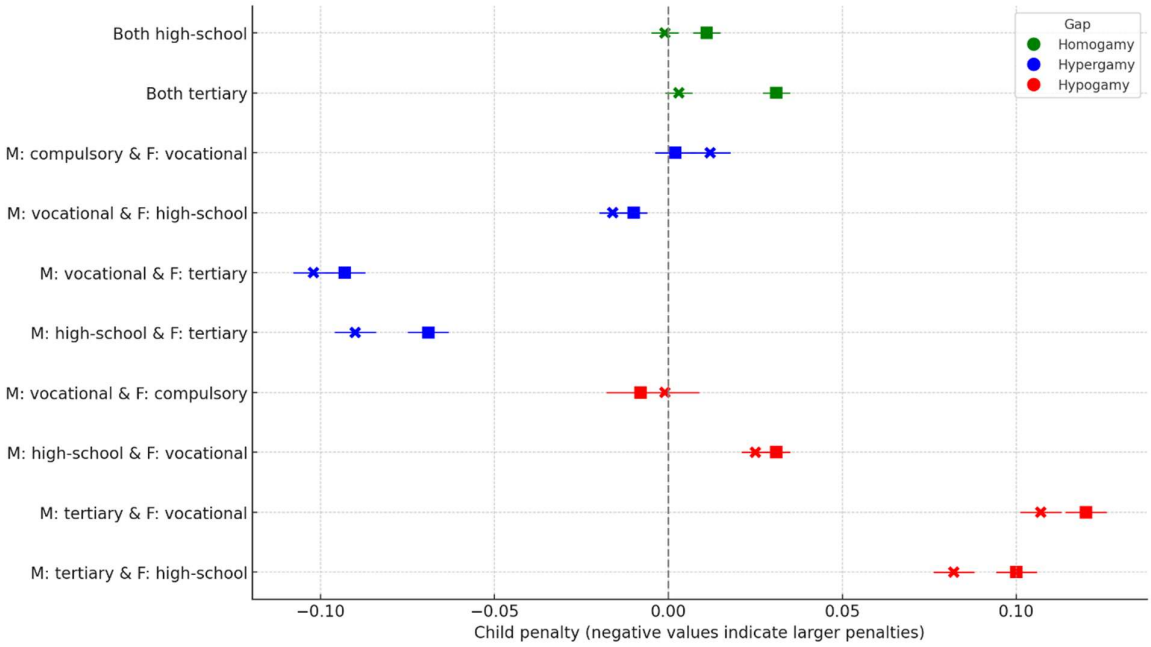


Fig. 4. Child penalty at the couple-level, by educational pairing.
Notes: The coefficient plot shows estimates (and their 95% CI) from a regression of the change in her relative earnings from t_{-2} to t_{10} on educational pairings plus controls. All effects are relative to homogamous couples where both have vocational education with an average penalty of -20% (Table 2). Five pairing types are excluded as they represent only a very 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}.

5.4 Sorting into hypogamous couples

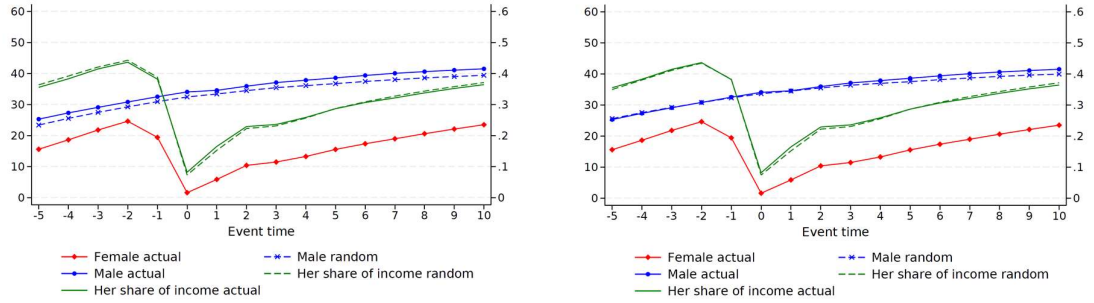
The literature suggests that hypogamous couples, where the woman has tertiary education, are negatively selected on household income, particularly on low and stagnant male earnings (e.g. finding for Sweden, by Chudnovskaya and Kashyap 2020). In a similar vein, it has been argued that individuals with a low productivity and earning potential tend to marry each other, with intertwined earnings trajectories after union formation (Dribe and Nystedt 2013; Qian 2018). If this is also true in the Austrian context, the question arises whether the comparatively small penalties for hypogamous women result from selection processes.

Research on the dynamics of sorting into hypogamous couples is scarce (but see Almås et al. 2023 for a study on selection into hypergamy), and the literature builds on a variety of mixed assumptions (see Steiber and Siegert 2024 for a review). From an assortative mating perspective, it could be argued that highly educated women tend to seek partners who are similar to them in terms of their socio-economic background (Becker 1973; Mare 1991). Thus, even if women form unions with (formally) less educated men, these men may have an income potential that is above average for their education level. A contrasting perspective, in line with gender revolution theory (Goldscheider et al. 2015), suggests that highly educated women are more likely to partner with 'modern' men who support their careers and take on a higher share of domestic labor and care responsibilities. This would imply the prediction that men's economic behavior in hypogamous couples is more gender-equal and may be associated with comparatively lower male earnings. From the viewpoint of preference-based selection, it can be argued that tertiary-educated women in hypogamous relationships who choose less educated partners — typically less progressive in their gender role attitudes — may themselves hold more traditional gender role attitudes than their counterparts in relationships with similarly educated men. This preference for gender specialization may also entail a preference for high-income men, all else being equal. Finally, some scholars argue 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).

To test for selection into hypogamous couples, we again focus on couples with a *tertiary educated woman* and examine whether hypogamous unions with a tertiary educated woman — the educational pairings with the smallest child penalties (Fig. 4) — are selected on *male* earnings. With this aim, we randomly match the tertiary-educated women in the *observed* hypogamous couples with non-tertiary-educated men (from other unions) and then compare the *observed* hypogamous couples with the *random* hypogamous couples in terms of their earnings trajectories. The random matches are conditioned on the actual level of education of the male partner (e.g., tertiary-educated women with a vocationally trained partner are matched with a man from the pool of all men with this level of education) and on the year of the birth (i.e. observed and random couples had their child in the same year).

The results of this exercise are shown in Fig. 5, which compares the (inflation-adjusted) earnings trajectories of observed couples with those of random couples (panel a). The results show that men's earnings trajectories are somewhat higher in the observed than in the random couples, indicating that men in hypogamous unions are slightly positively selected in terms of earnings. This finding is consistent with the assortative mating perspective: Highly educated women with high earnings potential tend to form unions and have children with men who also have such a high potential. The higher average earnings of men in the observed than in the random couples is due to non-random matching with respect to age (i.e., the men in the observed hypogamous unions tend to be older, cf. Annex Table A4). Indeed, once we

age-standardize earnings (panel b), the positive selection on men's pre-birth earnings in observed hypergamous unions disappears, leaving only a marginally steeper earnings profile. More importantly, the woman's earnings share (in green) is almost identical in the observed and random hypogamous couples, specifically at t_{-2} and t_{10}, i.e., the two time points that we use to calculate the child penalty in the multivariate analysis. We can thus conclude that our child penalty estimates for tertiary-educated women in hypogamous unions are *not* biased downwards due to selection on low male earnings.



(a) Not controlled for age

(b) Age standardized

Fig. 5. Earnings trajectories of observed and random hypogamous couples. *Notes*: The figure shows 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 in the observed couples 30.3 years; while it is 28.8 years in the random couples.

5.5 Discussion

The modest advantage observed for tertiary-educated women over less educated women when in *homogamous* unions, along with the lower child penalties for women with tertiary education when in *hypogamous* unions (as shown in Fig. 4), calls for a deeper investigation into the factors driving the hypogamy premium for these women. Couples where a tertiary-educated woman is partnered with a less educated man are a growing demographic group and have become a focus of analyses in other countries (Bütikofer et al. 2018; Chudnovskaya and Kashyap 2020). Also in Austria, though not yet dominant, the prevalence of such couples is steadily increasing.

A comparison of educational pairings shows that tertiary-educated women in *hypogamous* unions tend to have their first child earlier than their counterparts in homogamous unions, and their partners also tend to be younger (see Table 4 and Annex Tables A2-A4 for a comparison with other pairings). Despite earlier entry into parenthood, tertiary-educated hypogamous women are somewhat less likely to have a second child than those in homogamous unions. The multivariate analyses above (Fig. 4 and Table A6 in the Annex) indicate that among tertiary-educated women, those in hypogamous unions experience a significantly smaller drop in their relative earnings in the couple when they transition to parenthood, and that this advantage of approximately 7-10 pp remains consistent when controlling for parental age and minor differences in subsequent fertility. Returning to the event study approaches with this focus on *women with tertiary education*, we also find smaller child penalties

for the women in hypogamous compared to homogamous unions (Table 4). However, it is notable that the penalties are relatively large in both couple types: Due to childbearing, tertiary-educated women fall behind men in terms of their earnings by 39% when in homogamous unions and by 32% when in hypogamous unions, which translates into losses in terms of their earnings share in the couple by 20 pp and 16 pp, respectively. Overall, both the multivariate analyses and the event studies show that hypogamy offers some mitigation of child penalties for tertiary-educated women.

Table 4: Couples with tertiary educated women

	Hypogamous	Homogamous
Mean age mother	27.7	29.1
Mean age father	30.3	31.2
Additional child	73%	77%
Kleven penalty (1)	0.32	0.39
Musick penalty (2)	-0.16	-0.20
Av. % her earnings t_{-2} / t_{10}	44% / 36%	50% / 35%
N	16,427	19,351

Note: The table shows the characteristics of couples with a tertiary-educated woman that are either homogamous (i.e., the father is also tertiary-educated) or hypogamous (i.e., the father has a vocational or high-school education). (1) Based on Eq.1 (2) Based on Eq. 2

As has been pointed out in previous research, when examining the child penalty in terms of the woman's earnings relative to men's, it is important to decompose the child penalty into changes in her earnings and changes in his earnings (Billingsley et al. 2024; Musick et al. 2022). Descriptively, we find that tertiary-educated women in homogamous unions have more time to invest in their careers before childbirth due to their later entry into motherhood. On average, this leads to higher pre-birth earnings (green solid line at t_{-2} in Fig. 6), giving them an initial advantage over their counterparts in hypogamous unions. However, this advantage diminishes with the transition to motherhood. From t_0 onwards, average annual earnings for tertiary-educated women are similar regardless of union type. Nonetheless, as the penalty is defined by comparing pre-birth earnings with earnings at t_{10}, the estimated penalty for tertiary-educated women in homogamous unions is higher. At the couple level, tertiary-educated women in *homogamous* unions achieve a 50%-share of the couple's pre-birth earnings, while this share is around 15 pp points lower at t_{10}. The share at t_{-2} is lower for *hypogamous* women (44%) but falls less (by 8 pp to 36%, Table 4).

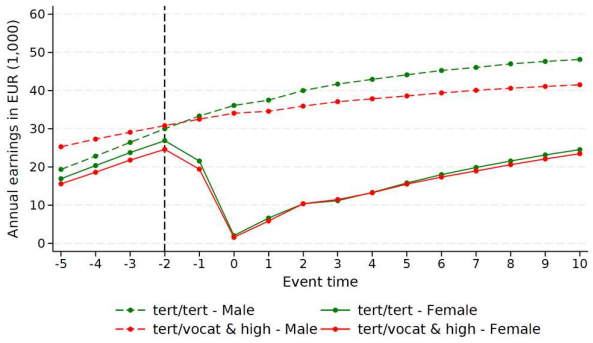


Fig. 6. Earnings trajectories for couples with a tertiary-educated woman. *Notes*: Shown are male and female annual earnings, adjusted for inflation (using CPI with base year 2015).

It is also worth noting that (tertiary-educated) men in homogamous unions have steeper earnings profiles (green dashed line in Fig. 5) due to stronger age effects on earnings than (non-tertiary-educated) men in hypogamous unions, whose earnings increase less with age (red dashed lines). Event studies control for age and time effects on earnings to isolate the effect of having children (Kleven et al. 2019). Thus, differences between couple types in the extent to which male earnings are upward sloping with age do not drive differences between couple types in the child penalty estimates from such event studies. However, it is still the case that gender earnings inequality increases for all couples when they become parents – and more so for homogamous than for hypogamous couples. Thus, by the time a second child is born, the level of gender earnings inequality may be higher for homogamous couples than for many hypogamous couples. This can amplify the costs associated with the second child for homogamous women and contribute to their disadvantage compared to hypogamous women. In line with such considerations, we find larger differences in child penalties between homogamous and hypogamous couples among those with multiple children, with a larger advantage for hypogamous women (Annex Fig. A1).

How do the different methodological approaches used in this study compare? The event studies that use the couple as the unit of analysis (Musick et al. 2020) have a clear advantage over event studies that compare average women with men: They link data from two individuals who form a couple and measure within-couple inequality. However, such approaches also have a disadvantage: They use a relative measure as the dependent variable – *the woman's share of the earnings* – and therefore all effects operate via two possible channels, his and her earnings. While in the Kleven approach, separate age and time effects are estimated for women's and men's earnings, thus effectively isolating age and time trends from child effects, in the couple-level approach, age effects can control for the increase in the gender earnings inequality within the couple that would have occurred in the absence of children. The multivariate setup has the advantage of allowing us to disentangle the effects of education from the effects of hypogamy and to show that relative education is an independent factor that can explain variation in the magnitude of the child penalty, over and above levels of education. The approach has also a disadvantage, i.e., it uses a measure of the child penalty, calculated for each couple, as the dependent variable that is *relative* in two respects: women's earnings relative to the partner and relative to the woman's pre-birth earnings. Adding controls for age to such models does not fully account for age trends in male and female earnings and thus is less effective in isolating child effects from age effects. If such models are less good than the event studies at controlling for rising gender earnings inequality that is due to upward sloping wage profiles of men, they may overestimate the magnitude of the child penalty. However, even if this is the case, the main conclusion that hypogamy shows a mitigating effect on the child penalty holds in all our analyses.

6 Conclusions

This study contributes to research on the economic consequences of parenthood with a focus on the effects at the couple level. It sheds light on how parenthood affects gender inequality in heterosexual couples, by comparing partners' relative earnings before the first birth and over a period of eleven years after entering parenthood. Compared to the event study approach proposed by Kleven et al. (2019), which examines the earnings of women relative to men but does not match women to their respective partners, the approach taken in this study uses the couple as the relevant unit of analysis when examining behavioral changes associated with parenthood. With this focus on couples, we contribute to the scarce literature on the variation in the magnitude of child penalties according to the couple's socioeconomic status. In this study, we focus on *education* as the core measure of partners' status, which has advantages and disadvantages compared to using wage potential as a basis for a measure of partners' relative economic power. Education is more than just a measure of economic power; higher education is also associated with social and cultural capital and plausibly better negotiating skills (Dribe and Nystedt 2013). Admittedly, education is not an ideal measure of earning potential, as women with the same level of education as men are often in lower paid jobs (e.g., due to their choice of field of education). However, pre-birth earnings would not have been a valid alternative measure of earning potential, given the young age at which some couples have their first child. Entering parenthood often occurs before the earning potential has been revealed, especially for those on tracks of higher education. Some previous studies that have attempted to examine the impact of partners' relative earning potential on the child penalty have had to impute each partner's earning potential based on rather strong assumptions, such as that in the absence of children, women would have similar earnings trajectories to men.[14] Overall, therefore, relative education was considered the preferable measure of women's relative status prior to the birth and one that can also be measured for those not in employment.

Using event study methods at the individual level (Kleven et al. 2019) and at the couple level (Musick et al. 2020), and stratifying our sample of 268,156 parental couples into three couple types, we consistently find the smallest child penalties for women in *hypogamous* couples (i.e., the woman has a higher level of education than her partner) and the largest penalties for women in *hypergamous* couples (i.e., the man has the higher level of education); with women in *homogamous* couples (i.e., the woman and the man have the same level of education) falling in-between. However, the differences between the three couple types are relatively modest and the penalties are large by international standards. Women in hypogamous couples lose about 20 pp of their earnings share between t_{-2} and t_{10} — about 4-5 pp less than women in homogamous or hypergamous couples. The differences are modest because many women, regardless of couple type, tend to work part-time when children are born and continue to do so for many years (in our sample, we find that by the time the first child is ten years old, around 69% of hypogamous and 74% of hypergamous women work less than 35 hours per week, Table 1).

In addition to event studies on stratified samples for each couple type, we used a more flexible multivariate approach with a dependent variable measured for each couple (i.e. the child penalty, calculated as the change in the woman's share of the couple's earnings between t_{-2} and t_{10}). This approach allowed us to disentangle the

[14] 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.

effect of the educational *level* of both partners from the effects of the woman's *relative* education in the couple, using diagonal reference models. Our results show that the level of education plays only a minor role in explaining heterogeneity in the size of the child penalty, while relative education has an independent effect: Compared to homogamy, hypogamy mitigates the penalty, while hypergamy exacerbates it. Moreover, the large register data allowed us to use a detailed measure of *educational pairings,* instead of lumping different types of couples at different levels of education into broad couple types – an approach which revealed a high degree of heterogeneity within the *hypogamous* couple type, with substantially smaller child penalties only observed for tertiary-educated women in such unions.

The different methodological approaches thus all show consistent results, but why do hypogamous women incur smaller penalties? While in other countries such as Sweden it has been found that low-productivity individuals are more likely to form hypogamous unions and that also after union formation hypogamy is associated with slow earnings development (Dribe and Nystedt 2013, Chudnovskaya and Kashyap 2020), no evidence for a negative selection into hypogamous unions or for negative effects of hypogamy on earnings growth was found in our study for Austria. Hence, selection does not explain the smaller penalties for hypogamous women. Also, the smaller penalty for hypogamous women cannot be explained by differences in their fertility behavior, either the age at first birth or higher order birth. At all events, we find no support for a *hypogamy penalty* that has been argued to arise from lower educated partners with less gender-egalitarian values or from normative pressures to conform to traditional gender roles. To the contrary, our findings show a *hypogamy premium* that is, however, unlikely to be the result of women's greater bargaining power or negotiation skills in such couples, given that no substantial child effects are found for men. Hypogamous couples do not appear to divide market work more equally as the men in such unions do not reduce their hours and earnings when they become fathers. Hypogamous couples may divide their care responsibilities and domestic chores more equally, and this has in fact been advanced as a core hypothesis in the literature. However, this does not appear to be associated with greater maternal earnings in hypogamous couples, at least not among the highly educated women in hypogamous unions who incur the smallest child penalties. A plausible explanation for the stark similarity of post-birth earnings trajectories of tertiary-educated women, regardless of union type, are counteracting mechanisms: whereas hypogamous couples may share childcare more equally (something that we cannot verify with our data), homogamous couples have greater economic resources at their disposal and may outsource more of the childcare and housework. Moreover, highly educated Austrian mothers show a high prevalence of long-term part-time work, regardless of their education and regardless of their union type. Most of the differences in the earnings of highly educated women between homogamous and hypogamous unions occur before the birth: Due to their delayed motherhood, the women in homogamous couples reach higher peak earnings than their counterparts in hypogamous unions – an advantage that is lost when the child arrives.

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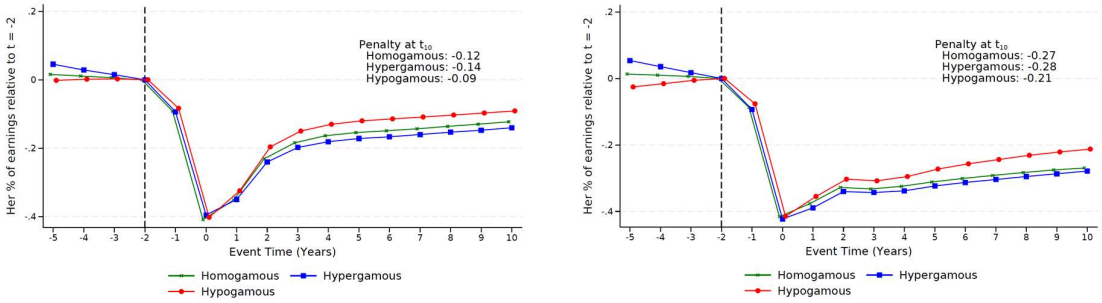
Annex

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 the balanced panel, 130,789 are due to individuals being self-employed in at least one period.

Table A1: Sample restrictions and sample size

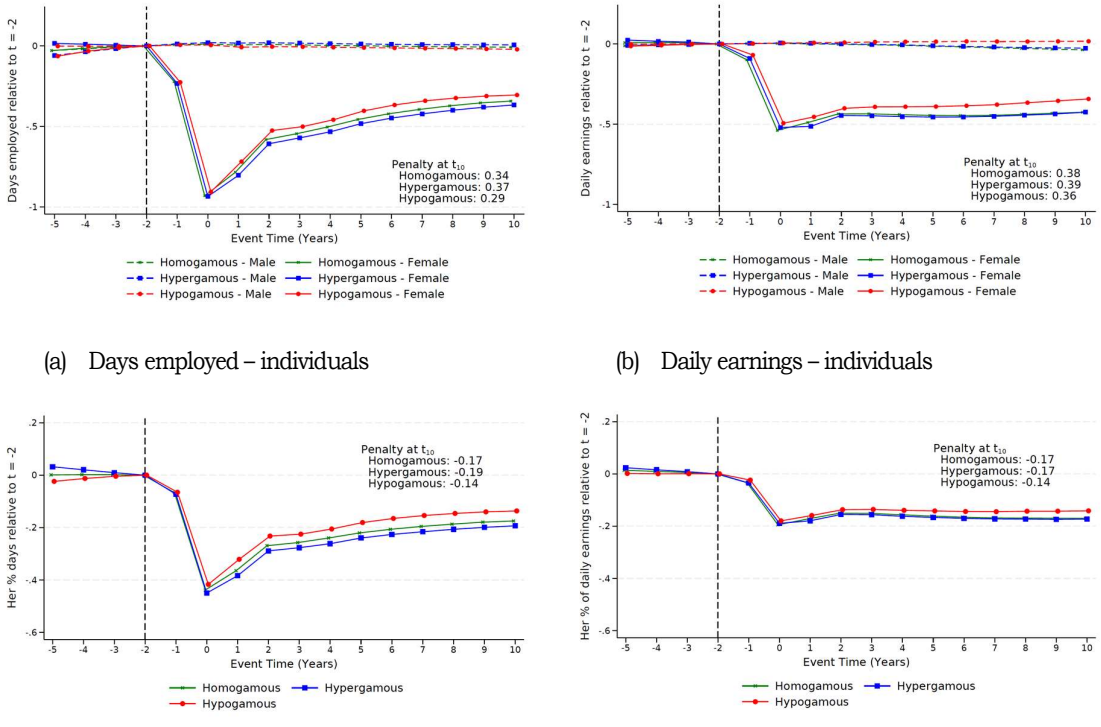
Initial sample	644,659	100%
Father unknown	41,483	6.43%
No education data on mother or father	11,835	1.84%
Age restriction	64,615	10.02%
Citizenship restriction	98,247	15.24%
Balanced sample restriction	157,899	24.49%
Final sample	268,165	41.60%

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}).



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

Fig. A1. Heterogeneity in the child penalty by number of children. *Notes*: The figure shows the child penalty in annual 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).



(a) Days employed – individuals (b) Daily earnings – individuals

(c) Days employed – couple level (d) Daily earnings – couple level

Fig. A2. Decomposition of the child penalty in annual earnings. *Notes*: The figures show estimates of the child penalty at the individual level according to Kleven et al. (2019) 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 decomposed into the woman's share of annual days worked (c) and the woman's share of average daily earnings (d), which are calculated conditional on both parents working in t_i. Given low participation, the female sample is highly selective at t_0 and t_1.

Table A2: 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	1,386	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: compulsory & F: vocational	11,991	4.5%	-0.20	51.2%	11.8%	84.7%	15.3%	60.2%
M: compulsory & F: high school	764	0.3%	-0.19	48.0%	13.8%	60.0%	40.1%	57.1%
M: compulsory & F: tertiary	283	0.1%	-0.27	43.5%	10.0%	59.7%	40.3%	55.1%
M: vocational & F: high school	23,752	8.9%	-0.21	49.5%	13.9%	44.8%	55.2%	71.7%
M: vocational & F: tertiary	6,934	2.6%	-0.29	52.0%	11.0%	60.3%	39.7%	68.3%
M: high school & F: tertiary	8,651	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: vocational & F: compulsory	3,020	1.1%	-0.19	33.3%	15.5%	71.9%	28.2%	59.5%
M: high school & F: compulsory	665	0.3%	-0.10	30.5%	21.7%	43.3%	56.7%	58.1%
M: tertiary & F: compulsory	288	0.1%	-0.01	26.4%	38.5%	45.8%	54.2%	58.0%
M: high school & F: vocational	32,935	12.3%	-0.15	47.9%	14.7%	42.4%	57.6%	71.5%
M: tertiary & F: vocational	8,543	3.2%	-0.06	47.8%	14.0%	45.8%	54.3%	71.3%
M: tertiary & F: high school	7,884	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 t10. ** This is conditional on being married at t0. Birth cohort refers to the years of childbirth.

Table A3: Descriptive statistics – mothers' characteristics

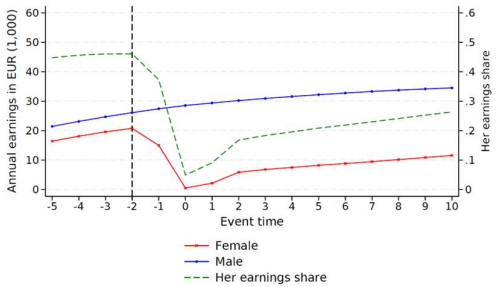
	Annual earnings in EUR at t_{-2}*	Annual earnings in EUR at t_{10}*	Age at first birth	Work experience before birth in yrs	Duration of maternity leave	Part-time rate in t_{-2} **	Part-time rate in t_{10} **
Homogamous	**22,032**	**13,773**	**26.3**	**8.0**	**624**	**14.3%**	**72.5%**
Compulsory	13,817	6,392	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: compulsory & F: vocational	16,068	7,776	26.3	8.4	598	18.7%	68.9%
M: compulsory & F: high school	16,999	8,607	26.5	7.9	639	19.1%	68.7%
M: compulsory & F: tertiary	16,491	9,590	28.5	8.0	643	13.6%	71.3%
M: vocational & F: high school	22,489	12,763	25.8	8.5	668	13.2%	76.2%
M: vocational & F: tertiary	25,621	13,711	28.0	10.0	629	13.3%	76.2%
M: high school & F: tertiary	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: vocational & F: compulsory	17,990	10,468	26.1	8.3	617	17.8%	67.5%
M: high school & F: compulsory	20,224	15,671	26.0	6.2	658	15.7%	65.3%
M: tertiary & F: compulsory	18,997	23,446	28.6	5.0	620	31.4%	56.2%
M: high school & F: vocational	23,734	16,118	25.7	6.5	657	12.0%	72.7%
M: tertiary & F: vocational	24,342	23,131	27.6	5.5	629	18.0%	61.5%
M: tertiary & F: high school	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 hours 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).

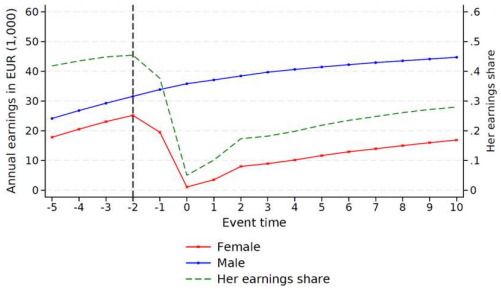
Table A4: Descriptive statistics – fathers' characteristics

	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: compulsory & F: vocational	23,121	29,783	28.9	10.7
M: compulsory & F: high school	28,156	39,167	27.7	8.1
M: compulsory & F: tertiary	20,144	37,863	31.0	5.4
M: vocational & F: high school	30,250	43,384	27.5	8.3
M: vocational & F: tertiary	27,396	45,782	30.2	6.0
M: high school & F: tertiary	30,002	48,649	30.5	6.1
Hypogamous	**27,905**	**36,668**	**29.6**	**10.7**
M: vocational & F: compulsory	19,213	24,131	30.5	9.2
M: high school & F: compulsory	19,463	23,596	31.1	8.3
M: tertiary & F: compulsory	19,517	24,285	32.7	7.8
M: high school & F: vocational	27,499	35,785	29.1	11.1
M: tertiary & F: vocational	28,529	36,9741	30.6	11.9
M: tertiary & F: high school	33,268	46,423	29.9	9.0

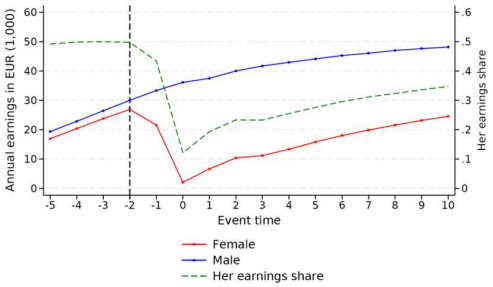
Notes: The table reports characteristics at the individual level. * Annual earnings include zeros and are adjusted for inflation (using CPI with base year 2015). Part-time rates omitted for fathers (see Table A3 for mothers) due to very low levels at both time points.



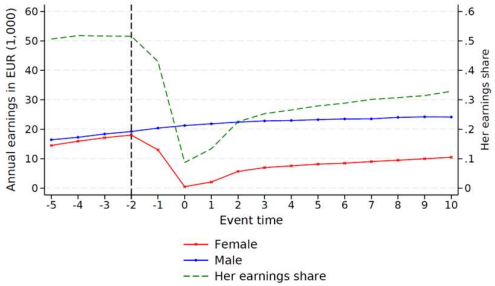
(a) Both vocational



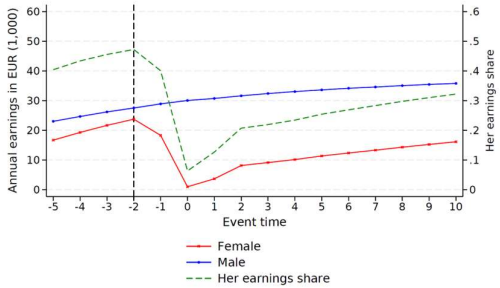
(b) Both high school



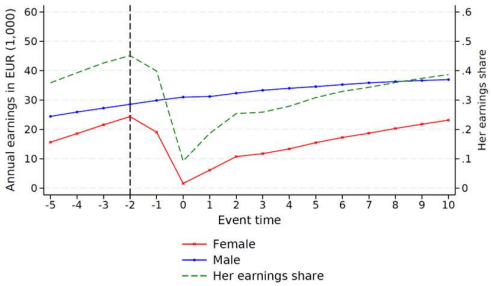
(d) Both tertiary



(a) Hypo: M: vocational, F: compulsory

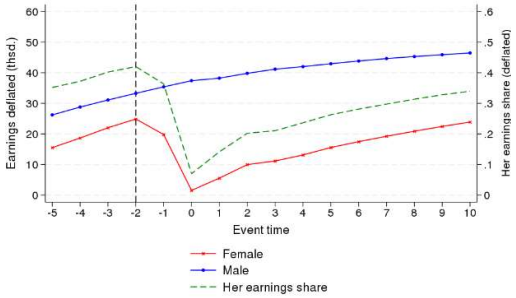


(b) Hypo: M: high school, F: vocational

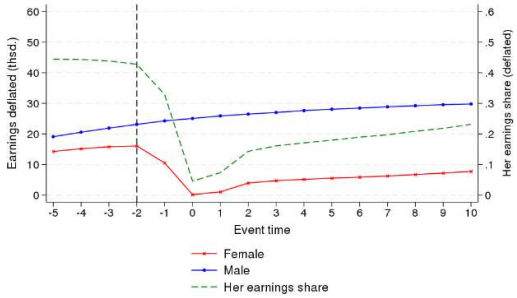


(d) Hypo: M: tertiary, F: vocational

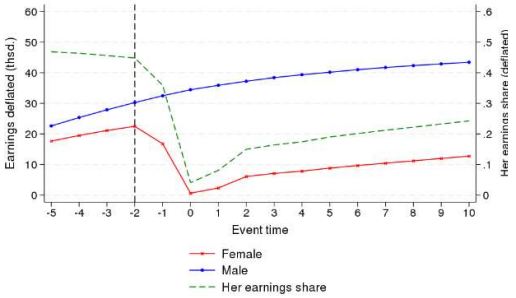
Fig. A3. Descriptive graphs of male and female earnings trajectories, by educational pairing. *Notes*: Annual earnings are adjusted for inflation (using CPI with base year 2015). The woman's mean earnings share at t_i (green) is not equivalent to her share of the average couple's joint earnings at t_i (sum of blue and red).



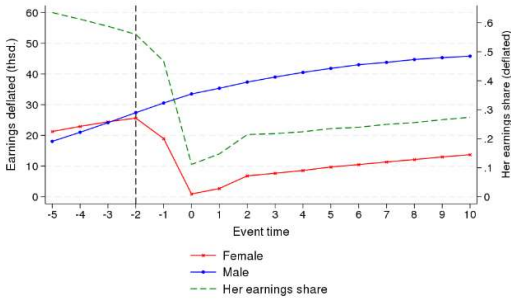
(a) Hypo: M: tertiary, F: high school



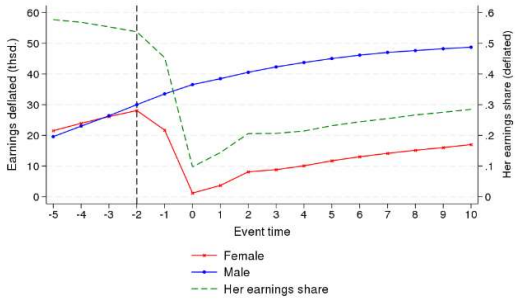
(b) Hyper: M: compulsory, F: vocational



(d) Hyper: M: vocational, F: high school



(f) Hyper: M: vocational, F: tertiary



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

Fig. A3. continued

Table A5: 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***
	(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} 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. Mean (SD) of outcome: -0.18 (0.28). *** p<0.001, ** p<0.01.

Table A6: 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 t10		-0.117***
		(0.001)
Observations	268,156	268,156
R-squared	0.045	0.089

Notes: This table shows estimation results from a regression of change in her relative earnings from t_{10} - t_{-2} 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 (<=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. Mean (SD) of outcome: -0.18 (0.28). *** p < 0.001, ** p<0.01.

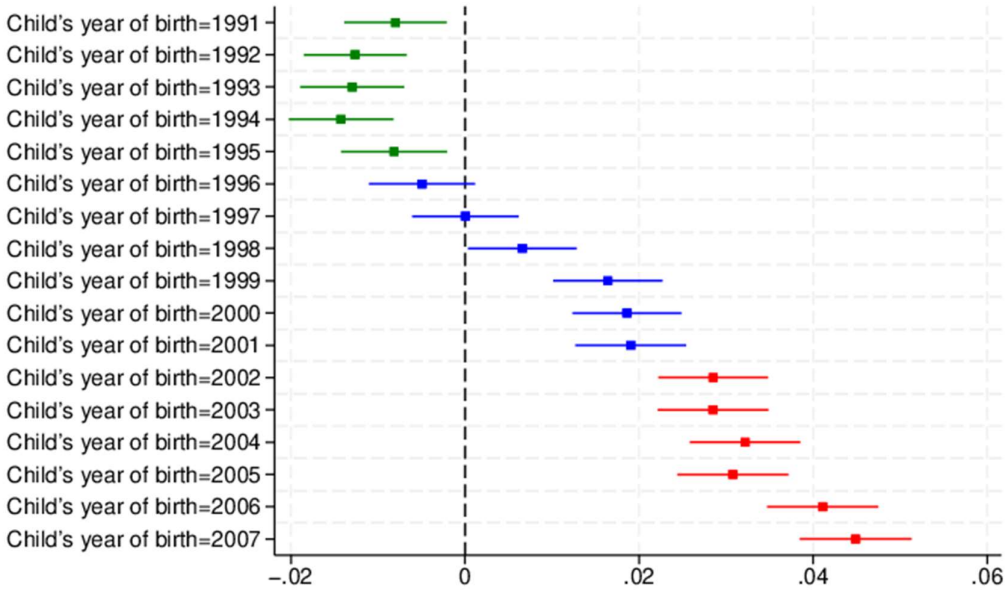


Fig. A4. Male and female earnings trajectories, by birth cohort. *Notes*: The figure shows estimates of the year effects on the child penalty (and 95% CI) based on Model 2 in Table A6.