DO GENDER ROLES DETERMINE LABOR MARKET OUTCOMES? EVIDENCE FROM DENMARK

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ABSTRACT

Using Danish administrative data, we study the impact of gender roles on gender inequality in the labor market. We make two essential findings which suggest an influence of gender roles on labor market outcomes after considering the effect of education and experience. First, more than two thirds of wives who have higher predicted earnings than their husband end up earning less than their husband. This is driven by wives underperforming their potential while husbands overperform theirs. Second, the arrival of children makes the earnings of highly educated women and men diverge sharply and persistently. Women's earnings drop immediately and barely recover within the following ten years, while the earnings of men increase with 15 percent after ten years. Although the earnings of highly educated women drop less upon parenthood than those of poorly educated women, the long-run gender gap is close to the same for high- and low educated individuals. We find no statistically significant effect of marriage on the labor market outcomes of highly educated individuals.

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1. Introduction

At first glance, Denmark seems to be a global front runner with regards to gender equality. Along with the other Scandinavian countries, Denmark was among the first to introduce paid and job-secured maternal leave and offer subsidized child-care, allowing women to balance family and career. Potentially as a result of this, Denmark has one of the world's highest female labor market participation rates, currently at 76.2 percent (World Economic Forum, 2020). The education gap between men and women has even been reversed such that today, a larger fraction of women (23.2 percent) than men (18.1 percent) hold a high-level education (Danmarks Statistik, 2020).

However, despite the above, The Global Gender Gap Report 2020 of World Economic Forum ranks Denmark 14th in the world in terms of overall gender parity, far behind their Scandinavian peers who all take the top 4 places. While Denmark obtains a top score when it comes to gender parity in educational attainment, they only rank 41st in the world when it comes to economic participation and opportunity. This is a drop of 22 places since 2006 and behind countries such as the United States (rank 26), Russia (rank 32), and Kazakhstan (rank 37) (World Economic Forum, 2020). Despite the high parity in Educational Attainment, there is still a persistent earnings gap among Danish men and women (Ibid.). This is particularly driven by women having a higher tendency than men to work part time[1] and few women reaching higher-paid jobs such as jobs within the private sector and leadership positions (World Economic Forum, 2020). In 2017, when considering full-time positions, men occupied 2/3 of the higher paid private sector jobs, while women occupied nearly 2/3 of public sector jobs (Nielsen & Larsen, 2019).

[1] A ratio of 1 to 1.6 men to women (World Economic Forum, 2020)

The same report places Denmark even further down the ranking in terms of women in leadership. Here, Denmark is ranked 102 globally out of 153 participating countries (World Economic Forum, 2020). Fewer Danish women than men make it to leadership positions in both the private and public sector, despite the proportion of women employed in each. In 2017, 44 percent of managers in the public sector and 19 percent of managers in the private sector were female (Danmarks Statistik, 2019). Furthermore, when narrowing the focus to top managers, the share of women drops further to 30.8 percent within the public sector and 12.3 percent within the private sector (Ibid). Similarly, only 27 percent of board members in Danish Large Cap companies are female[2], whereof almost half are non-Danish (Nielsen & Larsen, 2019), and half of the 1600 largest Danish companies have no women in their boards at all (Institut For Menneskerettigheder, 2018).

It can seem paradoxical that the high level of gender parity in educational attainment and labor force participation is not reflected in Denmark's leadership positions and economic participation. Many of the theories that have been offered to explain the different labor market outcomes of men and women focus on couple and household dynamics. One of the most renowned theories is Becker's theory of marriage and household division of labor (1973; 1985), which claims that getting married is essentially an income maximizing choice for two individuals. In the model, spouses are assumed to pool their resources, and each specialize in the area of production where they have a comparative advantage. The spouse with the highest comparative advantage in the labor market will thus be sent to work, whereas the spouse with the highest comparative advantage in home production will perform household duties. In this way, they obtain a higher joint income than they would each obtain individually. Other economists seem to agree with Becker, arguing that the family "is the oldest pin

[2] Including employee-elected members who constitute approximately 13 percent of board members (Institut For Menneskerettigheder, 2018).

factory of all" (Harford, 2008), referring to Adam Smith's description of a pin factory and how specialization and division of labor is vital to its success. This could also explain other findings from the literature, such as why women's earnings drop when having children, and men's earnings tend to rise after getting married (see e.g. Kleven, et al., 2019; Bertrand, et al., 2010; Bardasi & Taylor, 2008).

If Danish women systematically marry men who are comparatively more productive in the labor market as a result of their educational background, it makes economic sense that men earn more than women and have higher occupational ranks. From a societal point of view, it might even be preferred that couples divide their work to obtain the highest productivity in the labor market and in childcaring. In fact, allowing couples themselves to divide their work in the most economically efficient way is one of the main arguments for Denmark's reluctance to follow their Scandinavian peers in earmarking a significant proportion of parental leave to fathers[3].

However, other parts of the literature point to other, less rational explanations for the gender gap. There is ample evidence of discrimination against women in the labor market, stemming from e.g. unconscious biases, stereotypes, and certain beliefs about men and women (see e.g. Johnson & Kirk, 2020; Carplar, et al., 2017; Hengel, 2017; Goldin & Rouse, 2000). There is also evidence of women having different interests, goals, preferences, and qualities than men, caused by gender differences in socialization and upbringing (see e.g. Fortin, 2008; Kleven, et al., 2019; Brenøe, 2018; Gneezy, et al., 2009). This suggests that *gender roles*, referring to culturally determined expectations associated with the perception of masculinity and femininity, can serve as another root cause to the gender gap in earnings and occupational rank. This so by either fostering workplace agents to discriminate against women due to differences in

[3] Proportions of total designated leave for parent's earmarked for fathers are 4 percent in Denmark, 17 percent in Finland, 19 percent in Sweden, 33 percent in Norway, and 33 percent in Iceland (Cederström, 2019).

attitudes and beliefs about the genders, or by fostering men and women to have different aspirations and behaviors e.g. related to their choice of education and occupation.

Whether the different labor market outcomes of Danish men and women are best explained by rational income maximization arguments or culturally determined gender roles remains to be answered. On the one hand, Denmark's most powerful position, prime minster, is currently held by a woman, indicating that the country should have abolished the most traditional norms of how genders ought to behave. On the other hand, Danish women continue to take 90 percent of the parental leave around childbirth, which according to Becker's theory should imply that in these couples, the father has the comparative advantage in the labor market. This is a surprising implication if true, given the educational advancements of Danish women over the past decades.

Whereas the gender gap in earnings and occupational rank is unfavorable to women as individuals, it also impacts the economy of Denmark as a society. While women are taking up more than half of Denmark's fully subsidized university places, they are still not performing in the labor market to the same extent as men. Additionally, Denmark is missing out on well-documented performance benefits from workplace diversity, particularly in the higher management layers (see e.g. Gompers & Kovvali, 2018; Turban, et al., 2019). As a result, it is relevant to better understand the dynamics that lead to the different labor market outcomes of Danish men and women, and whether these are based on rational income maximization choices or influenced by gender roles.

1.1 Problem statement

With the aim of further informing the discussion of gender parity in Denmark, we seek to answer the following question:

Do gender roles influence the labor market outcomes of Danish men and women beyond their choice of education?

To do this, we look for evidence of two types of relevant phenomena:

1) wives earning less than their husbands despite having higher predicted earnings based on their educational background and experience; and
2) men and women with equally high levels of education responding differently to family-related events.

Finding evidence of both phenomena described above would indicate that gender roles play an important role in explaining gender differences in labor market outcomes in Denmark.

1.2 Structure of this thesis

The thesis is organized as follows. First, we review and discuss some of the relevant literature related to labor market behavior and gender. The theories and research considered in this section will aid the understanding and interpretation of our empirical results.

Secondly, we describe the methodological approach used to obtain our results. This section includes a presentation of the methodology chosen as well as the underlying philosophical assumptions that led to this choice of methodology.

Subsequently, we analyze Danish labor market data to empirically investigate whether the labor market outcomes of Danish men and women are best explained by gender

roles after controlling for human capital investments[4]. The analysis is structured in two parts; in the first part, we look for evidence of the first phenomenon described above. We do this by using OLS regressions to predict earnings for wives and husbands based on their educations and experience as if they were all men. We find that between more than two thirds of wives with higher predicted earnings than their husband in reality earn less than him. In the second part, we look for evidence of the second phenomenon described above. Here, we adopt a quasi-experimental approach based on event studies around the events of marriage and parenthood for individuals who have obtained a master's degree within information technologies, engineering, law, mathematics, or business. While we find no significant, sharp drop in earnings after marriage, we are able to prove that the birth of children causes a persistent drop in the earnings of highly educated women and a continuous increase in the earnings of highly educated men.

In sum, we find evidence of both phenomena of interest, indicating that gender roles indeed help explain the labor market outcomes of Danish men and women after controlling for human capital investments.

Finally, we attempt to gain a deeper understanding of our results from the analysis by discussing how these gender roles manifest themselves in the Danish society. We consider six scenarios: 1) couples value traditional gender roles; 2) couples imperfectly judge the labor market productivity of husbands relative to wives; 3) women are socialized to be less productive in/derive less utility from the labor market relative to men; 4) employers (consciously or unconsciously) prefer hiring men over women; 5) employers overestimate the labor market productivity of men relative to women; and 6) the labor market has not adapted to accommodate female personality traits. Based

[4] As will be defined in section 4.1, for the purpose of our analyses, the term "human capital investments" covers educational background and experience.

on previous research, we discuss which scenario best explains the results found in our analysis, with the final aim of improving the understanding of gender parity and labor market outcomes in Denmark as well as the policy implications of the current state of affairs.

2. Literature review

The following literature review aims to introduce relevant theories and empirical findings regarding labor market dynamics and how these can be influenced by gender roles. The purpose of this section is to situate our study within the scope of existing literature as well as to provide a basis for proper hypothesis derivation and interpretation of the quantitative results from our forthcoming analysis. Section 2.1 focuses on labor market dynamics including the influence of human capital investments on earnings and how discrimination and employers' cognitive biases can lead to lower earnings for certain groups of people. Subsequently, section 2.2 focuses on how men and women are socialized in different ways and how this impacts their labor market behavior e.g. through the genders' willingness to compete and couples' division of labor.

2.1 Dynamics of the labor market

In a perfectly competitive labor market with perfect information, firms are assumed to pay each worker their expected marginal product, where the productivity of each worker depends on randomly distributed innate skills and acquired human capital (Lundberg & Startz, 1983). Many economists have attempted to explain the underlying mechanisms for how individuals develop and apply their skills and abilities over their lifetime, as these individual decisions shape the labor market outcomes of individuals and thereby collectively shape society.

2.1.1 Human capital and choice of occupation

One of the first economists to examine which factors affect individuals' choice of occupation was A. D. Roy (1951). Prior to Roy's research, the common belief was that the distribution of income arising from economic processes was completely arbitrary. However, based on a simplified society of hunters and fishers, Roy set up a model to theoretically prove that individuals self-select into professions based on their comparative advantage in an occupation with the purpose of maximizing their earnings. This means that their choice of occupation depends on the fundamental distribution of skills and abilities in society and the correlation between these skills in the population, the technology available to use these skills, and consumer tastes that impact demand for different types of outputs (Roy, 1951). The model thus concludes that income inequality will naturally arise in a society where people have different talents, different occupations reward these talents differently, and people choose occupations to maximize their income.

A few years later, Becker (1962) elaborated on Roy's suggestions (1951) by in addition to recognizing different innate skills among workers, also recognizing the value of developing skills through training. In an attempt to break further with the common view at the time that labor basically consisted of an undifferentiated mass of workers, he was the first to formalize the now famous "human capital theory". Becker defines investment in human capital as "*activities that influence future real income through the imbedding of resources in people*" (Becker, 1962, p. 9). The earnings of an individual should thus reflect their level of human capital, i.e. the qualities and abilities that make them productive. Knowledge is an important constituent of human capital, and education can therefore be viewed as an investment in human capital and thereby future productivity (Becker, 1962).

According to Becker, investments in human capital should pay off for people, and well-educated people should earn more than their less educated counterparts. This explains why we observe students taking on debt to pay for university in the expectation of higher future earnings. Becker's theory can thus help explain the spread of education over time; with longer life expectancy, the expected payoff from investing in human capital in the form of education increases. He assumes individuals to be rational, welfare-maximizing agents; they should compare the expected future earnings of e.g. different educations and acquire human capital up until their marginal cost of this investment is equal to the resulting increase in their earnings from the investment (Becker, 1962).

2.1.2 Discrimination

Taken together, Roy (1951) and Becker (1962) argue that individuals are rational, welfare-maximizing agents that will invest in human capital and self-select into certain occupations to maximize lifetime earnings. The assumption until now has been that employers are similarly rational and reward the productivity of their workers. In reality however, we observe many different wage rates for similar jobs and for employees that seem equally productive. Much research has gone into understanding the drivers behind these differences that go beyond an individual's abilities and level of human capital.

One potential explanation that has been offered of why such differences in earnings persist, is the presence of discrimination. In Denmark, discrimination – defined as direct or indirect differential treatment of individuals based on characteristics such as race, skin color, religion, sexual orientation, and gender – is illegal (Beskæftigelses-ministeriet, 2019). It is based on the principle that it should be the qualifications of a worker, and nothing else, that determines whether that individual is offered an open position or a promotion (Ibid.). Despite such laws, which are in place in many countries around the world, researchers continue to find differential treatment of workers of

similar qualifications. In most of the literature, two categories of discrimination have been investigated; taste-based discrimination and statistical discrimination.

Taste-based discrimination

One of the first researchers to introduce an economic model of discrimination was Gary Becker in his book *The Economics of Discrimination* (1957). In Becker's model, some individuals (be that employers, co-workers or clients) will have a "taste for discrimination" and will require a compensation for the disutility of working with those they discriminate against. For example, if an employer has a taste for discrimination against a certain minority group (e.g. women), members of this group will have to compensate employers by either being more productive at a given wage or accepting a lower wage for the same productivity (Becker, 1957). Likewise, discriminatory co-workers will require a wage premium to work with members of the minority group, resulting in wage differentials unrelated to productivity. Finally, the averseness of discriminatory customers to purchase goods or services provided by the minority group will lower the labor market return to minority group workers (Ibid.).

Identity economics

Somewhat related to taste-based discrimination, Akerlof and Kranton (2010) have created a theoretical model of economic utility which includes identity as a salient variable. In this model, there are two social categories; men and women. These men and women and the environment they operate in possess certain norms and ideals, which in the context of gender and labor market outcomes means that certain tasks are labeled as appropriate for women, i.e. "women's jobs" while others are labeled "men's jobs". They then argue that due to a sense of identity, women lose utility from working in a man's job, just as the same happens to men working in a woman's job. Additionally, men working in men's jobs lose utility if working alongside a woman in a man's job. This model thus results in an equilibrium where employers mainly hire

men for men's jobs and women for women's jobs, and where no firm has an incentive to change these societal gender norms as any advantage arising from this would be quickly eroded by competition – the cost would therefore be too high compared to the benefits for the individual firm. Discrimination and occupational segregation thus persist due to the societal beliefs that men and women should perform certain jobs, regardless of individual tastes and abilities. According to the model, the only way to change these dynamics is by implementing society-wide changes that remove gender tags from jobs.

Statistical discrimination

While widely acknowledged, models of taste-based discrimination have also received critique. For example, some critics have pointed out that Becker's (1957) theory itself predicts that discriminating firms will be less profitable than non-discriminatory competitors, and taste-based discrimination should thus be competed away in the long run (see e.g. Aigner & Cain, 1977; Guryan & Charles, 2013; Arrow, 1971).

To overcome these flaws, Arrow (1971) and Phelps (1972) proposed an alternative to taste-based discrimination, which has later been further developed by Aigner and Cain (1977). Under this alternative model of so-called statistical discrimination, equal productivity does not result in equal pay, but employers and workers also have no "taste for discrimination", i.e. their utility does not decrease from working with certain groups. Instead, the model predicts, employers have limited information in the sense that the productivity of each worker cannot be perfectly observed. Because of this limited information, they become inclined to use group identity (e.g. gender) as a signal of the productivity of a given worker based on a group-specific mean productivity. Under statistical discrimination, while there is not equal pay for equal productivity, there is equal pay for equal *expected* productivity. Rational, optimising behavior in an environment of limited information (and not a preference for discrimination) can thus

lead employers to favor one group over another (Arrow, 1971; Phelps, 1972; Aigner & Cain, 1977).

Aigner and Cain (1977) furthermore distinguish explicitly between group discrimination and individual discrimination. They argue that individual discrimination is inevitable, but that this does not imply group discrimination. As an example, they present a scenario where all college graduates are offered one wage equal to their average productivity and higher than the wage offered to all high-school graduates. While it is very likely that this scenario entails individual discrimination (except if all college graduates happen to have the exact same abilities), it does not denote between-group discrimination. Meanwhile, group discrimination in labor markets becomes obvious when the average wage of a group is not proportionate to its average productivity, and groups with the same average ability thereby receive different average pay (Aigner & Cain, 1977).

2.1.3 Cognitive biases

A large body of literature within the field of psychology has been dedicated to understanding systematic cognitive errors that humans commit, also known as biases (Kahneman, 2011). Some of these findings have also been found of relevance for economics, and especially for the purpose of understanding seemingly unexplainable differences in labor market outcomes between e.g. men and women. For example, cognitive errors can lead to inaccurate statistical discrimination where employers miscalculate group-specific mean productivities, or they can lead to dynamics similar to those of taste-based discrimination.

Attribution bias

One cognitive error that has been found to result in differential treatment of groups in the labor market is known as *attribution bias*. This happens when there is a systematic variation in whether individuals attribute information to internal or external factors.

When receiving information that matches their expected outcome, individuals are usually unbiased. However, when observing an unexpected outcome, individuals need to revise their beliefs: were they wrong, or was the outcome simply an anomaly? This is where attribution bias has been found to play an important role, as individuals tend to rely (either consciously or unconsciously) on stereotypes or deeply rooted beliefs when processing new information (Fiske & Taylor, 1991, as cited in Sarsons, 2017). As a result of such bias, employers might hold flawed expected productivities of groups (e.g. women) and thereby rely on inaccurate statistical discrimination. An example of how such a bias could influence labor market outcomes is presented by Sarsons (2017). In her research, she examines how physicians make referrals and finds that physicians tend to believe that male surgeons are better than female surgeons. Because of attribution bias, this results in physicians systematically attributing good news about female surgeons to external factors (e.g. luck) and bad news to internal factors (e.g. ability), and the converse for male surgeons.

Intergroup bias

Another cognitive error that has been proven at play in the labor market is that known as *intergroup* or *ingroup bias* (see e.g. Balliet, et al., 2014; Dovidio, et al., 2017; Hewstone, et al., 2002). Intergroup bias describes the systematic tendency of individuals to evaluate members of their own group more favorably than others, beyond what would be objectively legitimate in a given situation (Hewstone, et al., 2002). Gender can be one such group; ingroup bias can then lead male employers to

favor men for jobs and promotions over women (just as the opposite could be the case) (Ibid.).

2.2 Differences between genders

Much research has also gone into examining how gender differences in labor market behavior can be explained by the process of gender socialization. Gender socialization is defined as "*A process by which individuals develop, refine and learn to 'do' gender through internalizing gender norms and roles as they interact with key agents of socialization such as their family, social networks and other social institutions"* (Unicef, 2017, p. 6)[5]. Which factors influence this process and how it manifests itself in individuals has been a topic of great interest among researchers over the years. For the purpose of this paper, it can provide a better understanding of why we observe gender differences in labor market outcomes.

2.2.1 Environmental influence

Gender socialization prior to labor market entry has been found to be an important determinant of an individual's labor market outcomes and occupational choices (see e.g. Eccles & Hoffman, 1984; Marini & Brinton, 1984). While many environmental factors in the upbringing of boys and girls affect the process of gender socialization as described above (e.g. family, friends and institutions), family background has received a great deal of attention in the literature.

For example, looking at which factors influence socialization processes prior to labor market entry, Marini and Brinton (1984) find family factors to be the most salient ones. Parents do not only serve as role models for their children, they also treat

[5] For the remainder of this paper, the concepts of 'gender socialization' and 'sex role socialization' will be used interchangeably in accordance with the UNICEF definition provided in this section.

daughters and sons differently and thus encourage them to develop different personalities; for example girls are often encouraged to be more passive and compassionate and less mathematical than boys (Eccles & Hoffman, 1984; Marini & Brinton, 1984). Furthermore, the sex-based division of domestic and market labor in families forms the basis for much of children's gender differences in behavior and attitudes and thereby has a significant effect on the occupational orientation of children. Boys see their fathers as role models while girls are likely to follow in their mothers' footsteps, leading to consistency over generations of traditional sex roles and thereby also occupational segregation. Both Marini & Brinton (1984) and Eccles & Hoffman (1984) find that the fact that women from very young ages aspire and expect to enter "female" occupations due to these early socialization processes are the reason that occupational segregation in the labor market exists.

By comparing first-born girls who grow up with a younger brother to first-born girls who grow up with a younger sister, Brenøe (2018) also finds family influence to have an important effect on women's gender conformity. She proves that women with second-born brothers are subject to more gender-specialized parenting, resulting in a stronger transmission of traditional gender norms. This ultimately leads to negative consequences for the labor market earnings of these women (Ibid.).

Another set of researchers that link family sex-role socialization with real labor market outcomes are Corcoran and Courant (1987). By examining a sample of young adults in 1981 in the US, they examine whether family factors believed to influence gender differences in aspirations also influence education and job choice. What they find is that pre-labor market differences between boys and girls may have an important effect on adult labor market outcomes. The results suggest that parents' differential treatment of boys and girls advantages boys once they enter the labor market by teaching girls to value behaviors that are relatively unprofitable in the labor market

(Corcoran & Courant, 1987). Furthermore, the research finds evidence that mothers' occupations influences daughters' future occupation, suggesting that sex-role socialization affects the labor market of women.

Similarly, Kleven, Landais and Søgaard (2019) show how changes in women's labor market behavior in response to having children is dependent on their mothers' labor market responses to having children. This result again supports the theory of sex role socialization as it confirms that certain gender differences in labor market outcomes are the result of differences in socialization processes between boys and girls – in this case how girls form their identities during childhood based on the gender roles of their parents (Kleven, et al., 2019, p. 183). Kleven et. al. moreover conclude that the large gender gap still observed today in Denmark is largely unrelated to differences in educations or preferences but is instead caused by the presence of children. In conclusion, they find that the arrival of children creates a long-run gender gap in earnings of around 20 percent, driven by hours worked, participation, and wage rates.

2.2.2 Gender differences in personality traits

The role of potential gender differences in non-cognitive skills and personality traits is another area that has received a great deal of research attention in the context of gender specific labor market outcomes. Empirical results suggest that such differences are indeed apparent among men and women, and evidence moreover indicates that sex role socialization and environmental factors play a key role in explaining them.

One specific personality trait that has received a great deal of attention in the research of gender differences is that of self-confidence. Another explanation as to why men and women differ in their occupational choices is offered by Furnham, Crawshaw and Rawles (2006), who examine gender differences in how individuals estimate their own IQ scores. They found that men tend to overestimate their intelligence and abilities,

while women tend to underestimate theirs. This underestimation of their own abilities could e.g. lead women to invest less in human capital, as it can result in an overestimation of the costs of choosing an occupation that requires a significant human capital investment.

Fortin (2008) further proves that men have higher self-esteem than women by investigating the impact of four noncognitive traits on wages among young workers in the US. These four traits are self-esteem, external locus of control (the belief that one's outcomes are controlled more by external than internal forces; luck vs. effort), the importance of money/work, and the importance of people/family. She finds that self-esteem and the importance of money/work have positive effects on wages, while locus of control and the importance of people/family have negative (but not always significant) effects. Low self-esteem and external locus of control are associated with lower investment in human capital, due to an expectation of low return on these investments. According to Fortin (2008), the proportion of men stating that "the chance to be a leader" and "having lots of money" (both components of the money/work composite) is important for them in their careers and lives exceeds that of women by around 10 percentage points. Meanwhile, the proportion of women who place high importance on "opportunities to work with people rather than things" and "opportunities to be helpful to others or useful to society" (both components of the people/family composite) exceed that of men by more than 10 percentage points. Gender differences in these noncognitive factors can thus help explain the gender wage gap. The fact that the factor with the highest explanatory power is the importance of work/money moreover supports the "negotiating divide hypothesis", a theory introduced by Babcock and Laschever (2003). Babcock and Laschever find that women feel less entitled to ask for promotions or higher wages than men do and are therefore less likely than men to initiate negotiations (and thereby also less likely to ultimately be promoted).

Somewhat related is the personality trait of competitiveness which is also argued to help explain why men have higher wages and generally reach jobs of higher status than women.

Gneezy, Niederle and Rustichini (2003) conducted laboratory experiments with engineering students at university to test their hypothesis that women are less effective than men in competitive environments. They find a significant gender gap in competitiveness: the more competitive the environment, the better the performance of men, while the performance of women does not increase with competitiveness. This gender gap in performance is not present when the participants are simply rewarded for their own performance, without any relation to other's performance (i.e. a non-competitive environment). Furthermore, the results show that the gender performance gap is smaller when women compete only against other women, suggesting that the reason is not that women are uncapable of performing in competitive environments. The researchers also propose an explanation for why women in Western societies might perform better when competing only against other women. Similar to the theory of statistical discrimination, Gneezy et al. (2003) suggest that women may perceive the gender of their competitor as a signal of their ability and thus believe that they have worse chances of winning when the competitor is male. This is much in line with the findings of Furnham, Crawshaw and Rawles (2006) on how women tend to underestimate themselves.

In a subsequent but related study, Gneezy and Rustichini (2004) conduct a similar experiment but with school children aged 9-10 years. Here, the children are to run races both individually and in competitive environments, to see how their performances differ. Again, the results suggest that, relative to a non-competitive environment, competition improves the performance for boys but not for girls. However, the newer study did not find the same effect of same-sex competition improving the performance

of girls (performance stayed constant from single race to races between two girls). The fact that the phenomenon of competition improving male performance is found in two such distinct studies suggests that competitiveness can indeed be a significant factor in understanding gender differences in labor market outcomes.

To further understand what drives these differences in competitiveness between men and women, Gneezy, Leonard and List (2009) investigate the gender differences in competitiveness in two distinct societies: the patriarchal Maasai society in Tanzania and the matrilineal Khasi society in India. They find competitiveness in the Maasai society to be similar to that of Western societies; men compete at circa twice the rate as women. However, in the matrilineal Khasi society, women select competitive environments more frequently than men, and even more frequently than the mean man in the Maasai society. This reveals that the gender differences in competitive behavior and potentially other gender specific personality traits observed in Western societies are indeed shaped by socialization processes, rather than genetic differences between men and women.

Similarly, Niederle and Vesterlund (2007) further examine self-selection of genders into competition, i.e. whether men and women are equally likely to select into a competition. The experiment they conduct involves a "tournament" with relatively simple and short math problems, where men and women are believed to have the same abilities. They also find a significant difference in competitiveness between men and women. Despite no gender difference in performance in the specific task, men were twice as likely to enter the competitive tournament. Examining the payoff-maximizing choices of the participants, they find that low-ability men enter the tournament too much, and high-ability women do not enter it enough (Niederle & Vesterlund, 2007, p. 1069). Possible explanations range from simple differences in preferences for competing across genders, to the greater risk-aversion of women and their tendency of

underestimating their own ability relatively to men, much in line with the findings of both Gneezy, Niederle and Rustichini (2003), Gneezy and Rustichini (2004), and Furnham, Crawshaw and Rawles (2006). The results indicate that gender differences in confidence are an important factor in explaining some of the gender gap in competition entry. This is relevant because, "*if women are less likely to compete, this not only reduces the number of women who enter tournaments, but also those who win tournaments. Hence, it decreases the chances of women succeeding in competitions for promotions and more lucrative jobs*" (Niederle & Vesterlund, 2007, pp. 1067-1068). The findings of Niederle and Vesterlund (2007) can also be related to Babcock and Laschevers negotiation divide hypothesis (2003), suggesting that gender gaps in labor market outcomes are the result of women's aversion for negotiations, if viewing negotiation processes as a two-person competition. Likewise, with this view, the results of Gneezy, Niederle and Rustichini (2003) and Gneezy and Rustichini (2004) also confirm the hypothesis of Babcock and Laschever (2003) that when forced to compete, women fail compared to men.

2.2.3 Gender specific division of labor in response to marriage and children

Finally, a great deal of literature has been dedicated to examining how family-related events such as marriage and parenthood may affect the labor market outcomes of men and women differently.

Becker (1973), the father of the human capital model introduced earlier, was also one of the first researchers to apply an economic model to marriage and its effects on the labor market. In *A Theory of Marriage*, Becker builds on his own model of human capital and on Roy's model of self-selection (1951) and argues that people do not only think about maximizing income when choosing their occupation, but also when choosing whether to marry and who to marry. With the help of several simplifying

assumptions, Becker presents an equilibrium model of the "marriage market", where the gain from marrying as opposed to remaining single depends on a man and woman's income, human capital, and relative difference in wage rates. Individuals will only marry if marriage raises their utility relative to being single.

Later on, Becker (1985) dives deeper into the gender-specifics of choice of occupation, and why marriage can help explain some of the gender differences in these choices. He argues that couples will exploit the increasing returns from specialized human capital and the gains from trade when allocating time between market work and housework. He moreover proposes that this division of labor will decrease married women's effort on each hour of market work relative to married men's, since housework and childcare activities are more effort intensive than leisure and other activities that men may engage in. Not only will this result in married women having lower hourly earnings than married men with the same market human capital, but the effect will reinforce itself as married women "*economize on the effort expended on market work by seeking less demanding jobs*" (Becker, 1985, p. S33). The increasing returns from specialized human capital thus end up creating a significant gap between the human capital investments, occupation choices and time allocated to the labor market between men and women. According to Becker, any gender wage differences are due to gender-role specialization by married women and men, and marriage thus has a negative impact on female earnings, but a positive effect on male earnings. While Becker builds his argument on married women having the primary responsibility for housework, he recognizes that household division of labor should actually be unrelated to gender and rather be based on comparative advantages in home production and labor market production. If none of the genders were pre-determined to specialize in domestic labor, we should see husbands specialized in housework and wives specialized in market activities in about half the marriages, and the reverse in the other half (Ibid.).

Becker's argument that married women may economize on their efforts by seeking less demanding jobs is confirmed by Flyer and Rosen (1997). In their research, they find that women tend to cluster in occupations such as teaching, which provide flexibility in the form of low wage penalties due to labor force interruptions associated with the care of children. Similarly, the research shows that individuals who already anticipate devoting less time to labor market activity choose less risky occupations, further reinforcing why women are more risk-averse and cluster in certain occupations.

Adding to this discussion, Gronau (1988) agrees with Becker in how the differences in earnings between men and women are related to the fact that women invest less in market human capital. However, he argues that this is not only due to the large effort women invest in childcare and housework, but also in response to the expectations of employers that women are more likely than men to drop out of the labor market to care for their children once they have them. However, Gronau goes a step further than Becker in his analysis, and questions which effect happens first; whether women have lower wages because they interrupt their careers and care for their children, or whether women interrupt their careers because they have lower wages due to the pre-existing expectations of employers that women will interrupt their careers.

Along the same lines, Mincer & Polachek (1974) also argue that because women expect to be in and out of the labor force, they invest less in human capital in the form of education and skills as these investments will only provide a return if the women work. Women thus have weaker incentives to augment their market skills over their life cycle, just as employers have less incentives to invest in the worker skills of female workers. This is presented as the main reason why occupational segregation occurs and persists, and why women end up in jobs where less human capital investment is required (Mincer & Polachek, 1974). Viewing the family as one economic unit, they argue that a division of labor and differentiation of roles will naturally occur in families due to

the differential skills and comparative advantages of its members in an attempt to promote family life and maximize income for the family unit.

While focusing on the effect of marriage on the wages of men rather than women, the findings of Bardasi and Taylor (2008) are much in line with the theory proposed by Becker (1973; 1985). They test Becker's specialization hypothesis by examining the relationship between marriage and wages among British men in 1991-2003 and find a wage premium for married men that can be largely attributed to the productivity advantages of married men over single men arising from specialization within the household. This premium can be due to more time available for investment in market-specific human capital for married men, or that the wife contributes directly to the husband's human capital. It is also suggested as a plausible explanation that employers discriminate in favor of married men if marriage is associated with unobservable features such as loyalty, reliability, and ability. Finally, it is possible that the causal effect happens the other way around; high-wage men may be more likely to marry (Bardasi & Taylor, 2008).

In summary, Becker and most of the theorists discussed above present the differential impacts of children and marriage on the labor market outcomes of men and women as the result of a 'rational' marital division of labor (or the expectation of this). However, a great deal of research has also gone into challenging these theories by instead exploring how gender socialization processes and gender roles offer an explanation for the gender differences in the impact of these family-related events.

One example of such is the "identity model" of Akerlof and Kranton (2010) presented earlier (cf. section 2.1.2), which also applies to the division of labor in married households. According to traditional gender norms, women *should* do the housework. Following their model, this means that if a man performs the housework or if a woman

does *not* perform the housework, either of them will lose utility. This results in an equilibrium where even when a woman is responsible for the majority of the family's income, she is also still performing the majority of the housework (Akerlof & Kranton, 2010). Furthermore, the model claims that women will generally have a lower attachment to the labor market because of these society-wide gender norms that state that women are "supposed to" stay at home, raise children, and thus move intermittently in and out of the labor market – something men are not supposed to do.

While looking for empirical evidence of sex role socialization, Corcoran and Courant (1987) (also discussed in section 2.2.1) furthermore examined how married couples divide labor among them; specifically, whether valuing traditional sex roles can explain the labor market behavior of adults. They test this empirically by examining a sample of couples where the wives' predicted earnings are higher than the husbands' predicted earnings and looking at how they divide labor within the household. This is done under the hypothesis that if couples solely aim to maximize income, as is suggested by e.g. Becker (1973), then these "unusual" couples should also have an untraditional division of labor, where the wives' actual income exceeds the husbands'. If this is not the case, it must prove that individuals place a certain value on traditional sex roles, as suggested by Akerlof and Kranton (2010). They find that the empirical evidence on labor division in "unusual" couples suggests that maintaining traditional sex roles is indeed more valuable to couples than income maximization, and potentially that different tastes that can arise from socialization leading to these different behaviors in men and women.

Another researcher who proves Becker's hypothesis of income maximization wrong is England (1982; 1984), who also suggests sex role socialization as a better explanation of gender segregation in occupations. She strongly disagrees with the suggestion of

human capital theorists such as Becker, Mincer and Polachek that individuals select occupations to maximize their lifetime earnings, and that these choices will differ between men and women largely due to the childbearing responsibilities of women. Testing these human capital hypotheses, England (1982; 1984) finds that women find no pecuniary benefits nor are penalized less for intermittent labor force participation by selecting sex-typical occupations. Contrary, her results suggest that women pay a net wage penalty when selecting female occupations, and would have higher wages if employed in occupations containing more males (all else equal). By disproving the hypothesis that women maximize lifetime earnings by choosing "female" occupations, England simultaneously suggests that other, nonpecuniary motivations such as sex role socialization provide better explanations for occupational sex segregation.

In addition, Kleven, Landais and Søgaard (2019) claim that the theories of differences in human capital and labor market discrimination are no longer relevant as the similarity of men and women's educations increases and anti-discrimination policies have been implemented. Instead, they find children to be the primary driver of gender inequality. Their results show that the share of gender inequality attributed to children has increased from 40 percent in 1980 to 80 percent in 2013. While women and men evolve on similar paths initially, they diverge immediately after the birth of their first child and do not converge again (Kleven, et al., 2019). The authors define the percentage amount that women lag behind men in earnings as a result of children as the "child penalty". They report the long-run child penalty in women's earnings to be around 20 percent in the period 1980-2013 and increasing with the number of children (Ibid.). The results are driven by sharp changes to labor force participation, hours worked, wage rates, occupation, sector, and firm choices. Meanwhile, the authors show that the effect of women investing less in human capital or pursuing family-friendly careers in anticipation of children has been decreasing. As discussed in section 2.2.1, Kleven et. al. (2019) moreover find that child penalties are actually transmitted

through generations, indicating that environmental factors such as culture, social norms, or discrimination explains the persistence of the child penalty.

Finally, to determine the effect of women's human capital investments relative to the effect of societal factors, Bertrand, Goldin and Katz (2010) investigate gender differences in income for graduates with equally high levels of human capital in the form of education. They use a sample of MBA students graduating between 1990 and 2006 from the prestigious business school of the University of Chicago and follow their career and income progressions over several years following graduation. While male and female graduates have almost identical income from the labor market immediately after graduation, their earnings eventually diverge, with men earning significantly more than women 10-16 years after graduation. The researchers find three factors explaining the differences in earnings between genders: differences in business school courses and grades; differences in career interruptions; and differences in weekly hours worked (Bertrand, et al., 2010, p. 230). Furthermore, they find children to be the most important element explaining all three factors described – female MBA graduates with children are found to reduce their activity in the labor market after their first child, thereby having less experience, greater work discontinuity and less work hours than their male counterparts. This is an interesting finding that arguably contrasts a bit with those of the other researchers discussed in the present section, just as the findings of Kleven et. al. (2019) do. Where much research finds that education explains most of the gender wage gap, Bertrand and her colleagues find that even for individuals that are nearly identical in terms of education and human capital and who start off with the same salaries, a gender wage gap eventually arises.

2.3 Conclusive remarks

In summary, many researchers have examined what drives gender differences in occupations, wages and general labor force participation.

Traditional economists argue that differences in the labor market outcomes of men and women are essentially due to differences in their human capital investments, as varying levels of human capital should lead to varying levels of labor market productivity, which will be reflected in wages (Becker, 1962). Becker (1973; 1985) further argues that gender differences in human capital investments result in different comparative advantages for husbands and wives that lead each spouse to specialize in the area in which they are relatively best, be that domestic labor or market labor.

In reality however, it is not necessarily the case that workers are equally rewarded for their marginal productivity. Much research has therefore also been dedicated to understanding why some employers may reward men and women differently for the same productivity, and both discrimination (Becker, 1957; Arrow, 1971; Phelps, 1972; Aigner & Cain, 1977) and cognitive biases (Kahneman, 2011; Sarsons, 2017) have been offered as potential explanations.

Others argue that the gender differences in labor market outcomes can be related to the different socialization processes men and women go through (Eccles & Hoffman, 1984; Marini & Brinton, 1984). These different socialization processes may result in different utility preferences and personality traits for men and women, that ultimately lead to the observed gender differences in labor market outcomes. Indeed, a long line of research documents that environmental factors influence the gender conformity of women's labor market behavior (e.g. Brenøe, 2018; Kleven, et al., 2019). Recognizing these potential gender differences in utility preferences, Akerlof and Kranton (2010) present a theoretical model of economic utility which includes gender as a salient variable. Their model explains why spouses will not necessarily specialize in domestic and market labor according to where they have the comparative advantage. Rather, women may be more likely to specialize in the home and men to specialize in the

market due to the different gender roles they have adopted through their respective socialization processes.

3. Methodology

The following sections present the methodology of our study, including advantages and drawbacks related to it. Section 3.1 reviews our research approach and design together with the philosophical assumptions behind it. Section 3.2 describes our data sources and some special characteristics of it. Section 3.3 explains essential assumptions for our analyses. Finally, section 3.4 concludes on the quality of our research by exploring its validity and reliability as well as highlighting its limitations. Detailed explanations of our empirical strategies and sample selections are provided in the subsequent analyses in section 4.

3.1 Research approach and design

Our study relies mainly on the philosophical assumptions of internal realism. The ontology of internal realism assumes that there is one single reality which is independent of the observer and can only be accessed by collecting indirect proofs of what fundamental processes take place in this reality (Easterby-Smith, et al., 2015). At the same time, we follow a positivistic approach and assume that the social world is of an external existence and that its characteristics are best revealed through objective methods such as observations and measures rather than through subjective sensations and intuition (Ibid.). Due to this assumption, we will translate our problem statement into a set of hypotheses that can be objectively tested (the hypotheses will be presented in section 4). At the same time, we acknowledge that gender roles, the phenomenon that we look for evidence of in this study, are a socially constructed concept that need not exist. Such an acceptance that some parts of reality are socially constructed is usually associated with the methodological approach of social

constructionism. However, as our goal is not to disclose how these social phenomena are constructed, but rather to establish truth based on objectively observed correlations and causalities, we claim that our approach remains positivistic.

Following this positivistic approach, we examine whether the labor market outcomes of Danish men and women are best explained by gender roles (the central question of this study), by looking for quantitative evidence that can prove or disprove our hypotheses. Such a quantitative strategy is preferred over qualitative methods when investigating a well-defined problem which has been explored previously (Creswell, 1994). Studies using quantitative methods are usually orchestrated to empirically test predetermined hypotheses developed on the grounds of existing theory through the process of deductive reasoning (Weathington, et al., 2012). This entails that the theoretical structure of the study is determined at the first stage of the research process while the parameters to be observed are also clearly defined before the analysis begins (Creswell, 1994). We follow this deductive reasoning process by taking a top-down approach and constructing our research question based on prevalent literature as outlined in section 2 and testing it with quantitative analyses, to ensure the highest level of objectivity.

3.2 Data collection and treatment

It is typical for economic research to make use of secondary data to explore new patterns and relationships within existing public data and statistics (Easterby-Smith, et al., 2015). The present study follows this approach and makes use of different types of secondary data to answer the research question.

The first type of secondary data used is high-quality administrative data on the full Danish population in the time period 1987-2011. This quantitative data constitutes the main object of analysis used to test our hypotheses and is thus an essential source for

the study. We have been granted access to the administrative data by Statistics Denmark which is the central authority for Danish statistics. They collect, process and publish statistic data on the Danish society and population (Danmarks Statistik, 2020) and can thus be considered one of the most objective and reliable sources of data in Denmark. The data we use is a combination of several registers that encompass rich information on education, earnings, occupation, spouses, children, and several other variables, and enable us to track and link individuals of the Danish population over time through their personal identification numbers. The data is panel data of nature as it is comprised of several periods of cross-sectional data, i.e. observations on several characteristics of certain individuals over a period of time. Some of this data is then used to construct derived measures such as the natural logarithm of earnings or earnings indexed to a certain point in time.

Worth noting for this data is that Statistics Denmark does not allow us to present individual information. As a result, for any of our presented summary statistics, minimums and maximums have been converted to show bottom 1 percentiles and top 1 percentiles, just as medians show percentiles 49-51. We have also constructed our graphs with this limitation in mind. Accordingly, in our cumulative income distribution graphs, maximum values represent an average of the top 5 values.

All quantitative analyses in this paper are conducted using the statistical software program Stata. Codes are available on request.

The second type of secondary data employed is qualitative and includes existing literature in the form of theories, analyses, and scientific conclusions. Taken together, this is used to establish a knowledge base upon which we are able to 1) build our hypotheses; 2) build models to test our hypotheses; and 3) accurately interpret and discuss the results from our analysis.

3.3 Assumptions

Before we can properly discuss the validity of our research, including whether the measures employed in our research design are accurate, we need to review the assumptions behind our analyses.

3.3.1 Assumption 1: Competitive labor markets

We assume that without the existence of any potential gender roles, the Danish labor market is competitive. This means we assume that the labor force is homogenous except for their varying levels of human capital, and that an individual's earnings reflect the value generated by that individual in the labor market as there are no wage makers and takers. When controlling for human capital levels, an individual's earnings should thus reflect other labor market outcomes of that individual such as labor market participation, hours worked, occupational rank, and sector (public/private) as these outcomes should be directly related to the individual's value generation. Following previous research, such as Corcoran and Courant (1987), we define market-related human capital level as a function of education and years of work experience. However, by including not only level but also field of education, we recognize that educations vary in effort requirements and in subsequent returns on the labor market, as has been widely proven in the literature (see e.g. Brown and Corcoran, 1997; Daymont & Andrisani, 1984)

3.3.2 Assumption 2: Equal productivity at home production

For the interpretation of our results, we have furthermore assumed that men and women are equally talented at home production. According to Becker (1985), each spouse should specialize in the area in which they have a comparative advantage. This means that if a wife has a slight advantage over her husband in the labor market, but a much larger advantage over him in home production (i.e. the wife has a comparative

advantage in home production), it is most efficient for the wife to specialize in domestic activities while the husband specializes in market activities. However, given our assumption of equal productivity at home production, this scenario becomes impossible, and wives who have an absolute advantage in the labor market (in the form of higher predicted earnings than their husbands) will automatically also have the comparative advantage in the labor market.

We argue that in most aspects, men and women should indeed be born equally talented at home production. While there are undoubtedly certain childcaring activities that men are simply biologically unable to perform, such as breastfeeding, there are no biological reasons why women should be better than men at cleaning, cooking, or laundering. If the majority of women are in fact better at these domestic activities than men are, it is more likely due to different socialization processes for each gender than different innate talents of how to operate vacuum cleaners and washing machines; devices only quite recently introduced to the humankind. As clarified in section 4.1.4, among the wives we identify to earn less than their husbands despite having higher predicted earnings, the wives' predicted earnings are on average 21-42 percent higher than their husbands' predicted earnings across cohorts. Since a rational division of labor depends on comparative advantages, it thus seems unlikely that a slight absolute advantage of women within a subcategory of home production (child-caring) sufficiently explains why some women specialize in the home when they have large absolute advantages in labor market production.

For these reasons, we believe that the assumption of equal productivity in home production is appropriate for the purpose of this study. We furthermore argue that even if the assumption of equal productivity in home production does not hold, then gender roles and socialization processes are still the root cause of the majority of these gender differences in endowments (e.g. cooking and cleaning talents). This means that

our conclusion is actually the same independently of whether the assumption holds or not; in both scenarios, the different labor market behavior of men and women seems to be best explained by different gender roles of men and women.

3.4 Quality of research design

3.4.1 Validity and reliability

Following the positivistic research approach, we consider our research valid and reliable if the measures used provide a good approximation of the underlying concepts of interest and if our research makes it possible to eliminate plausible alternative explanations (Easterby-Smith, et al., 2015).

Looking at validity first, we are especially concerned with the extent to which measures and research findings provide an accurate representation of the things they are supposed to be describing (Easterby-Smith, et al., 2015, p. 343). In the case of this study, measures and research findings are ultimately supposed to describe whether gender roles provide the most plausible explanation for Danish labor market outcomes. Specifically, we investigate this by clarifying if spouses' division of labor can be explained by comparative advantages or not, and how men and women of similar backgrounds react to marriage and parenthood in terms of labor market outcomes.

To ensure construct validity of our research, we have constructed our measures for labor market outcomes and human capital based on theory and previous literature discussed in section 2. We have moreover based our choice of model variables in each part of the analyses on acknowledged research within the field. Our results corroborate previous findings on the topic (as will be discussed in section 5), furthermore suggesting a strong degree of criterion validity. However, while we consider our chosen measures to be an accurate representation of the concepts of interest, there are still certain

aspects of our analyses that could hamper the validity of our research. These include violations of OLS assumptions and omitted variable bias for our first analysis and complications regarding the identification of long-run effects for our second analysis. These aspects are further specified under limitations in the following section.

Finally, research is considered reliable if it would be possible for future researchers to conduct the same research and reach the same conclusions (Easterby-Smith, et al., 2015). The fact that we rely on administrative data and not on surveys or other types of sources that could risk altering the consistency of our measures across time and observers adds to the reliability of our study. In section 4 we moreover document and describe in detail all methods of data collection and analysis applied to examine the research question at hand. With this in mind, it should be possible for any other researcher to easily investigate the same topic and obtain the same results as us by following these procedures and employing the same data (Ibid.).

3.4.2 Limitations

In our first analysis, we use an OLS regression model to predict the earnings of Danish individuals (presented in detail in section 4.1). To confidently trust the model, certain assumptions need to hold. We test and discuss these assumptions in section 3.4.3 below and find that some of them do not hold fully. Based on these findings, we conclude that there may be omitted variable bias in our predicted earnings model. This seems plausible. Needless to say, the model is likely to be very endogenous. To predict an individual's earnings, we only include education and experience as proxies for human capital. While we do believe that in a fair labor market, these should be some of the salient components of market-related human capital, we recognize that various other factors such as abilities and effort can also be relevant human capital levers that affect one's earnings. Meanwhile, those same variables may also influence e.g. one's choice of education, making the model endogenous. Although these variables are difficult to

measure, abilities could e.g. be approximated via primary school grades. Unfortunately, this data is only available from year 2001 and does therefore not apply to our samples. Hence it is important to be aware that some of the effects attributed to education and experience in our model may actually be the result of omitted variables, leading to potentially biased parameter estimates (Stock & Watson, 2015). While this is far from ideal, we have based our choice of variables in the model on acknowledged research within the field, and we thus still believe our model provides the best description of the concepts of interest with the available data. Nevertheless, the model should not be interpreted without this limitation in mind.

Furthermore, it is worth mentioning that our variable for labor market experience has been constructed as years since completion of highest obtained education. It therefore represents an individual's potential labor market experience rather than precise labor market experience, i.e. it does not take it into account if an individual has been out of both work and education for some time. Another relevant concern regarding our results could be whether women who marry men with lower predicted earnings than their own have unobservable characteristics that depress their actual income, or similarly, whether men marrying women with higher predicted earnings than their own have characteristics that accelerate theirs. That being said, it is important to note that our first analysis simply examines relationships, and not causalities.

In our second analysis, we exploit within-person variation in an event study design and find a causal relationship between parenthood and earnings trajectories of highly educated men and women. However, this relationship is mostly compelling for short-run effects, since the identification of any long-run effects necessitates stronger assumptions than the usual smoothness assumptions required in event studies. Moreover, in addition to the robustness checks outlined in section 4.2.1, there are other identification checks which could have been useful to further check children's causal

impact on the earnings of highly educated men and women. Inspired by Kleven et. al. (2019), this could for example have been in the form of a difference-in-difference event study design, comparing individuals who have children to individuals of the same gender who never have children.

Finally, our conclusions from the analyses are based on certain simplifying assumptions about the Danish labor market, as described in section 3.3 above. Moreover, while our analyses are able to infer that gender roles seem to be a good explanation for the labor market outcomes of Danish men and women, they do not confirm the detailed underlying mechanisms of how this is the case. Instead, this will be discussed in section 5. Similarly, our paper is agnostic about the societal welfare implications of our results, but simply highlights that the labor market behavior of Danish men and women seems better explained by gender roles than by rational income maximizing behavior. It is also worth noting that much of the existing literature on which we base our discussions is related to other countries than Denmark (often the US). Ideally, research related to only the Danish labor market would provide a better basis for interpretation, but such research of relevance for this study is unfortunately scarce. However, we consider it reasonable to assume that some of the proven drivers of labor market outcomes for men and women in other Western cultures may also help explain the gender gap in Danish labor market outcomes.

In summary, we consider our models and thereby our results to be valid and reliable in understanding the relationship between gender roles and labor market outcomes in Denmark. However, the simplifying assumptions on which the analyses are built and the risk that relevant variables are omitted from our predicted earnings model should be kept in mind when interpreting our results.

3.4.3 OLS assumptions for analysis I

To confidently report the results from the predicted earnings model and analysis I, it is necessary to check whether certain assumptions of OLS models hold. If not, this can affect the reliability of the model. These assumptions include; (i) there should be a linear relationship between the dependent and the independent variables; (ii) no large outliers should disproportionately influence the model; (iii) the residuals should be independently and identically distributed (i.i.d.) as well as normally distributed; (iv) the variance of the error term should be homogenous (homoskedasticity); and (v) there should be no perfect multicollinearity (Stock & Watson, 2015).

Assumption (i) can be checked by plotting the dependent variable against the various independent variables to reveal whether the relationships are indeed linear. Such plots of our dependent variable, *ln(earnings),* against the independent variable *experience* can be found in Appendix A. From these plots we see that the relationship between *ln(earnings)* and *experience* shows a slightly curvilinear relationship. This makes intuitive sense; as people have more experience, the marginal effect of extra experience is lessened. For this reason, we include both experience and experience squared as explanatory variables in our model. Assumption (i) thus holds. We do not report plots of the dependent variable against any other independent variables, as the remaining independent variables are categorical variables and thereby automatically linear (Stock & Watson, 2015).

To make sure assumption (ii) holds, we have excluded extreme outliers from the sample as will be described in section 4.1.1. Additionally, the use of the natural logarithm of earnings further mitigates this problem by giving less weight to individuals that should still earn far more (or less) than the rest of the sample. It thus seems reasonable to accept assumption (ii) as valid for these models.

Assumption (iii) of i.i.d. residuals is expected to hold given that all the observations from our samples have been independently drawn from the Danish population, and no repeated measures to the data have been taken at several time points. When it comes to the normality of the residuals, there are several ways to check whether the residuals are in fact normally distributed. These include visually examining a histogram of the residuals as well as P-P and Q-Q plots of the residuals. Such displays have been created for each of the relevant regression models and can be found in Appendix A. All four regression models show similar residual trends. The histograms of residuals show that the residuals are mostly centered around 0, but with some negative skew. The P-P plots show a slightly inversed S-shape, while the Q-Q plots show a deviation from normality in the lower tail. These figures all suggest that the residuals are not exactly normally distributed, but instead have some negative skew. This can be due to the fact that all men in the working force and with a positive income have been included in the sample. Some men with very low incomes will have lower earnings than predicted, resulting in negative residuals. However, the P-P plot suggests that the median is correctly specified. We conclude that assumption (iii) of normally distributed residuals does not hold completely, but this is not of great significance for our results. A regression model with non-normal residuals still provides unbiased estimates of the regression coefficients as long as they are i.i.d. The departure from the normality assumption only potentially affects the validity of the p-values for t- and F-tests of the model (Stock & Watson, 2015).

Assumption (iv) of homoskedasticity can be tested by visually examining a plot of the residuals against the fitted values of the regression. If the residuals are homoskedastic, there should be no obvious pattern to their distribution, suggesting constant variance. Conversely, a cone-shaped distribution indicates heteroskedasticity of the residuals. As can be seen from the plots appended in Appendix A, while the residuals in this case do not show a clear cone-shaped distribution, they do not seem random enough to be

considered homoskedastic. As is best practice in empirical studies, we employ heteroskedasticity robust standard errors to account for this.

Finally, assumption (v) of no multicollinearity implies that there is no perfect linear relationship among the predictor variables. This assumption can be checked by computing the variance inflation factors (VIFs) of the different variables. Generally, the rule of thumb is that variables with a VIF above 10 are at risk of multicollinearity (Stock & Watson, 2015). Similarly, if the mean of all the VIF values is significantly larger than 1, this can also indicate some degree of multicollinearity (Ibid.). The VIF values for the different models have been computed and are presented in Appendix A. As can be seen from the table, *experience* and *experience*^{2} are highly collinear for all cohorts, which makes sense given the obvious relationship between the variables. However, this multicollinearity is not expected to have any adverse impact on the reliability of the model, as it does not change the p-values of the variables nor the R^2 of the model, and the collinearity could be easily fixed by centering the variables (i.e. measuring them in deviations from the mean). Furthermore, the VIF for *Basic programmes and qualifications* has a very high value. This can be due to field of education being a categorical variable, and as can be seen from table 6 in section 4.1.3, the proportion of cases in the reference category is quite small. This will necessarily result in high VIFs for the other variables, even if they are not associated to each other. The implications of this are that the p-values for the different education variables may be somewhat unreliable; however, nothing else in the regression is affected, and it thus is not expected to significantly impact the reliability of our model. While assumption (v) does not fully hold for our model, it is not deemed an important limitation in interpreting our results.

In sum, we see that our predicted earnings models partly adhere to the OLS assumptions required for reliability of the regression. The limitations of not adhering

fully include that the p-values and standard errors of individual estimates may be slightly inaccurate. However, as we are simply concerned with the coefficients of the estimators and the validity of the model as a whole, the issues described in this section, while important to keep in mind, are not considered to diminish the usefulness of our models for prediction purposes.

4. Analysis

Through this analysis, we seek to better understand whether the labor market outcomes of Danish men and women are best explained by gender roles after controlling for human capital investments. The analysis is structured in two parts; in analysis I (section 4.1) we look for evidence of wives earning less than their husbands despite having higher predicted earnings based on their educational background and experience; and in analysis II (section 4.2) we look for evidence of men and women with equally high levels of market-oriented human capital responding differently to family-related events.

4.1 Analysis I: Predicted and actual earnings of husbands and wives

In analysis I, we want to examine if gender roles influence Danish labor market outcomes by investigating how the relative actual earnings of husbands and wives compare to their relative predicted earnings. As outlined in section 2, economic theories predict that the spouse with the highest human capital level should have the intra-couple comparative advantage in the labor market. Thus, without the presence of gender roles, couples should divide work such that the spouse who has made the best human capital investments and thereby has the highest predicted earnings specializes in the labor market, while the other specializes in home production. As a result of women's educational advancements, we expect that many wives, particularly in young

cohorts, will have higher predicted earnings than their husbands. However, due to existing theory and evidence of e.g. sex role socialization and gender discrimination (also discussed in section 2), we hypothesize that few of these will have higher actual earnings because gender roles lead women to specialize in home production rather than in labor market production.

Specifically, the purpose of this section will be to test hypothesis 1:

H1: Wives have lower actual earnings than their husbands despite having higher predicted earnings

If we confirm this hypothesis, it suggests that gender roles do play an important role in understanding Danish labor market outcomes. If we disprove the hypothesis, it suggests that gender roles are irrelevant for the division of labor in Danish households since couples simply divide their labor according to what is most efficient from a productivity perspective.

We will first build a model to predict the earnings for married couples based on their human capital investments, defined as their educational background and level of experience. We will then examine how the relative actual earnings of the spouses compare to their relative predicted earnings. Specifically, we will compute the share of wives that have lower actual earnings than their husbands despite having higher predicted earnings. As we are also interested in how the impact of gender roles has evolved over time, we will investigate couples with wives born in four different cohorts: 1947, 1955, 1963, and 1971 and observe each couple when the wife is 40 years old. We find labor market outcomes at age 40 to be of interest since most individuals will be well underway with their careers at this time. Furthermore, most women who have children will already have had them at this age, while very few (if any) should be

deliberately scaling down on their careers due to age or retirement. For these reasons, age 40 is a good time to observe the couples to be able to capture enduring and systematic differences in husbands' and wives' labor market behavior.

Analysis I will be structured as follows. Section 4.1.1 presents our samples for the predicted earnings model and the couples to be analyzed. Section 4.1.2 presents our empirical strategy. Section 4.1.3 presents relevant descriptive statistics of our samples. Section 4.1.4 presents the results from the predicted earnings model as well as from the analysis of couples. Finally, section 4.1.5 interprets our results and concludes.

4.1.1 Sample selection

Model for predicting earnings

For the predicted earnings model, the sample will only include men. Other studies that have constructed models for determining the potential earnings of men and women include Bertrand et al. (2015) and Corcoran and Courant (1987). Both of these studies create separate models for men and women under the assumption that men and women will have different potential earnings despite having the exact same human capital characteristics. These studies thus take the presence of gender roles as a given.

Meanwhile, the purpose with our analysis is to confirm or disprove the influence of gender roles in the Danish labor market. As discussed in section 2, women are likely to earn less than men due to the presence of gender roles. This can e.g. be because they have developed a preference for domestic work, and therefore seek jobs that are less demanding than what their qualifications allow for. Meanwhile, they might also be discriminated against in the labor market due to employers holding biases, stereotypes, and beliefs about the genders. For this reason, we choose to use only men to construct our predicted earnings model, since without the presence of gender roles,

men and women with similar human capital levels should be able to realize the same earnings in the labor market.

We observe men across our four cohorts of interest at age 40. This means that we create separate predicted earnings models for men born in 1947, 1955, 1963, and 1995, based on observations from 1987, 1995, 2003, and 2011 respectively. By creating separate models for each cohort, we account for potential changes over time in the payoffs to education and experience. To account for the fact that some of the husbands that we later want to predict earnings for will be both older and younger than the wives from our cohorts of interest, we add two extra predicted earnings models for men born in 1939 and 1979. Since we only have data available from 1987-2011, these men cannot be observed at age 40. Instead, men from cohort 1939 will be observed in 1987 at age 48 and men from cohort 1979 will be observed in 2011 at age 32.

We exclude individuals who are not active participants in the labor market, i.e. individuals who are students, retired, disabled, or on leave, as well as anyone with non-positive earnings in the given year of observation. We moreover exclude individuals who have not completed primary school ("folkeskolen", 9^{th} grade). Immigrants are excluded since many of these lack data points, while e.g. culture and language abilities may also impact their earnings dynamics relative people who have grown up in Denmark. Finally, we remove a couple of extreme outliers that would otherwise risk distorting our estimates. To use a consistent approach across cohorts, we define extreme outliers as individuals with earnings more than 20 standard deviations from the mean. Table 1 below provides an overview of the constructed models and their respective sample sizes. Descriptive statistics of the samples can be found in section 4.1.3.

Table 1: Overview of samples

Cohort	Year observed	Sample size
1939	1987	25,276
1947	1987	36,822
1955	1995	30,448
1963	2003	33,045
1971	2011	30,503
1979	2011	23,704

Couples to be analyzed

We look at couples within our cohorts of interest when the wife is 40 years old. This means we include married couples where the wife is born in year 1947, 1955, 1963, and 1971 as well as their husbands. To observe the wives at age 40, the couples will thus be analyzed in year 1987, 1995, 2003, and 2011 respectively. Couples are excluded if any of the spouses are students, on leave, retired, or disabled. We also exclude couples where one of the spouses is an immigrant as well as couples where the age difference constitutes a sample outlier based on the IQR-rule[6] to obtain a more homogenous sample. Finally, we exclude couples if one of the spouses has missing data on education or other variables that makes it impossible to predict the individual's earnings.

This leaves us with a sample size of 27,005 couples in cohort 1947; 20,169 couples in cohort 1955; 20,190 couples in cohort 1963; and 17,793 couples in cohort 1971. Descriptive statistics of the samples can be found in section 4.1.3.

4.1.2 Empirical strategy

For each cohort of men, we run the following OLS-regression:

$$\ln(E_i) = \alpha_0 + \beta_1 exp_i + \beta_2 exp_i^2 + D_1 edu\_level_i + D_2 edu\_field_i$$

[6] The IQR-rule states that any observations more than 1.5 times the inter-quartile range greater than the third quartile or smaller than the first quartile represent potential outliers. We have excluded couples with age differences that exceeded either of these extremes for each cohort.

where earnings are predicted as a function of experience, experience squared, level of education, and field of education. A detailed overview and description of each variable can be found in table 2. We follow a long list of researchers in using education and experience to explain variation in earnings (see e.g. Corcoran & Courant 1987; Brown & Corcoran 1997; Daymont & Andrisani 1984), and in employing the natural logarithm of earnings rather than levels to avoid overweighting the few that earn significantly more or significantly less than the rest of the sample (even after the most extreme outliers have been removed) (see e.g. Bertand et. al, 2010). We run the regression using robust standard errors to account for heteroskedasticity.

Table 2: Overview of variables

Dependent variable	**Name**	**Description**
Natural logarithm of earnings	$\ln(E_i)$	Total annual income including the value of all perks and stock options as well as net profits for self-employed.
Independent variables	**Name**	**Description**
Education level	edu_level_i	Dummy variable for level of highest attained education (ranging from primary school/"folkeskole" to PhD/ researcher).
Field of education	edu_field_i	Dummy variable for classification of field of the highest attained education based on the 38 ISCED-subgroups developed by UNESCO.
Labor market experience	exp_i	Proxy for labor market experience constructed as year of observation minus year of completion of highest obtained degree (i.e. years since the individual finished his education).
Labor market experience squared	exp_i^2	

Based on the predicted earnings model outlined above, we predict earnings for each spouse in the sample couples. The wives' earnings are predicted using the model made specifically for their respective cohorts. Since the husbands' ages may vary, their earnings are predicted using the model that comes closest to their year of birth. This is to account for time trends such as wage inflation and business cycles that could

impact their earnings path. An overview of the husbands' year of birth and the cohorts used to predict their earnings is provided below.

Table 3: Overview of regression models

Husband's Year of Birth	Relevant Predicted Earnings Model
1976-1977	1979
1968-1975	1971
1960-1967	1963
1952-1959	1955
1943-1951	1947
1936-1942	1939

4.1.3 Descriptive statistics

Model for predicted earnings

Table 4 below describes the distribution of earnings, the natural logarithm of earnings, and experience for the samples of men used to make our predicted earnings models.

Table 4: Summary statistics for regression model

	Mean	Median	Min	25%	75%	Max	SD	*Sample*
Earnings								
1939	226,697	196,514	9,104	158,533	256,142	1,162,540	149,516	*25,276*
1947	227,083	202,576	11,948	165,536	259,553	957,348	123,584	*36,822*
1955	281,345	250,833	11,477	205,347	323,483	1,219,133	158,618	*30,448*
1963	368,387	321,468	17,700	259,692	421,909	1,789,301	230,005	*33,045*
1971	466,909	405,306	20,052	322,973	529,226	2,566,495	320,034	*30,503*
1979	377,059	360,171	14,513	290,314	443,434	1,448,052	191,168	*23,704*
ln(earnings)								
1939	12.17	12.19	8.94	11.97	12.45	13.91	0.62	*25,276*
1947	12.21	12.22	5.46	12.02	12.47	14.59	0.55	*36,822*
1955	12.41	12.43	4.81	12.23	12.69	14.89	0.60	*30,448*
1963	12.67	12.68	5.44	12.47	12.95	15.52	0.59	*33,045*
1971	12.90	12.91	0.00	12.69	13.18	15.63	0.62	*30,503*
1979	12.71	12.79	9.34	12.58	13.00	14.12	0.61	*23,704*
Experience								
1939	16.82	17.00	6.86	17.00	17.00	22.23	1.25	*25,276*
1947	15.85	17.00	1.00	17.00	17.00	24.00	2.65	*36,822*
1955	18.70	19.00	1.00	16.00	22.00	25.00	4.77	*30,448*

	Mean	**Median**	**Min**	**25%**	**75%**	**Max**	**SD**	*Sample*
1963	17.85	19.00	1.00	15.00	21.00	27.00	5.08	*33,045*
1971	16.50	18.00	1.00	13.00	20.00	27.00	5.35	*30,503*
1979	8.57	9.00	1.00	5.00	11.00	17.15	4.11	*23,704*

The statistics show that the average earnings of men have increased, although it is important to keep in mind that this is not corrected for inflation. Furthermore, from cohort 1955 to cohort 1971, men's average years of experience in the labor market have decreased by 2.2 years. This is consistent with the increase in level and thus years of education shown in the subsequent table 5, since the experience variable is a proxy constructed as years since completing highest attained degree.

Tables 5 and 6 below describe the education level and fields of education of the samples of men used to make our predicted earnings models. "High school" includes high school and vocational training, "Short H.E." (sometimes referred to as "Short higher edu.") includes professionally oriented programs, "Medium H.E." (sometimes referred to as "Medium higher edu.") includes bachelor's degrees and the equivalent, "Long H.E." (sometimes referred to as "Long higher edu.") includes master's degrees and equivalents, and "PhD and research" includes doctoral degrees and longer research educations.

Table 5: Distribution of level of education for regression models

Level of edu.	**Primary school**	**High school**	**Short H.E.**	**Medium H.E.**	**Long H.E.**	**PhD and research**	*Sample*
1939	36.8%	43.4%	3.2%	10.9%	5.5%	0.1%	*25,276*
1947	26.3%	49.1%	4.2%	13.1%	7.1%	0.3%	*36,822*
1955	26.5%	48.9%	4.6%	11.6%	8.0%	0.5%	*30,448*
1963	21.2%	52.9%	6.2%	11.2%	7.6%	1.0%	*33,045*
1971	15.6%	47.9%	9.0%	14.3%	11.9%	1.3%	*30,503*
1979	13.0%	49.2%	8.0%	14.6%	14.5%	0.7%	*23,704*

Table 6: Distribution of field of education for regression models

ISCED	**Field of education**	**1939**	**1947**	**1955**	**1963**	**1971**	**1979**
1	Basic programmes & qualifications	38.6%	28.7%	31.2%	26.9%	20.7%	19.5%
11	Education	3.5%	3.7%	3.5%	1.3%	2.4%	2.5%
21	Arts	2.6%	2.4%	1.6%	1.1%	2.1%	2.2%
22	Humanities (except languages)	0.2%	0.4%	0.5%	0.4%	0.9%	1.1%
23	Languages	0.1%	0.6%	0.6%	0.3%	0.9%	0.9%
30-31	Social and behavioral sciences	0.2%	0.9%	1.0%	1.2%	2.1%	2.5%
32	Journalism and information	0.3%	0.4%	0.5%	0.5%	0.8%	0.8%
41	Business and administration	12.9%	14.2%	10.5%	15.3%	17.1%	16.8%
42	Law	0.7%	0.7%	0.7%	0.6%	0.9%	1.0%
50	Natural sciences, mathematics & statistics	0.1%	0.1%	0.2%	0.2%	0.4%	0.5%
51-52	Biological and related sciences	0.2%	0.3%	0.4%	0.2%	0.5%	0.6%
53-54	Physical sciences, mathematics & statistics	0.0%	0.5%	0.6%	0.4%	0.6%	0.8%
61	Information & communication technologies	0.1%	0.4%	0.6%	1.3%	2.6%	3.5%
70	Engineering, manufacturing & construction	0.2%	0.3%	0.1%	0.3%	0.4%	0.2%
71	Engineering and engineering trades	21.2%	22.3%	24.3%	27.3%	25.3%	22.1%
72	Manufacturing and processing	4.4%	4.0%	2.1%	3.8%	3.9%	2.8%
73	Architecture and construction	7.8%	11.3%	9.3%	8.3%	7.4%	9.3%
80-81	Agriculture, forestry, fisheries & veterinary	1.7%	1.9%	3.8%	4.1%	3.0%	2.9%
82	Forestry	0.1%	0.1%	0.2%	0.2%	0.3%	0.3%
83-84	Fisheries & Veterinary	0.1%	0.1%	0.2%	0.1%	0.1%	0.1%
91	Health	1.3%	1.7%	2.1%	1.4%	1.7%	2.1%
92	Welfare	0.8%	1.7%	2.1%	1.5%	2.2%	2.4%
101	Personal services	1.0%	1.1%	1.2%	1.2%	1.3%	1.7%
103	Security services	0.9%	1.4%	2.0%	1.4%	1.6%	2.0%
104	Transport services	0.9%	0.7%	0.8%	0.8%	1.0%	1.5%
Sample size		*25,276*	*36,820*	*30,448*	*33,045*	*30,503*	*23,704*

We see a general trend that men's education level has increased over time. While the majority of men in all the cohorts have obtained high school or vocational training ("gymnasium") as their highest education, the proportion with either primary school or high school as highest education has decreased, while the proportion of men with higher educations has increased over time. With regards to field of education, *basic programmes and qualifications*, *business and administration*, and *engineering and engineering trades* are the fields of education where most males cluster. However, in line with men becoming more educated, the proportion of men with only *basic programmes and qualifications* has decreased over the years.

Couples to be analyzed

Tables 7-10 present statistics for the wives and husbands as couples. From these tables we see that generally, those with high levels of education tend to marry others with high levels of educations, and vice versa for low levels of education. Yet across all cohorts, a large and increasing proportion of wives obtain medium higher educations while husbands do not. Many wives with such medium-level degrees thus marry men who have only finished high school, particularly among the younger cohorts. Similarly, for earlier cohorts, husbands with high levels of education have had a larger tendency than wives with high levels of education to marry spouses with low education levels. For cohort 1947, 33.7 percent of husbands with long higher educations or above have married wives with less than medium higher educations, compared to 17 percent of wives with long higher educations or above having married husbands with less than medium higher educations. This seems inevitable given the low proportion of wives with high levels of education at the time. Interestingly, for younger cohorts, the tendency has been reversed. In cohort 1971, 25.4 percent of wives with long higher educations or above have married husbands with less than medium higher educations, compared to 18.3 percent of husbands with long higher educations having married wives with less than medium higher educations. Taken together, this suggests that wives should be increasingly more likely to have a comparative advantage over their husbands in the labor market given their education levels.

Table 7: Education mix in couples, cohort 1947

		HUSBANDS						
	Edu. level	Primary school	High school	Short H.E.	Medium H.E.	Long H.E.	PhD	Total
WIVES	Primary school	**16.2%**	**16.9%**	1.0%	1.6%	0.4%	0.0%	36.0%
	High school	8.0%	**26.8%**	2.3%	5.0%	1.5%	0.0%	43.6%
	Short H.E.	0.4%	1.1%	0.2%	0.5%	0.3%	0.0%	2.5%
	Medium H.E.	1.7%	5.0%	0.8%	5.2%	2.7%	0.1%	15.5%
	Long H.E.	0.1%	0.3%	0.0%	0.3%	1.5%	0.0%	2.3%
	PhD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Total	26.3%	50.1%	4.3%	12.6%	6.5%	0.2%	***n=27,005***

Table 8: Education mix in couples, cohort 1955

		HUSBANDS						
	Edu. level	Primary school	High school	Short H.E.	Medium H.E.	Long H.E.	PhD	Total
WIVES	Primary school	**12.0%**	**22.2%**	1.4%	2.0%	0.5%	0.0%	38.1%
	High school	6.3%	**19.3%**	1.6%	2.7%	1.2%	0.0%	31.2%
	Short H.E.	0.6%	1.9%	0.3%	0.6%	0.4%	0.0%	3.8%
	Medium H.E.	2.0%	8.5%	1.2%	7.4%	3.8%	0.2%	23.0%
	Long H.E.	0.1%	0.5%	0.1%	0.6%	2.4%	0.1%	3.9%
	PhD	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
	Total	20.9%	52.4%	4.7%	13.3%	8.3%	0.4%	***n=20,169***

Table 9: Education mix in couples, cohort 1963

		HUSBANDS						
	Edu. level	Primary school	High school	Short H.E.	Medium H.E.	Long H.E.	PhD	Total
WIVES	Primary school	5.6%	8.8%	0.6%	0.6%	0.2%	0.0%	15.8%
	High school	**10.0%**	**31.3%**	3.1%	4.1%	1.8%	0.1%	50.5%
	Short H.E.	0.6%	2.3%	0.7%	0.6%	0.4%	0.1%	4.7%
	Medium H.E.	2.3%	**9.3%**	1.8%	5.8%	3.0%	0.3%	22.5%
	Long H.E.	0.1%	1.1%	0.3%	1.3%	2.8%	0.4%	6.0%
	PhD	0.0%	0.1%	0.0%	0.1%	0.3%	0.2%	0.6%
	Total	18.7%	52.8%	6.5%	12.5%	8.4%	1.1%	***n=20,190***

Table 10: Education mix in couples, cohort 1971

		HUSBANDS						
	Edu. level	Primary school	High school	Short H.E.	Medium H.E.	Long H.E.	PhD	Total
WIVES	Primary school	2.5%	5.0%	0.5%	0.3%	0.2%	0.0%	8.5%
	High school	7.0%	**26.4%**	3.5%	3.6%	1.7%	0.1%	42.3%
	Short H.E.	0.5%	3.4%	1.2%	0.9%	0.5%	0.1%	6.5%
	Medium H.E.	2.3%	**11.9%**	3.0%	**7.5%**	4.1%	0.4%	29.2%
	Long H.E.	0.3%	2.1%	0.9%	2.5%	5.8%	0.9%	12.4%
	PhD	0.0%	0.1%	0.0%	0.1%	0.5%	0.2%	1.1%
	Total	12.5%	49.0%	9.0%	15.0%	12.8%	1.7%	***n=17,793***

Table 11 confirms this hypothesis. Within couples, husbands used to have 0.7-0.8 more years of education than their wives. This changed for cohort 1971, where wives on

average have 0.2 additional years of education compared to their husbands. The table moreover reveals that over time, the educational advantage of some wives over their husbands has gotten larger. Where the 25 percent of wives from cohort 1947 who are more educated than their husbands have at least 0.3 more years of education, this number increases to 1.9 years for cohort 1971 (i.e. the 25 percent of wives who are more educated than their husband have at least 1.9 years more education). Similarly, fewer husbands have remarkably longer educations than their wives as cohorts of wives get younger.

Table 11 furthermore shows that there is no significant change in age differences between husbands and wives over time. Within couples and across cohorts, husbands are on average 2-2.6 years older than their wives, and maximum 25 percent of couples contain wives that are older than their husband[7]. The fact that most husbands are older than their wives could provide them with a comparative earnings advantage as it allows them to have more experience in the labor market. This is confirmed by looking at the differences in experience. However, since the variable of experience has been calculated as years since obtaining one's highest degree, individuals with longer educations will also have less experience. The development of husbands having increasingly more experience than their wives thus goes well in hand with wives taking increasingly longer educations. Thereby, experience has an ambiguous effect on predicted earnings as it depends on the effect of the education one pursues at the cost of years of experience.

[7] Remember that couples with significant age differences (outliers based on the IQR rule) have been removed.

Table 11: Differences within couples (husband - wife)

	Mean	Median	Min	25%	75%	Max	SD	Sample
Education (H-W)								
1947	0.8	0.3	-10.0	-0.3	2.5	13.0	3.3	27,005
1955	0.8	0.5	-10.0	-1.0	3.0	12.0	2.9	20,169
1963	0.7	0.0	-12.0	-1.3	1.5	10.0	2.5	20,190
1971	-0.2	0.0	-11.0	-1.9	1.0	9.0	2.4	17,793
Age (H-W)								
1947	2.1	2.0	-6.0	0.0	4.0	10.0	2.8	27,005
1955	2.6	2.0	-7.0	0.0	5.0	12.0	3.4	20,169
1963	2.1	2.0	-7.0	0.0	4.0	11.0	3.4	20,190
1971	2.0	2.0	-6.0	0.0	4.0	10.0	3.2	17,793
Experience (H-W)								
1947	0.0	0.0	-16.0	0.0	0.0	17.0	3.1	27,005
1955	1.6	1.0	-24.0	-2.0	5.0	24.0	6.3	20,169
1963	3.3	3.0	-23.0	-1.0	7.0	32.0	7.6	20,190
1971	3.2	3.0	-23.0	-1.0	7.0	30.0	7.2	17,793

4.1.4 Results

Model for predicted earnings

Tables 12-17 below present the results of the predicted earnings models for the different cohorts. As outlined in section 4.1.2, earnings are predicted as a function of experience, experience squared, level of education, and field of education:

$$\ln(E_i) = \alpha_0 + \beta_1 exp_i + \beta_2 exp_i^2 + D_1 edu\_level_i + D_2 edu\_field_i$$

The results overall reveal that human capital investments are important for obtaining high earnings. Since field of education contains 38 dummy variables, the coefficients have been omitted in below tables, but can be found in Appendix B. The coefficients for the dummy variables of field of education in Appendix B should be interpreted in comparison to having studied within the field of *education* (ISCED code 11). The coefficients for the dummy variables of level of education below should be interpreted in comparison to having the lowest level of education, i.e. primary school ("folkeskole", 9th grade).

Table 12: Regression results, cohort 1939

Cohort 1939	**β**	**Robust SE**	**p-value**	**95% conf. int.**	
Experience	0.0315	0.0138	0.023*	0.0044	0.0586
Experience²	-0.0001	0.0005	0.868*	-0.0012	0.0010
Level of education					
High school	0.4566	0.0413	0.000*	0.3757	0.5375
Short higher education	0.6706	0.0461	0.000*	0.5802	0.7609
Medium higher education	0.8614	0.0434	0.000*	0.7764	0.9465
Long higher education	1.0827	0.0472	0.000*	0.9902	1.1753
Ph.d. and research educations	0.9121	0.1540	0.000*	0.6103	1.2140
Intercept	10.9462	0.0979	0.000*	10.7543	11.1381
R^2	**0.1421**				

Table 13: Regression results, cohort 1947

Cohort 1947	**β**	**Robust SE**	**p-value**	**95% conf. int.**	
Experience	0.0749	0.0075	0.000*	0.0602	0.0896
Experience²	-0.0025	0.0003	0.000*	-0.0032	-0.0019
Level of education					
High school	0.1996	0.0251	0.000*	0.1503	0.2489
Short higher education	0.3481	0.0298	0.000*	0.2897	0.4065
Medium higher education	0.5581	0.0289	0.000*	0.5015	0.6147
Long higher education	0.6973	0.0327	0.000*	0.6332	0.7614
Ph.d. and research educations	0.8376	0.0408	0.000*	0.7575	0.9176
Intercept	11.1530	0.0461	0.000*	11.0627	11.2433
R^2	**0.1244**				

Table 14: Regression results, cohort 1955

Cohort 1955	**β**	**Robust SE**	**p-value**	**95% conf. int.**	
Experience	0.0866	0.0046	0.000*	0.0795	0.0977
Experience²	-0.0027	0.0002	0.000*	-0.0030	-0.0023
Level of education					
High school	0.1329	0.0238	0.000*	0.0862	0.1795
Short higher education	0.2748	0.0312	0.000*	0.2137	0.3358
Medium higher education	0.5172	0.0305	0.000*	0.4574	0.5770
Long higher education	0.6468	0.0336	0.000*	0.5810	0.7127

Cohort 1955	β	Robust SE	p-value	95% conf. int.	
Ph.d. and research educations	0.8595	0.0507	0.000*	0.7601	0.9590
Intercept	11.2661	0.0442	0.000*	11.1794	11.3528
R^2	**0.1159**				

Table 15: Regression results, cohort 1963

Cohort 1963	β	Robust SE	p-value	95% conf. int.	
Experience	0.0367	0.0039	0.000*	0.0291	0.0443
Experience^2	-0.0007	0.0002	0.000*	-0.0010	-0.0004
Level of education					
High school	0.3377	0.0214	0.000*	0.2957	0.3797
Short higher education	0.5413	0.0285	0.000*	0.4855	0.5972
Medium higher education	0.7648	0.0279	0.000*	0.7101	0.8196
Long higher education	0.9043	0.0304	0.000*	0.8447	0.9638
Ph.d. and research educations	1.0912	0.0335	0.000*	1.0256	1.1568
Intercept	11.5884	0.0325	0.000*	11.5246	11.6521
R^2	**0.1455**				

Table 16: Regression results, cohort 1971

Cohort 1971	β	Robust SE	p-value	95% conf. int.	
Experience	0.0277	0.0040	0.000*	0.0198	0.0355
Experience^2	-0.0003	0.0002	0.034*	-0.0007	-0.0000
Level of education					
High school	0.3325	0.0253	0.000*	0.2830	0.3821
Short higher education	0.5591	0.0311	0.000*	0.4982	0.6200
Medium higher education	0.7550	0.0318	0.000*	0.6927	0.8173
Long higher education	0.9382	0.0331	0.000*	0.8734	1.0031
Ph.d. and research educations	1.0312	0.0365	0.000*	0.9595	1.1028
Intercept	11.9114	0.0316	0.000*	11.8495	11.9733
R^2	**0.1610**				

Table 17: Regression results, cohort 1979

Cohort 1979	β	Robust SE	p-value	95% conf. int.	
Experience	0.0701	0.0064	0.000*	0.0576	0.0826
Experience^2	-0.0028	0.0005	0.000*	-0.0036	-0.0019

Cohort 1979	$\boldsymbol{\beta}$	**Robust SE**	**p-value**	**95% conf. int.**	
Level of education					
High school	0.1436	0.0327	0.000*	0.0795	0.2076
Short higher education	0.3487	0.0387	0.000*	0.2728	0.4245
Medium higher education	0.3933	0.0396	0.000*	0.3156	0.4710
Long higher education	0.6622	0.0392	0.000*	0.5854	0.7389
Ph.d. and research educations	0.7812	0.0440	0.000*	0.6949	0.8675
Intercept	12.1172	0.0365	0.000*	12.0457	12.1886
$\mathbf{R^2}$	**0.1341**				

As expected, we see that higher levels of education and more experience yield higher predicted earnings across all cohorts. Experience seems to have had a greater positive impact on earnings for cohorts 1947 and 1955 than for the younger cohorts, 1963 and 1971. The fact that the coefficient on experience squared is negative for all is to be expected, implying that the returns from experience diminish as individuals gain more experience. Conversely, we see that the gains from education are greater for the younger 1963 and 1971 cohorts than for the older 1947 and 1955 cohorts. This goes well in hand with the increasing proportion of men in these cohorts with higher educations. From Appendix B we also see that over the years, the education fields *information and communication technologies; engineering, manufacturing and construction*; *law*; *mathematics and statistics* and *business* have yielded the highest earnings. Finally, the explanatory power of the model seems to be greatest for the two youngest cohorts, suggesting that experience and education are better at explaining the earnings of these cohorts than of the older cohorts. The fact that none of the models have an R^2 value above 16.1 percent indicates that unobservable factors are likely to influence the variation in earnings among individuals. Further elaboration on this can be found in section 3.4.

Comparing couples' relative predicted earnings to couples' relative actual earnings

Table 18 shows how the predicted earnings of wives from different cohorts and their husbands compare (on the left side) as well as the relationship between their actual earnings (on the right side).

Table 18: Comparison of predicted and actual earnings of spouses

Cohort	**PE(w) > PE(h)**	**PE(w) < PE(h)**	**PE(w) = PE(h)**	**AE(w) > AE(h)**	**AE(w) < AE(h)**	**AE(w) = AE(h)**	*#Couples*
1971	56.7%	41.2%	2.1%	25.2%	74.5%	0.4%	*17,793*
1963	59.5%	38.4%	2.1%	22.0%	77.7%	0.3%	*20,190*
1955	58.3%	38.4%	3.3%	18.9%	80.7%	0.4%	*20,169*
1947	37.0%	44.7%	18.3%	12.5%	87.1%	0.3%	*27,005*

PE(w) = predicted earnings of wife and PE(h) = predicted earnings of husband
AE(w) = predicted earnings of wife and AE(h) = predicted earnings of husband

Here, we see that from 1995-2011, a majority of 40-year-old wives have higher *predicted* earnings than their husbands.

The shift from 37 percent for cohort 1947 to 58.3 percent for cohort 1955 in the share of wives having higher predicted earnings than their husbands is particularly remarkable. Knowing that level of education has a significant positive impact on one's predicted earnings, this is presumably driven by younger wives becoming better educated as outlined earlier in tables 7-11. As mentioned in the related section, the share of wives obtaining medium higher educations jumps from 15.5 percent for cohort 1947 to 23 percent for cohort 1955, and many of these wives marry husbands with shorter educations. Moreover, an increasing share of wives have obtained long higher educations while marrying a low-educated spouse. Finally, the increase in proportion of wives with higher predicted earnings than their husbands can also be due to a shift in the choice of educational field of both husbands and wives. If many wives have

moved into educational fields resulting in high predicted earnings while their husbands have moved into fields with lower predicted earnings, this could also explain our results. An overview of the distribution among fields of education for husbands and wives is provided in Appendix C.

Table 19 below looks only at those couples where the wife has higher predicted earnings than the husband and examines how their actual earnings compare.

Table 19: Comparison of spouses' actual earnings in couples where the wife has higher predicted earnings than the husband

Cohort	**AE(w) > AE(h)**	**AE(w) < AE(h)**	**AE(w) = AE(h)**	*# Couples*
1971	31.1%	68.6%	0.3%	*10,086*
1963	26.5%	73.2%	0.3%	*12,006*
1955	22.8%	76.8%	0.4%	*11,766*
1947	16.0%	83.7%	0.3%	*10,005*

Of the wives that have higher predicted earnings than their husbands, the vast majority have lower actual earnings than their husbands. Although the share has increased over time, for cohort 1971, only 31.1 percent of wives with higher predicted earnings than their husbands also have higher actual earnings. Of couples where the wife is deemed to have the largest labor market potential, less than one third seem to divide their work according to what would be income maximizing, contradicting Becker's theory of household division of labor (Becker, 1985).

A closer look at these couples (where the wife has higher predicted earnings but lower actual earnings than her husband) is presented in table 20 below, showing how both the predicted and actual earnings of spouses compare.

Table 20: Comparison of predicted and actual earnings of spouses in couples where the wife has higher predicted earnings than the husband, but lower actual earnings

Cohorts	**1947**		**1955**		**1963**		**1971**	
	$\frac{PE(w)}{PE(h)}$	$\frac{AE(w)}{AE(h)}$	$\frac{PE(w)}{PE(h)}$	$\frac{AE(w)}{AE(h)}$	$\frac{PE(w)}{PE(h)}$	$\frac{AE(w)}{AE(h)}$	$\frac{PE(w)}{PE(h)}$	$\frac{AE(w)}{AE(h)}$
Mean	1.21	0.53	1.37	0.57	1.42	0.61	1.27	0.63
Median	1.15	0.54	1.29	0.62	1.30	0.65	1.21	0.67
Min	1.00	-	1.00	-	1.00	-	1.00	-
25 percent	1.06	0.35	1.12	0.39	1.12	0.46	1.10	0.48
75 percent	1.30	0.74	1.54	0.80	1.57	0.81	1.38	0.83
Max	2.84	1.00	4.58	1.00	4.44	1.00	2.85	1.00
SD	0.22	0.27	0.32	0.28	0.41	0.26	0.30	0.26
Couples	*8,373*	*8,373*	*9,031*	*9,031*	*8,789*	*8,789*	*6,920*	*6,920*

PE(w) = predicted earnings of wife and PE(h) = predicted earnings of husband
AE(w) = predicted earnings of wife and AE(h) = predicted earnings of husband

While wives in these couples are supposed to earn on average between 21 percent and 42 percent more than their husbands, they actually earn an average of between 37 percent and 47 percent less, meaning the relative amount that these wives earn less than their husbands is greater than the relative amount they should earn more than him. Given this large earnings differential, it seems plausible that these wives specialize in home production while their husbands specialize in labor market production. Looking at the development over time, the earnings gap between these wives and their husbands has been slowly decreasing but is still remarkably high for the youngest cohort (keeping in mind that these are wives that are predicted to earn more than their husbands). However, wives with higher predicted earnings than their husbands have over time also been supposed to earn increasingly more than their husbands on average (despite a slight decrease in the predicted earnings ratio from cohort 1963 to 1971).

Figures 1-4 present a graphical representation of table 20 and depict the predicted and actual earnings of husbands and wives for each cohort.

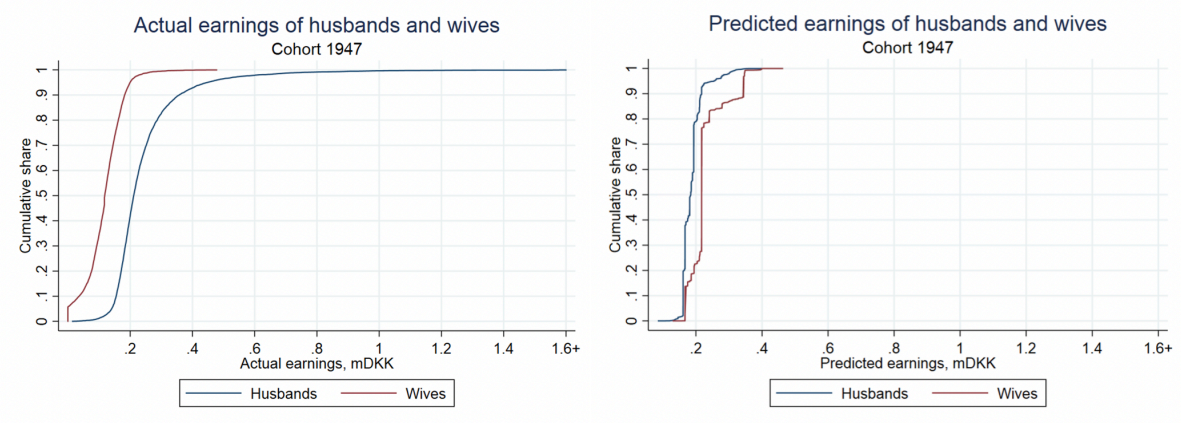

Figure 1: Actual and predicted earnings of husbands and wives, cohort 1947

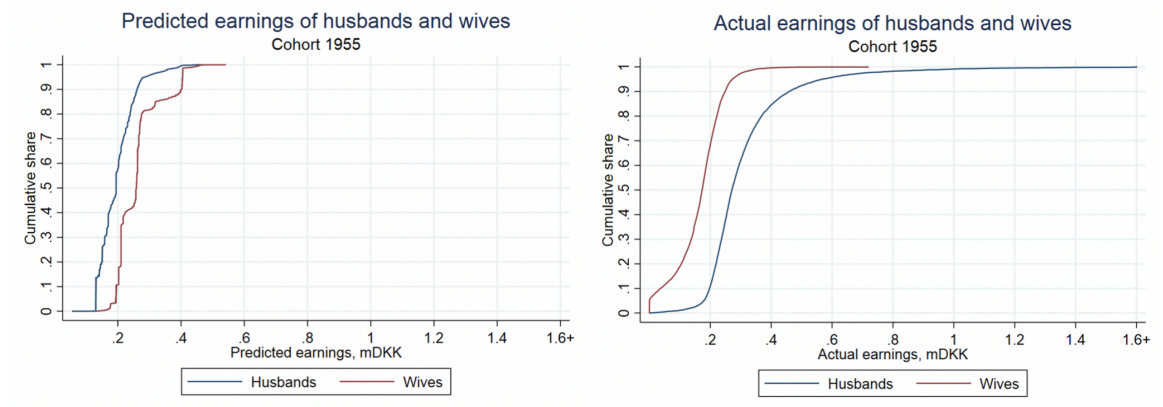

Figure 2: Actual and predicted earnings of husbands and wives, cohort 1955

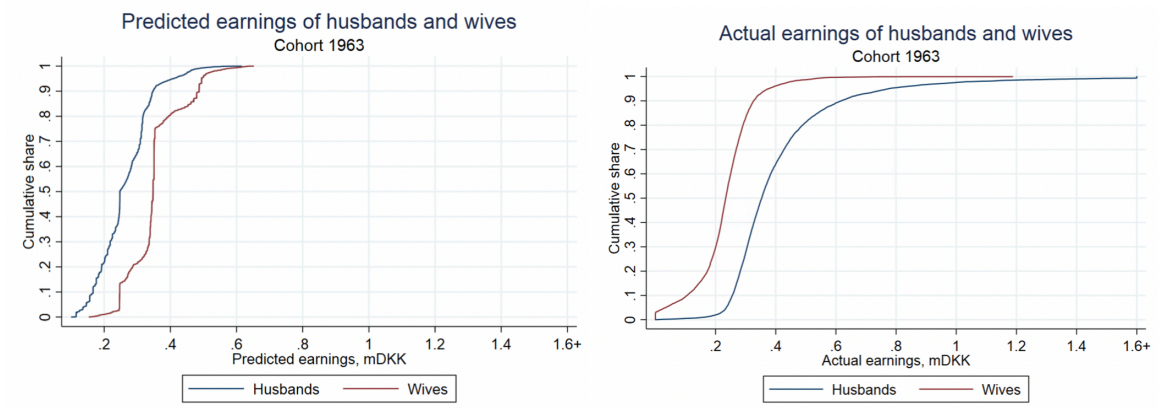

Figure 3: Actual and predicted earnings of husbands and wives, cohort 1963

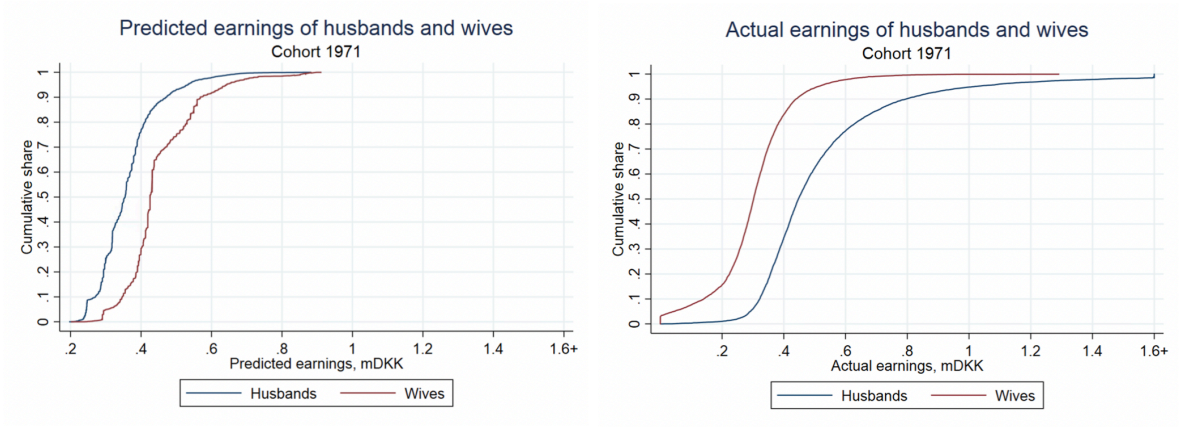

Figure 4: Actual and predicted earnings of husbands and wives, cohort 1971

These figures indicate that the gap in predicted earnings seems to have increased over time, not only in relative terms, but also in absolute terms. When looking at the actual earnings curve, the curve of wives is much steeper than that of husbands. This indicates a larger spread in earnings for husbands, whereas wives all earn closer to the same amount. Once again, the figures highlight how little the wives earn relative to the husbands; few wives (less than 10 percent) earn more than what the median husband earns.

It is also worth noting that the husbands in these couples do not appear to be particularly wealthy relative to the rest of the population. When comparing the figures above to table 4 in section 4.1.3 (which shows the earnings distributions of all men used for our predicted earnings model), we can infer that the earnings quartiles of husbands in these couples are quite similar to those of men in general. The seemingly inefficient division of labor among these couples therefore cannot be explained by some remarkable and exceptional labor market productivity on the husbands' side.

Still focusing on couples where the wife has higher predicted earnings but lower actual earnings than her husband, table 21 below shows the actual earnings of wives and husbands divided by their predicted earnings.

Table 21: Actual earnings divided by predicted earnings for spouses in couples where the wife has higher predicted earnings but lower actual earnings than her husband

AE/PE	**1947**		**1955**		**1963**		**1971**	
	Husbands	*Wives*	*Husbands*	*Wives*	*Husbands*	*Wives*	*Husbands*	*Wives*
Mean	1.30	0.52	1.65	0.64	1.67	0.66	1.49	0.67
Median	1.14	0.53	1.47	0.67	1.43	0.67	1.29	0.69
Min	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25 percent	0.97	0.37	1.17	0.46	1.12	0.53	1.08	0.55
75 percent	1.41	0.70	1.87	0.86	1.89	0.83	1.63	0.83
Max	4.08	1.11	32.41	2.83	26.10	3.10	24.16	3.31
SD	0.68	0.26	0.93	0.31	1.07	0.28	0.97	0.27
Couples	*8,373*	*8,373*	*9,031*	*9,031*	*8,789*	*8,789*	*6,920*	*6,920*

The ratios in table 21 reveal that wives seem to earn remarkably less than their predicted earnings, while husbands earn remarkably more than their predicted earnings. When comparing old to young cohorts, wives' actual earnings have approached their predicted earnings more in recent cohorts. However, in 2011, wives who had higher predicted earnings but lower actual earnings than their husbands still only made 67 percent of their predicted earnings, while the husbands made 149 percent of their predicted earnings on average.

4.1.5 Conclusion: Analysis I

In sum, over time, wives have increased their human capital investments to be on par with or even exceed their husbands'. As a result, since 1995, a majority of wives at age 40 have had higher predicted earnings than their husbands. The proportion of women earning less than their husband despite having higher predicted earnings has slowly decreased over time, suggesting a change in trend within household division of labor. However, in 2011, only 31.1 percent of the wives who had higher predicted earnings than their husbands also had higher actual earnings.

These results are much in line with the findings of Corcoran and Courant (1987), who use a comparable approach to ours and predict earnings for each spouse in American

couples. They find that only in 25 percent of the couples where the wife's expected earnings exceed those of the husband, her actual earnings are also greater than his. Our results seem to be driven by wives underperforming their labor market potential and their husbands overperforming theirs when the wife has higher predicted earnings than the husband. This is similar to the finding of Bertrand et. al. (2015) that wives whose income is likely to exceed that of their husbands are less likely to participate in the labor force and earn less than their potential earnings if they do work. Additionally, they find that couples where the wife's income exceeds that of the husband are more likely to divorce, implying that labor may be divided traditionally to maintain marital happiness and stability. Our findings contradict Becker's theory of division of labor (1985) in the sense that couples do not divide work according to their comparative advantages. Meanwhile, as demonstrated through husbands earning remarkably more than their predicted earnings, our findings do indicate that husbands gain from having their wife specialize in domestic labor, letting them specialize in market work. This was also suggested by Bardasi and Taylor (2008), who provide empirical evidence of the existence of a "marriage premium" in men's wages. However, this could also be caused by other dynamics including statistical discrimination and unobservable productive characteristics of men who get married.

We confirm hypothesis 1 that wives earn less than their husbands despite having higher predicted earnings based on their educational background and experience. This allows us to preliminarily conclude that gender roles provide a good explanation for gender differences in Danish labor market outcomes.

4.2 Analysis II: Responses of highly educated men and women to family-related events

In analysis I, we concluded that the vast majority of women who have higher predicted earnings than their husbands still have lower actual earnings. We now want to

understand the dynamics behind Danish men and women's labor market behavior further.

In analysis II, we want to examine whether gender roles may influence Danish labor market outcomes by investigating whether the earnings of men and women with equally high levels of human capital[8] respond differently to two family-related events; marriage and children.

Kleven et. al. (2019) show that having children has large and persistent labor market implications for Danish women while Danish men are essentially unaffected. As outlined in section 2, theory suggests that this may be because women have invested less in market-oriented human capital due to an expectation of specializing in home production (see e.g. Flyer & Rosen, 1997; Gronau, 1988; Mincer & Polachek, 1974). However, Betrand et. al. (2010) investigate this hypothesis by comparing the career dynamics of male and female MBA graduates from the University of Chicago; one of the most prestigious business schools in the world. These graduates have indisputably undertaken large human capital investments. Nevertheless, as their careers progress, the annual earnings of male and female MBA graduates diverge considerably. This divergence is particularly driven by children, whose presence alters the women's labor market behavior.

In line with Bertrand et. al. (2010), we are particularly interested in investigating Danish women who have undertaken intensive and ambitious human capital investments. More specifically, we want to clarify if these women act gender-conforming in their response to family-related events that may prompt intra-household specialization, despite their large human capital investments. We choose our sample

[8] The main focus of this analysis will be human capital in the form of education. However, as is described in section 4.2.3, the men and women also have similar levels of human capital in the form of work experience.

based on results from analysis I, where we found that *information and communication technologies; engineering, manufacturing and construction*; *law*; *mathematics and statistics* and *business* are the five education fields that yield the highest predicted earnings across cohorts. We define individuals with at least a master's degree within these fields as *highly educated* individuals. Drawing on the results from Kleven et. al. (2019) and Bertrand et. al. (2010), we expect that family-related events will prompt a divergence in the annual earnings of highly educated men and women.

Specifically, the purpose of this section will be to test hypothesis 2:

H2: Highly educated men and women respond differently to family-related events, demonstrated by a divergence in their annual earnings trajectories

If we confirm the hypothesis, it once again suggests that gender roles do play an important role in understanding Danish labor market outcomes, even for highly educated individuals. If we disprove the hypothesis, it suggests that gender roles are irrelevant for the labor market behavior of highly educated men and women.

Using an event study approach, we will first examine the earnings responses of highly educated men and women to getting married. We will then do the same around the event of having one's first child. To comprehensively interpret our results, we will compare the labor market dynamics of the highly educated individuals to those of low educated individuals as we go along. We define low educated individuals as individuals that have obtained high school education ("gymnasium") or the equivalent at the most. We will refer to these as *low educated* individuals or *poorly educated* individuals interchangeably.

Analysis II will be structured as follows. Section 4.2.1 presents our samples for each event study. Section 4.2.2 presents our empirical strategy. Section 4.2.3 presents relevant descriptive statistics of our samples. Section 4.2.4 presents the results, and finally, section 4.2.5 interprets and concludes the results.

4.2.1 Sample selection

The sample will include all men and women with a master's degree in *information and communication technologies* (ICTs)*; engineering, manufacturing and construction* (engineering); *law*; *mathematics and statistics* (maths) and *business* who experienced the event between 1990 and 2000. By men and women who "experienced the event" we mean individuals who got married in this period (for the first part of the analysis), and individuals who had their first child in this period (for the second part of the analysis). The time frame is chosen to ensure than we can follow the individuals four years prior to and ten years succeeding the event. As a result, for the analysis around marriage, the individual will need to remain married ten years into the marriage.

As earlier, immigrants are excluded to obtain a more homogenous sample. Moreover, individuals with less than SU level of DKK 75,000 in yearly annual income one year prior to the events are excluded as we want to investigate individuals who are already underway with their career before experiencing the events. We have chosen not to exclude individuals with outlier values of extremely high earnings in this analysis to avoid shrinking the sample further. Instead, as a robustness check for the potential influence of positive outliers, we will also conduct the analysis using medians instead of means. This analysis can be found in Appendix D. Finally, we employ a balanced panel of men and women who we can observe for 15 years around the event time. For the analysis around marriage, we are left with a total sample of 1,571 highly educated men and 658 highly educated women. For the analysis around the birth of one's first child, we are left with a total sample of 2,065 highly educated men and 1,016 highly

educated women. There may be some overlap between the samples, as some individuals may both have had children and gotten married within the relevant time frame. Meanwhile, as is obvious from the different sample sizes, there will also be individuals who have only experienced one of the events and are therefore only present in one of the analyses.

To be able to compare the results to those of individuals with low educations, we will construct an additional sample for each event study. These samples will be identical to the ones above except that they will contain individuals whose highest level of education is high school instead of individuals with master's degrees in *ICTs, engineering, law, maths* and *business*.

4.2.2 Empirical strategy

This analysis is closely related to some parts of the paper by Kleven et. al. (2019) who investigate the effect of children on gender inequality in Denmark. However, our approach differs by primarily focusing on individuals who have made high investments in human capital, and by looking at the effect of marriage in addition to children.

While the ideal way of investigating the impact of marriage and parenthood would be to randomize the events, this is not possible. Instead, following previous studies such as Angelov et. al. (2016) and Kleven et. al. (2019), we employ an event study approach exploiting potentially sharp changes in the earnings of men and women following marriage or parenthood. As is reasoned by Kleven et. al. (2019), family-related choices are not exogenous, but they still tend to produce sharp changes in labor market outcomes. Such sharp changes should be orthogonal to any unobserved determinants, since labor market outcomes and their unobserved determinants are expected to evolve smoothly over time. Furthermore, by looking at a large sample of many individuals,

the event study enables us to utilize individual-level variation in the timing of getting married and having one's first child to isolate the effect of the relevant event.

For the separate analyses of the events of marriage and children, we denote $t = 0$ as the year in which the event happens for each individual. We will index the individuals' earnings using one year before the event (t = -1) as base year. We observe each individual from four years before the event until ten years after. For each of the events, we then run the following regression separately for highly educated men and highly educated women as well as poorly educated men and poorly educated women:

$$Y_{ist}^{g} = \sum_{j \neq -1} \alpha_j^g \cdot \mathrm{I}\,[j = t] + \sum_{k} \beta_k^g \cdot \mathrm{I}\,[k = age_{is}] + \sum_{y} \gamma_y^g \cdot \mathrm{I}\,[y = s] + \nu_{ist}^{g} \qquad (1)$$

where Y_{ist}^{g} denotes annual earnings before taxes and public transfers for individual i of gender g in year s at event time t. The first term denotes a full set of event time dummies; the second term denotes a full set of age dummies; and the third term includes a full set of year dummies. We use robust standard errors to account for potential heteroskedasticity. Incorporating full sets of age- and year dummies in the regression allows us to control for individual life-cycle trends such as experience in the labor market as well as macro-related time-trends such as business cycles and wage inflation. Thanks to the variation in the time and age at which the individuals get married and have their first child, the effect of all dummies can be measured. The event time dummy is omitted at event time t = -1, making the event time coefficients pinpoint the impact of getting married or becoming a parent relative to the year just prior to the event.

The effects from equation (1) are transformed into percentage terms of the counterfactual outcome (i.e. had the event not occurred). This is done through the following equation:

$$P_t^g \equiv \hat{\alpha}_t^g / \mathrm{E}\left[\tilde{Y}_{ist}^g \mid t\right] \qquad (2)$$

where

$$\tilde{Y}_{ist}^g \equiv \sum\nolimits_k \hat{\beta}_k^g \cdot \mathrm{I}\left[k = age_{is}\right] + \sum\nolimits_y \hat{\gamma}_y^g \cdot \mathrm{I}\left[y = s\right],$$

i.e. predicted annual earnings when excluding the influence of event dummies.

Since we are dealing with earnings data and employ level rather than log-specifications, it is legitimate to question whether the results are primarily driven by outliers at the top of the distribution. To address this concern, Appendix D presents the median rather than mean effects of marriage and children on earnings. The dynamics of mean- and median effects are virtually identical, and the results presented in this analysis should therefore be reliable.

4.2.3 Descriptive statistics

The highly educated men and women have at least 18 years of education within fields that are deemed highly demanding and of great value in the labor market as concluded in 4.1.4. For both samples, men and women were about the same age at graduation (around 26) with only 0.4-0.5 years of variation in mean age, women being the youngest. Upon graduation, the male and female graduates should thus have the exact same qualifications in terms of human capital to pursue a career, assuming that there are no significant differences in the quality of the education men and women have received.

For the analysis of both events (parenthood and marriage), the majority of individuals in the samples are born around 1960-1961 for men and 1961-1962 for women, as is

depicted in figures 5 and 6 below. This means that the highly educated women are slightly younger than the highly educated men when getting married and having their first child.

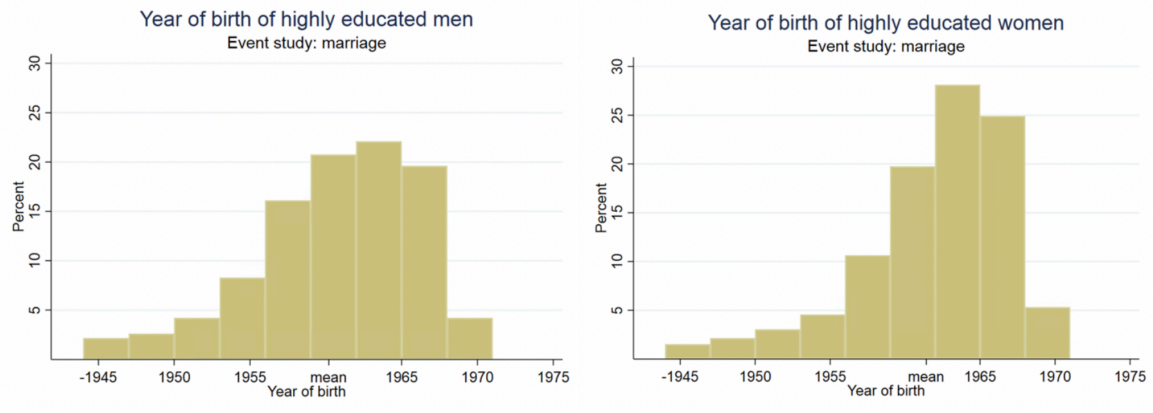

Figure 5: Year of birth of highly educated individuals related to the event study of marriage

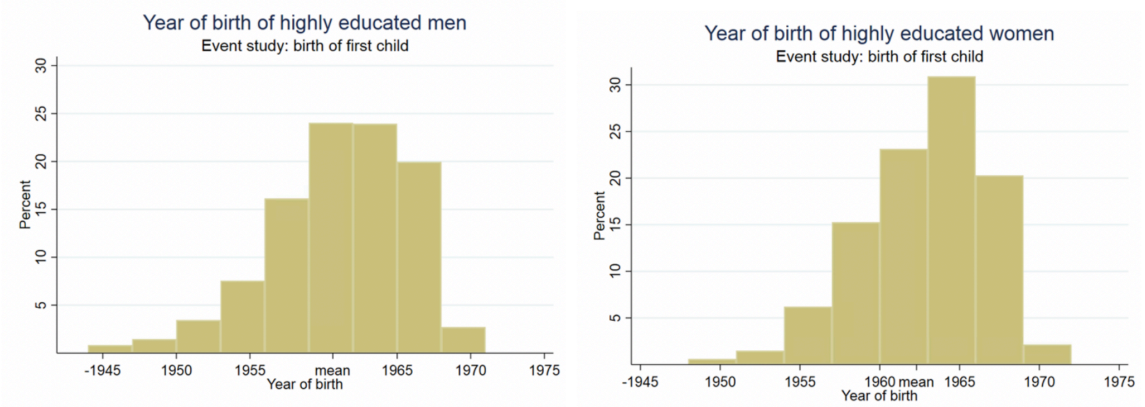

Figure 6: Year of birth of highly educated individuals related to the event study of parenthood

Looking at age rather than birth year, figures 7 and 8 below confirm that the highly educated men are indeed 1 year older on average than highly educated women when they get married and 1.4 years older when they have their first child. The average age of our sample for examining marriage is 35.5 for men and 34.4 for women. In the case of parenthood, both men and women are slightly younger; the average age of fathers in our sample is 34.6 and the average age of mothers is 33.2. In both event studies, the

age distribution of the men is more left skewed than that of the women, indicating that a fraction of men is significantly older than their female peers when they get married or become a parent. This seems natural given the finding from the analysis in section 4.1.3 that husbands are commonly around two years older than their wives. As a result, female graduates should have lower earnings than male graduates when they get married and/or have their first child due to their lower amount of experience in the labor market. Apart from highlighting some behavioral patterns among men and women related to timing of family-events (that may be explained by biological reasons or gender roles), the age difference also highlights the importance of having included age dummies in our regression.

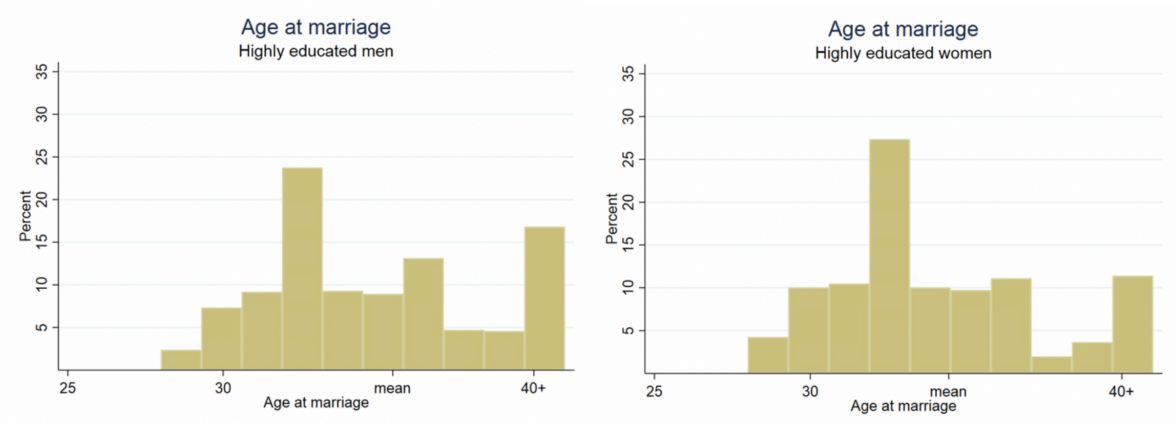

Figure 7: Age at marriage of highly educated individuals

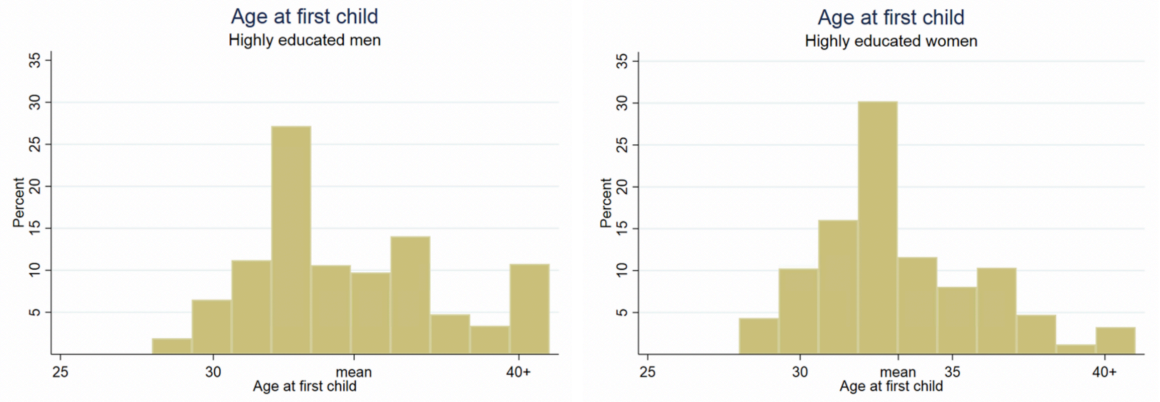

Figure 8: Age at first child of highly educated individuals

Finally, looking at the earnings distributions of these highly educated individuals the year before the relevant event, we see that they are similar in both event studies. Whether observing them the year before they get married or the year before their first child, men earn an average of around 420,000 DKK and women earn an average of around 330,000 DKK. This confirms that the selected educations yield high earnings, comparing this to the average earnings of a 40-year old man from cohort 1963 (368,387 DKK, cf. table 4), keeping in mind that the average age of our samples is 33-35. The fact that women earn less than men at time t = -1 could be due to the fact that women are a bit younger than men both when getting married and when beginning to have children.

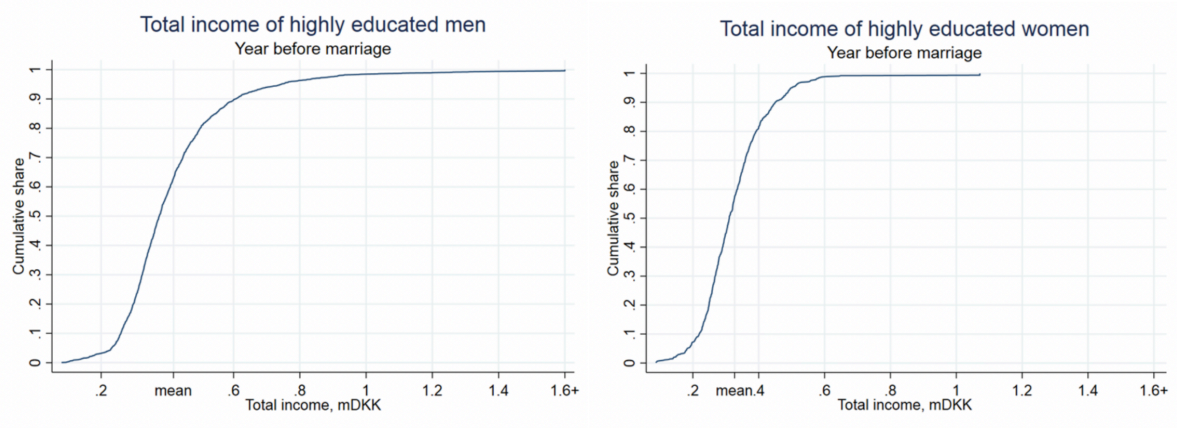

Figure 9: Income of highly educated individuals related to the event study of marriage

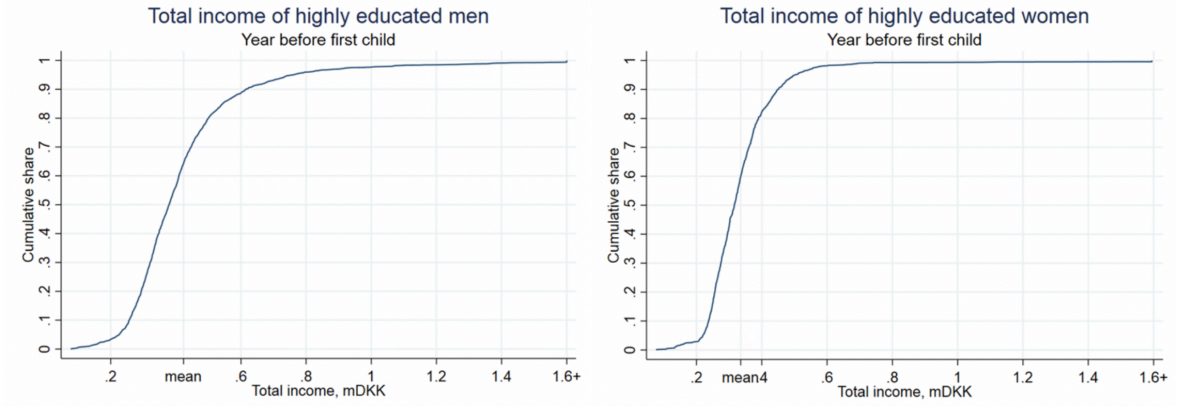

Figure 10: Income of highly educated individuals related to the event study of parenthood

4.2.4 Results

Event 1: Marriage

Figure 11 below plots the gender-specific impacts of marriage, $P_{mt}{}^{m}$ and $P_{mt}{}^{w}$, across event time for highly educated individuals. As outlined above, these are earnings before taxes and transfers at event time t relative to the year just before the individual gets married, i.e. year t = -1, when having controlled for age- and year trends. The grey-shaded area represents 95 percent confidence bands around the best guess event coefficients.

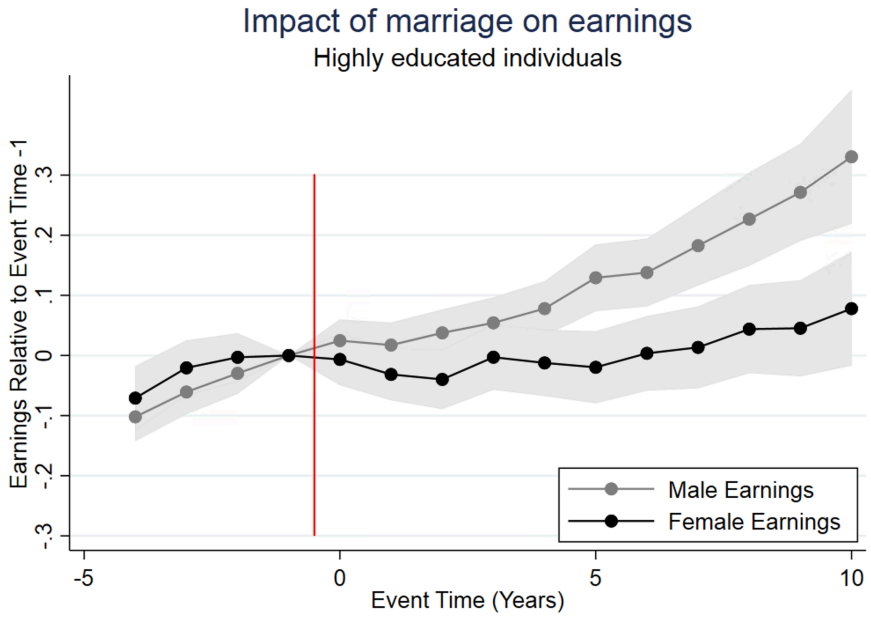

Figure 11: Impact of marriage on earnings, highly educated individuals

For these highly educated individuals, there are no sharp changes in earnings for neither men nor women around the event of marriage when controlling for lifecycle- and year trends. Before getting married, men and women have comparable earnings. However, after getting married, their earnings trajectories start to diverge, and after a couple of years, men earn more than women with statistical certainty. By year ten, after controlling for lifecycle- and year trends, highly educated men earn almost 35 percent more relative to what they did before getting married, whereas women's

earnings have not increased significantly (a bit less than 10 percent according to the best guess estimate).

That being said, the short run divergence from marriage is not statistically significant, and when we look in the longer term, other events, such as the birth of children, can have occurred in the meantime and also impacted the earnings paths. Thus, the identification of long-term effects of marriage may call for the use of a control group who gets married but does not have children. The results for this control group appear in figure 12 below.

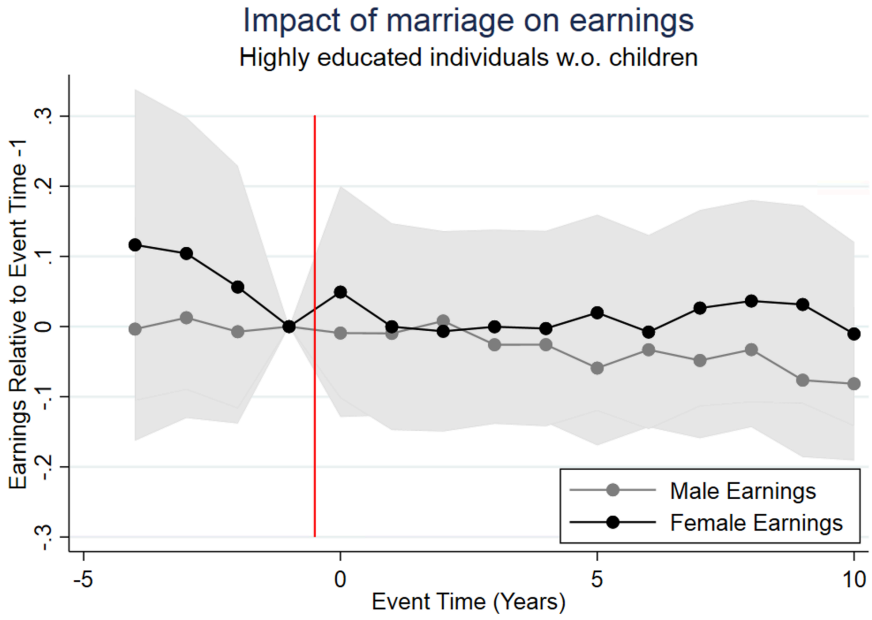

Figure 12: Impact of marriage on earnings, highly educated individuals without children

The best guess estimates indicate that there are no short nor long run differences in how highly educated men and women respond to marriage. However, narrowing the sample to individuals without children has shrunk the sample size to 80 women and 148 men, and this implies that there are big uncertainties associated with the estimates. This is also clear from the large grey-shaded confidence bands. Finally, we would be concerned that highly educated individuals who get married but do not have children

hold unobservable characteristics compared to those who do have children, which could impact their different responses to marriage.

Comparing this to low educated individuals, we see that the highly educated and low educated individuals differ in their responses. Figure 13 below plots the gender-specific impacts of marriage, $P_{mt}{}^{m}$ and $P_{mt}{}^{w}$, across event time for poorly educated individuals, using the exact same approach as that outlined above for the highly educated individuals.

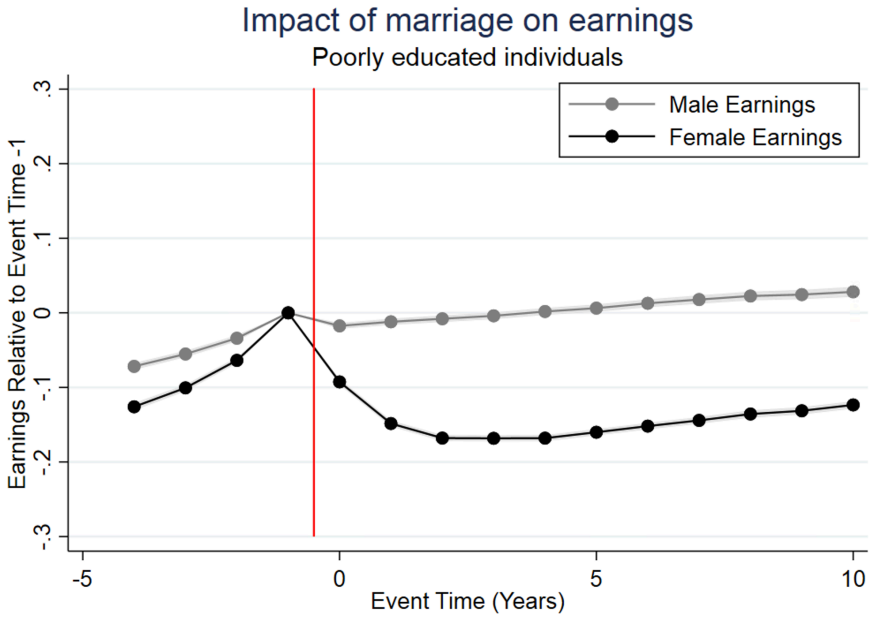

Figure 13: Impact of marriage on earnings, poorly educated individuals

The earnings paths of poorly educated men and women diverge significantly upon the event of marriage. Women's earnings drop with close to 10 percent and an additional 5 percent in the following year. Meanwhile, men's earnings drop with only a couple of percent and then rise gradually the following years relative to when they got married. By year ten, after controlling for lifecycle- and year trends, men in this group earn around 3 percent more relative to before they got married, whereas women earn around 12 percent less than what they did before. However, the long run dynamics can, once

again, not exclusively be attributed to the event of marriage, since other events such as the birth of children have likely occurred in the meantime.

To verify whether this is the case, we once again conduct a robustness check by examining the effects of marriage on individuals with the same level of human capital who have not had any children. The results are presented in figure 14 below.

Figure 14: Impact of marriage on earnings, poorly educated individuals without children

As figure 14 shows, while women's earnings now drop less, the earnings trajectories of men and women still diverge significantly one year after marriage. Somewhat similarly to the highly educated, men who do not have children ten years after getting married do not experience the same earnings premium from marriage as men who do have children. In fact, their earnings seem to decrease after getting married. Either way, poorly educated women's earnings still drop significantly more than poorly educated men's during the years following marriage, independently of whether there are children involved or not.

In sum, we conclude that we cannot infer with certainty that the earnings of highly educated men and women react differently to marriage. Meanwhile, the earnings trajectories of men and women with low levels of education do diverge after marriage. In this group, women's earnings drop by approximately 11 percent relative to before getting married, while men's earnings are only slightly impacted. Preliminarily, this indicates that gender roles do not affect the labor market outcomes of women who have undertaken ambitious human capital investments.

Event 2: Parenthood

Figure 15 below plots the gender-specific impacts of parenthood, $P_{ct}{}^{m}$ and $P_{ct}{}^{w}$, across event time for individuals with high levels of human capital. As outlined above, these are earnings before taxes and transfers at event time t relative to the year just before the individual gets married, i.e. year t = -1, when having controlled for age- and year trends. The grey-shaded area represents 95 percent confidence bands around the best guess event coefficients.

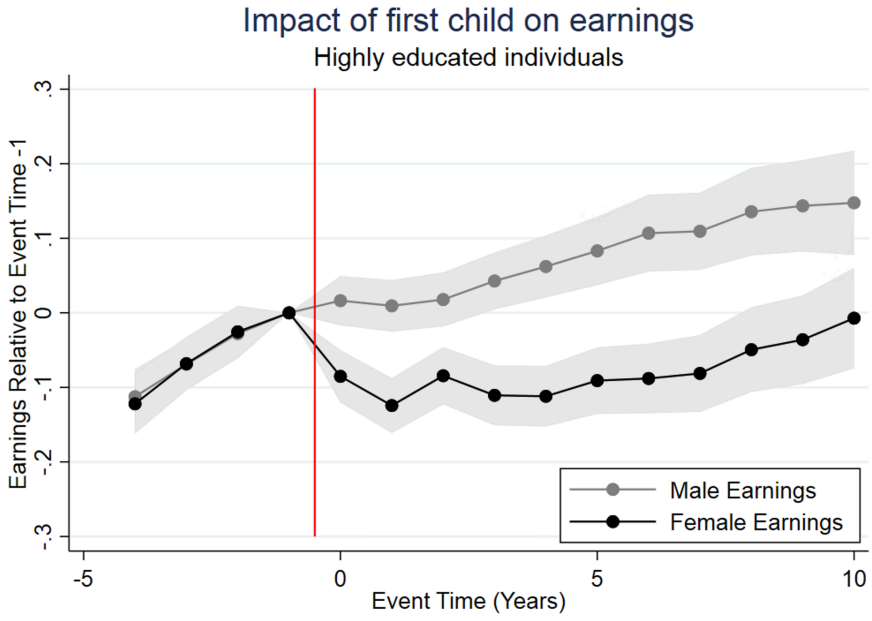

Figure 15: Impact of first child on earnings, highly educated individuals

We see that for highly educated individuals, when controlling for lifecycle- and year trends, the earnings trajectories of men and women are strikingly similar until they have their first child. However, exactly upon the birth of the first child, their earnings paths diverge sharply and significantly. Women's earnings drop immediately with close to 10 percent while men's in fact appear to increase slightly, continuing the smooth pre-trend from before the birth. In the following year ($t = 1$), women's earnings drop even more, down to a level corresponding to what they had five years earlier in time. Following the birth of the first child, it takes ten years before the earnings of the highly educated women have returned to their original level from just before the birth. In the meantime, the earnings of their male counterparts have steadily increased with around 15 percent from their original level (at time t = -1). Following the arrival of the first child, the male and female earnings trajectories do not overlap again with statistical certainty. It is important to note that our sample is constructed irrespective of the number of children the individuals end up having. This means that the dynamic patterns, particularly in the long run, also include the effects of all children born after the first one. Resultingly, the long-run impacts can be interpreted as the total effect of children.

For individuals with low educations, the trend is similar but even more drastic, as can be seen from figure 16 below. It plots the gender-specific impacts of parenthood, ${P_{ct}}^m$ and ${P_{ct}}^w$, across event time for low educated individuals, using the exact same approach as that outlined above for the highly educated individuals.

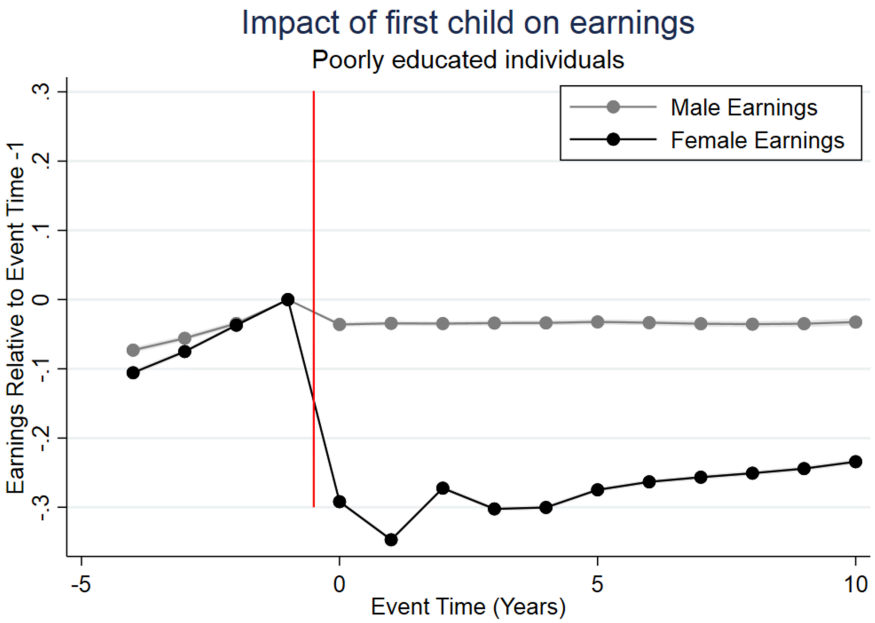

Figure 16: Impact of first child on earnings, poorly educated individuals

When controlling for lifecycle- and year trends, the earnings trajectories of these men and women are similar until they have their first child. However, exactly upon the birth of the first child, the earnings of low educated women drop with 30 percent while those of men are close to unaffected. Once they have become parents, women's earnings never recover to their original level. By year ten, their earnings are more than 20 percent lower than before having a child. The long-run impacts can, once again, be interpreted as the total effect of children since the dynamic patterns also include the effect of children born after the first one.

Taken together, we see that the earnings trajectories of men and women react differently to parenthood, independently of whether they possess a high or low level of human capital. Although highly educated women experience a smaller drop in earnings as a result of children than poorly educated women do, the highly educated women's earnings are still far from the 15 percent earnings premium that their male peers reach ten years after becoming a parent. As a result, the long-run gender gap in earnings is similarly large for highly educated and poorly educated individuals.

This could be rationally explained if all of these highly educated women had lower levels of relevant human capital than their husbands and it therefore made sense for them to specialize in home production. However, looking at our data, this seems to be an unlikely scenario. Table 22 below (an adaptation of table 9 in section 4.1.3) looks at those couples from Analysis I where the wife is born in 1963, which is around the time most of the highly educated women in our samples in Analysis II are born. Specifically, the table shows the education level of spouses of wives and husbands *who have a master's degree* from the cohort sample 1963. I.e. given that an individual has a master's degree, the table illustrates what education level the individual's spouse has.

Table 22: Educational level of the spouses of husbands and wives with a master's degree, cohort 1963

	Spouse's education level					
	Primary school	*High school*	*Short H.E.*	*Medium H.E.*	*Long H.E.*	*PhD*
Women	2.4%	21.2%	4.7%	35.3%	32.9%	3.5%
Men	1.7%	18.3%	5.0%	21.7%	46.7%	6.7%

Table 22 shows that more than 63 percent of the wives in this cohort with master's degrees are married to husbands with educations levels lower than themselves. Accordingly, these wives should have the intra-household comparative labor market advantage, all else equal. It is still possible that some of the spouses of these highly educated women have higher labor market potential as a result of greater experience; however, given that level and field of education have a much higher impact on earnings than experience does (cf. our regression results and their coefficients in Appendix B), this would not be enough to explain why highly educated women earn less than they would absent children, or had they been men.

In sum, this part of the analysis strongly indicates that gender roles do impact the labor market outcomes of even those Danish individuals who have undertaken some of the highest human capital investments.

4.2.5 Conclusion: Analysis II

Even among individuals who have undertaken some of the most intensive and ambitious human capital investments, there are substantial differences in how men and women respond to family-related events. Marriage in itself shows no sharp and significant effect on the labor market behavior of highly educated men and women. On poorly educated individuals, marriage has a sharper effect. Meanwhile, the arrival of one's first child indisputably decelerates the earnings trajectories of highly educated women while it accelerates that of highly educated men. Specifically, the earnings of highly educated women drop with 10 percent immediately when having their first child and only barely recover within the following ten years. Meanwhile, the earnings of highly educated men have increased with around 15 percent by year ten. Although the earnings of highly educated women drop less upon becoming a parent than those of low educated women, the long run gender gap in earnings trajectories is similarly large among low educated and highly educated individuals, due to the highly educated men's child premium.

While proving the drivers behind the diverging earnings paths of men and women is beyond the scope of this paper, we can draw some inferences from earlier related work. Several studies have found indications of a "fatherhood premium", where the wages of men increase following parenthood, potentially due to gender specific specialization following childbirth resulting in men spending less time on domestic labor and more time on market labor (see e.g. Killewald, 2013; Lundberg & Rose, 2002; Andersen, 2017). Moreover, when investigating the entire Danish population, Kleven et. al. (2019) find a persistent female child penalty in earnings close to 20 percent. They find that this is driven by sharp impacts of children on labor force participation, hours worked, wage rates, occupation, sector, and firm choices. Similarly, Bertrand et. al. (2010) find that the career outcomes of MBAs from top U.S. business schools differ by gender. Lesser job experience, greater career discontinuity, and shorter work hours for females

as results of children play a key role in this regard. As a result, we can speculate that at least some of these drivers are also driving the divergence of the earnings trajectories of men and women in our samples.

We confirm hypothesis 2 and thereby that highly educated men and women respond differently to family-related events. Accordingly, we once again infer that gender roles provide a good explanation for gender differences in Danish labor market outcomes.

4.3 Conclusive remarks

In Analysis I, we predicted the earnings of cohorts of Danish wives at age 40, as if they had been men. Our results showed that for most cohorts, the majority of wives have higher predicted earnings than their husbands. Despite this, in the vast majority of married couples, the husband has higher actual earnings than the wife. Of the wives who have higher predicted earnings than their husbands, only 31 percent also have higher actual earnings than their husbands. This share represents an increase of 3.7 percentage points from 40-year old wives in 1995 to 40-year old wives in 2003, and 4.6 percentage points from 40-year old wives in 2003 to 40-year old wives in 2011. Assuming that these wives do not hold a comparative advantage over their husbands in home production (as discussed in section 3.3.2), this contradicts Becker's specialization theory (1973).

Analysis II showed that the earnings trajectories of highly educated men and women diverge sharply and significantly upon becoming a parent. After having their first child, women have many years with lower earnings relative to before they became parents. By year ten, the earnings of highly educated men have increased by around 15 percent relative to the year before parenthood after controlling for lifecycle- and year trends, while the earnings of highly educated women have barely recovered. The dynamics among highly educated individuals are somewhat different from those of low educated

individuals in the sense that the earnings of highly educated women drop less than those of poorly educated women's; however, the gender gap from parenthood is similarly large due to the earnings premium of highly educated men. Looking at our data, we find that the earnings divergence of highly educated men and women upon parenthood cannot be explained by all these women having lower human capital levels than their husbands which could lead them to specialize in home production as would make sense according to Becker's specialization theory (1985). Despite causing a significant earnings divergence among low educated men and women, we could not infer a sharp and statistically certain effect from marriage on highly educated individuals.

In summary, we have found evidence of 1) wives earning less than their husbands despite having higher predicted earnings based on their educational background and experience; and 2) men and women with equally high levels of market-oriented human capital responding differently to family-related events. Together, these findings suggest that gender roles do play an important role in explaining the labor market outcomes of Danish men and women.

5. Discussion

From our analysis, we have found evidence of 1) wives earning less than their husbands despite having higher predicted earnings based on their educational background and experience; and 2) men and women with equally high levels of market-oriented human capital responding differently to family-related events. We thereby conclude that gender roles do seem to influence the labor market outcomes of Danish men and women beyond their choice of education.

In particular, we have found that women tend to specialize in the home while men tend to specialize in the labor market, even when the spouses' comparative advantages

from human capital investments suggest this to be a suboptimal division. This is even the case for individuals who have made the most efficient human capital investments possible.

To better understand the underlying drivers behind the labor market behavior of Danish men and women, we will discuss potential ways in which gender roles can lead couples to divide their labor inefficiently and highly educated women but not men to earn less when becoming a parent. Based on existing literature, we argue that gender roles can drive these results through dynamics within couples or through dynamics in the labor market. More specifically, we present six potential drivers of our results. Within couple dynamics, we look at three potential drivers: couples valuing traditional gender roles, couples imperfectly judging the labor market productivity of each spouse, or women not being suited for the labor market. Within labor market dynamics, we look at three equivalent drivers: employers valuing traditional gender roles, employers imperfectly judging the labor market productivity of each gender, or the labor market not accommodating women. In the below, we discuss each of these drivers in the context of previous research, and finally conclude whether any are more probable than others.

5.1 Couple dynamics

Gender roles can lead to the seemingly irrational division of labor within many Danish households as well as the downscaling[9] by highly educated women in the labor market following parenthood by impacting spouses' preferences, self-perceptions, and personality traits. One possibility is that gender roles foster a preference among couples

[9] By downscaling, we refer to the observed drop in earnings of highly educated women relative to those of highly educated men following parenthood (i.e. we do not necessarily imply that this is a downscaling in hours worked; we simply refer to the downscaling in earnings which can be driven by several factors including but not limited to a downscaling in hours worked).

for a traditional division of labor, leading couples to divide their work in a way which is optimal from a utility perspective, but not from a productivity perspective. Another possibility is that gender roles make couples overestimate men's labor market potential relative to women's, leading couples to divide their work in a way which they *perceive* to be optimal from a productivity perspective, although it might really be suboptimal. A final possibility is that husbands due to their personality traits have a comparative advantage over their wives in the labor market, even when the wife is better educated. All three potential drivers will be discussed in the below.

5.1.1 Driver 1: Couples value traditional gender roles

The results from our analyses could be explained by one or both spouses within a couple valuing traditional gender roles, where men earn the majority of household income in the labor market, and women do the majority of housework. This would be in line with Akerlof and Kranton's 'identity model' of economic utility (2010) where an individual's utility depends positively on their adherence to gender norms and negatively on divergence from gender norms. If true, while not maximizing their joint income, Danish couples could still be maximizing their marital utility when dividing work such that the wife specializes in domestic work while the husband specializes in the labor market, even though their human capital levels dictate that the reverse division would be more efficient.

This reasoning is much in line with previous findings that have proven the influence of gender roles on labor market outcomes. By examining the development of the US population's attitudes towards gender roles from 1977 to 2006, Fortin (2015) finds that the female labor force participation rate increases (decreases) with the proportion of the population who value egalitarian (traditional) gender roles.

Looking into the issue of household division of labor, Thielemans et al. (2019) find that Danish marriages are most stable when the wife performs the majority of routine household activities. Similarly, Bertrand et. al. (2015) find larger dissatisfaction and a sharp increase in divorce rates in the US when husbands earn less than their wives. Much like our finding from section 4.1.4, they also show that when the wife's potential income is likely to exceed her husband's, wives are less likely to participate in the labor force and more likely to earn less than their potential if they do work. Furthermore, the same study reveals that the gender gap in household production (with women producing the most) is *larger* when the wife earns more than the husband. This is also found by Bittman et. al. (2003) who investigate American and Australian couples. Indeed, this sort of division of labor contradicts Becker's theory of marriage and division of labor which predicts a negative relationship between a spouse's share of market income and relative contribution to home production. Instead, it confirms Akerlof and Kranton's identity model where divergence from gender norms is costly. Moving beyond earnings, a Swedish study moreover reveals that the probability of divorce more than doubles when a wife is promoted to a top job, whereas there are no implications for marriage stability when husbands are promoted (Folke & Rickne, 2020).

The phenomena described above can be driven by either men, women, or both preferring to adhere to their respective gender roles. Furthermore, either men, women, or both might prefer to have a spouse that adheres to *their* gender roles. Whether wives who earn more than their husbands also perform the majority of household duties to satisfy their own gender identity or to satisfy their husband therefore remains an open question. The literature provides no finite answer for this, and it is possible that all the mechanisms take place. On the one hand, some research suggests that men avoid female partners that appear to be more intelligent and professionally ambitious than themselves (Fishman, et al., 2006; Brown & Lewis, 2004; Greitemeyer, 2007).

Accordingly, single female students have been found to underreport their ambition levels relative to female students in relationships when told that their answers will be shared with male peers (Bursztyn, et al., 2017). This could indicate that men like women to adhere to traditional gender roles. On the other hand, female gender identity formed during childhood has also been found to explain the degree of gender conforming labor market behavior of women. For example, women incur a larger child penalty if they have grown up in traditional families with a male breadwinner and a female homemaker (Kleven, et al., 2019), and due to gender-specialized parenting, women act more gender conforming in terms of choice of education and occupation when having a brother relative to a sister (Brenøe, 2018).

5.1.2 Driver 2: Couples imperfectly judge their productivity

Another potential explanation for our results could be that gender roles lead couples to imperfectly judge the labor market potential of each spouse. Rather than deliberately dividing labor according to traditional gender norms, differences in characteristics between men and women may systematically lead couples to erroneously evaluate the husband to be the spouse with the highest predicted earnings and with the comparative advantage in the labor market.

By examining gender differences in how individuals estimate their own IQ scores, Furnham, Crawshaw and Rawles (2006) show that men overestimate their intelligence and abilities, while women tend to underestimate theirs. This finding is confirmed by Fortin (2008), who examines gender differences in noncognitive traits, and also finds that men have higher self-esteem than women. Investigating how groups select a leader, Reuben et al. (2012) find that men are selected as leaders more often than they should based on their actual abilities, because of a male tendency to exaggerate past performances. It is worth mentioning that this exaggeration is not found to be intentional; men are honestly overconfident when recalling their own performance,

independently of whether or not a leadership position is at stake. This gender difference in overconfidence is found to explain why groups select women as leaders much less than what would be optimal for the group given their abilities (Reuben, et al., 2012).

Such a male overconfidence could thus offer a potential explanation of our finding that husbands often end up specializing in the labor market in spite of the opposite being more efficient from a productivity perspective. If the husbands of highly educated women overestimate their own labor market potential to the extent that it seems to exceed their wives', this can further explain why even those women with the highest levels of human capital do not realize their earnings potential.

While the research on potential under-confidence of women is somewhat ambiguous, other researchers have e.g. found women to underreport their abilities when knowing these would be shared in public. This implies that women are more "modest" in public than under private conditions (see e.g. Heatherington, et al., 1993; Kay & Shipman, 2014). Another study, as referred to in section 5.1.1 above, examines MBA students and finds a significant difference in how single women and women in a relationship describe their ambition levels. When told that their answers would be shared with fellow students, single women drastically underreported their ambition levels relative to the women already in a relationship (Bursztyn, et al., 2017). This indicates that women may try to act more gender conforming to satisfy a potential spouse, as was discussed in section 5.1.1. Resultingly, if women deliberately underreport their abilities and/or ambitions to their spouse, it might only be the husband who misjudges their relative labor market potential.

5.1.3 Driver 3: Women are not suited for the labor market

Another potential driver for our results is that women have been socialized such that their personality traits make them unproductive in the labor market or make them

derive less utility from the labor market relative to men. This would make women less likely to specialize in market work than men and more likely to specialize in home production, all else equal.

Johnson et. al (2018) suggest that the Big Five and Dark Triad personality traits are correlated with annual earnings, and these traits are found to systematically and cross-culturally differ between men and women (Schmitt, et al., 2008; Jonason, et al., 2017). In fact, researchers have found that personality traits tend to vary more between men and women in countries where there is larger gender equality (Falk & Hermle, 2018; Giolla & Kajonius, 2019). This so, as these are often also countries with high economic development and thus higher availability of and gender-equal access to material and social resources which allow the genders to manifest their varying preferences to a larger extent (Ibid.).

Similarly, Fortin (2008) finds that the importance of money/work has positive effects on wages, while the importance of people/family has negative (but not always significant) effects. This so, as the level of importance one puts on money/work vs people/family influences one's choice of job including the effort level, altruistic rewards, and wage associated with the job. She also finds that men tend to place higher value on the former while women tend to place higher value on the latter, and she thereby argues that such differences in personality traits modestly help explain the gender pay gap. Fortin (2008) furthermore finds that women place high value on "*Opportunities to work with people rather than things*" and "*Opportunities to be helpful to others or useful to society*" when choosing their career. Women therefore derive less utility from pursuing the higher-paying male-typical jobs, assuming that they do not emphasize those traits. Instead, women will tend to pursue lower-paying female-typical jobs and/or specialize in home production even if they have undertaken higher human capital investments than their husbands. One can also speculate whether women

simply enjoy childcaring more than men do, but this is not found to be the case (Connelly & Kimmel, 2013).

The same inferences can be made regarding other female-typical traits. For example, as accounted for in section 5.1.2, women are found to be less self-confident than men. This gender difference in overconfidence is found to explain why women are not selected as leaders (Reuben, et al., 2012), and as such, lack of confidence might make women less productive in market work relative to men.

5.2 Labor market dynamics

In addition to the potential dynamics within couples outlined above, gender roles can also lead to suboptimal division of labor within households or different labor market outcomes of men and women with equally high human capital characteristics by impacting how employers act and think. One possibility is that gender roles lead employers to prefer employing men over women. Alternatively, gender roles might induce employers to perceive a man's labor market productivity as higher than a woman's. Finally, the labor market might fail to attract and incentivize women by not appealing to female personality traits. All the drivers imply that men will be more likely to receive a job offer than women, and/or women will face inferior incentives in the labor market. As a result, men will be more likely to specialize in the labor market relative to their wives, even when the wife has a higher level of human capital. All three potential drivers will be further discussed below.

5.2.1 Driver 4: Employers value traditional gender roles in jobs

Our results might be explained by employers consciously or unconsciously having a preference for men over women. If true, the real predicted earnings of women are lower than those of their male counterparts with the same level of human capital. It is then

rational for more couples to let the wife specialize in home production and the husband in labor production, even though the wife would have higher predicted earnings than her husband had she been a man.

The literature provides plenty of evidence which could indicate that employers prefer to hire men over women. For example, Goldin and Rouse (2000) show that female musicians auditioning for the top US symphony orchestras became 50 percent more likely to advance from a preliminary round to the next round and several fold more likely to be selected in the final round after the adaptation of blinded auditions. In fact, the blinding is estimated to account for 25 percent of the orchestra's 20 percentage point increase in share of women during 1970-1990 (from 5 percent to 25 percent). Terrell et. al. (2017) show that women have a larger contribution acceptance rate than men in open source software communities when they cannot be identified by gender, while this is not the case when gender is observable. Similarly, Johnson and Kirk (2020) find that female applicants began to have higher success rates than male applicants applying for funding and access to the Hubble Space Telescope, once personally identifying information was blindfolded from the applications. Men have moreover been found to receive significantly more call backs than women when applying for jobs in large U.S. law firms (Rivera & Tilcsik, 2016).

As accounted for in section 2.1.2, if employers perceive a negative value associated with a minority worker, this would be referred to as taste-based discrimination. In the context of gender, Akerlof and Kranton's identity model (2010) claims that, as a result of socialization, employers in occupations that are labeled "men's jobs" can lose utility from deviating from gender norms and hiring a woman. While these mechanisms might happen unconsciously, it can lead employers in men's jobs to refrain from hiring a female candidate even if she is objectively speaking more qualified for the position than any male candidate. As many traditionally male jobs offer higher pay than female jobs,

this also means that even if a wife in our model from section 4.1 has higher predicted earnings than her husband, her real earnings potential may actually be lower, because she will not be employed for the higher-paid male jobs. Alternatively, if employed, she will have to settle for a lower wage than men in those jobs and generally adhere to higher performance standards to compensate employers for their disutility.

In this context, a related phenomenon is the well-documented status quo bias in individuals' decision-making processes (Samuelson & Zeckhauser, 1988). Since 2/3 of full-time employees in the private sector and 12.3 percent of CEOs in Denmark are men, the presence of such a bias in the Danish labor market could entail that private employers and board members unconsciously prefer to hire more men for these roles. Johnson, Hekman and Chan (2016) tested this bias specifically in the context of changing the status quo among finalists for a job position. They found that participants tended to recommend hiring a male candidate when the finalist pool they were given contained a majority of men, whereas they recommended a female candidate when the pool contained a majority of women. Thus, women can have lower chances of getting hired if the majority of the other applicants for the job are men, which lowers the real potential earnings of women working in typical men's fields. A similar cognitive error is that of in-group bias where individuals favor and have higher empathy for members of their own group (e.g. Balliet, et al., 2014). The effect of this is shown to be stronger when in-group members have social ties, compared to when they have just been labeled as belonging to the same group (Goette, et al., 2012). With this bias in mind, women may be kept out of the labor market due to what is often known as *the old boys' club* (Cullen & Perez-Truglia, 2020). Here, established business relationships between men mean that women, who are not part of this club, will have a harder time getting hired or being promoted to prominent positions. In the case of status quo bias and in-group bias, husbands may have comparative advantages over their wives in the labor market even though they have lower human capital levels. This could explain couples'

seemingly irrational division of labor as found in section 4.1.4 as well as why highly educated women to a larger extent than highly educated men scale back in the labor market after having their first child as found in section 4.2.4.

5.2.2 Driver 5: Employers imperfectly judge genders' productivity

Our results could also be explained by employers making imperfect judgements about the genders' productivity in the labor market in a way which favors men. In fact, the empirical results outlined in the beginning of section 5.2.1 as indicators of employers having a preference for men over women, might just as well be indicators of employers misjudging employees as a result of their gender.

Firstly, this can happen through statistical discrimination where decision-makers may use expected group-averages or stereotypes to fill an information void, as accounted for in section 2.1.2. In our case, employers may use gender as an easily observable characteristic to infer the expected productivity of candidates in response to having limited information. If employers believe that men are more likely than women to possess productivity enhancing characteristics such as intelligence and commitment, they will be more likely to hire men, ceteris paribus, and women will have to settle for lower wages.

This is consistent with the finding of women with the same level of ability as men obtaining extra years of schooling, because education is more important for signaling ability among women than men (Nielsson & Steingrimsdottir, 2018). Indeed, laypeople's beliefs about the importance of raw intellectual talent for success within a field has been found to be predictive of the field's female representation (Meyer, et al., 2015). Moreover, a large body of literature documents that people tend to associate e.g. intelligent ability more frequently with men than with women (see e.g. Bennett, 2000; Leckklider, 2011; Dutt, et al., 2016). For example, parents rate their sons'

intelligence higher than their daughters' (Furnham & Gasson, 1998). Despite consistent evidence that young girls use a more complex language than young boys do, parents search Google for information on whether their sons are "gifted" 2.5 times more than they do with their daughters (Stephens-Davidowitz, 2014). Furthermore, women are less likely to be referred by their affiliates for an open role if the job description mentions intellect (Bian, et al., 2018). Bian, Leslie, and Cimpian (2018) show that this stereotype of high intellectual ability being a male quality is endorsed by children as young as 6. Another recent study finds that while belief in competence equality has increased remarkably in the US over the past decades, women are still perceived as more communal (compassionate, emotional, generous, and other traits related to social-skills), and men are still perceived as having higher agency (self-oriented traits like ambitious, assertive, and competitive) (Eagly , et al., 2019).

Our finding from section 4.2.4 that the earnings trajectories of highly educated men and women diverge sharply when they have their first child is also consistent with many studies documenting discrimination against mothers (e.g. González, et al., 2019; Datta Gupta, et al., 2008; Fuegen, et al., 2004) (although one study, Bygren, et al., 2017, finds no evidence of discrimination against mothers in Sweden). As apparent from our analysis, mothers scale back on their careers upon parenthood more often than fathers do, and employers can therefore – consciously or subconsciously – use gender and parental status to infer whether candidates will be committed and productive in the job. As a consequence, employers might pay mothers less or deny them promotions. However, even if such employer perceptions about mothers being less productive are actually incorrect, mothers might still behave exactly as employers predict in response to having fewer labor market incentives. Accordingly, the decrease in earnings of mothers could be also explained by inaccurate statistical discrimination, rather than actual low levels of commitment (Gronau, 1988).

Secondly, imperfect judgement of the genders' productivity can happen by being under the influence of gender dependent attribution bias, as described in section 2.1.3. Due to stereotypes of men having e.g. higher intelligence than women as outlined above, employers might, consciously or unconsciously, attribute good outcomes to ability (internal factor) for men and to noise (external factor) for women, or conversely attribute bad outcomes to ability for women and noise for men. Attribution bias can therefore result in employers evaluating the past performance of men and women differently, which can have unfavorable consequences for women in e.g. hiring processes, promotion processes, and negotiation settings.

The literature provides plenty of evidence of such effects. For example, female financial advisors are more likely to be fired for misconduct than male advisors are (Egan, et al., 2017). Sarsons (2017) shows that female but not male surgeons experience a large drop in referrals from physicians after a patient death, while male but not female surgeons experience an increase in referrals after a good patient outcome. Furthermore, a bad experience with a female surgeon makes physicians less likely to refer to other female surgeons, whereas an experience with one male surgeon has no impact on a physician's behavior toward other male surgeons. Generally, individuals in gender-incongruent jobs are shown to be judged more harshly than their gender-congruent counterparts when making small mistakes (Brescoll, et al., 2010). This has implications for women pursuing higher-paid male-typical jobs, such as those in our highly educated sample from section 4.2 (as well as men pursuing typical women's jobs for that matter).

Thirdly, employers can misjudge genders due to their different communication styles. For long, the labor market been dominated by men, and workplaces can therefore have internalized typical male communication styles.

Tannen (1995) explains that girls and boys grow up internalizing different linguistic norms, and that these norms follow individuals into their workplace. Girls spend a lot of time playing in small groups in which they learn conversational rituals that focus on relationships and a delicate game of balancing one's own needs with those of others to avoid appearing e.g. "bossy". On the contrary, boys play in larger groups where not everyone is expected to be equals, and those with high status are expected to emphasize rather than downplay this status. For these reasons, Tannen argues that conversation between men and women can be like cross-cultural communication. This means that women may be interpreted by employers as being e.g. less ambitious or confident, which can make them appear less productive, ultimately reducing their wages.

Indeed, there are indications of such misperceptions of women's signals in the Danish labor market. In a large survey conducted among Danish companies, two-thirds of HR executives reported that their female employees had other priorities and lacked the motivation to get promoted into top leadership positions. However, within those same companies, 73 percent of female leaders stated the exact opposite, namely that they were actively seeking a promotion or had recently been promoted (Poulsen, 2016). Obviously, this miscommunication limits women's opportunities to advance in their careers.

5.2.3 Driver 6: The labor market does not accommodate women

A final potential explanation for our results is that the labor market has not adjusted to be able to attract and develop female talent.

From a historic perspective, women's entrance and greater advancement into the labor market is relatively new, and men have been the primary talent mass available to employers. As already touched upon, it is therefore natural that incentive schemes and work methods have been structured in ways that cater to male rather than female

personality traits. For example, in prominent high-paying occupation fields, the incentive schemes and promotion structures might be largely characterized by competition and monetary rewards.

However, when women, as Fortin (2008) finds, place lower importance on monetary rewards and higher importance on "*Opportunities to work with people rather than things*" and "*Opportunities to be helpful to others or useful to society*", women will be less inclined to pursue such prominent occupation fields. Moreover, they will be less likely to advance in their careers when employers have not adjusted their incentive schemes to cater to women's preferences.

That being said, there seems to already be a trend of companies shifting to a culture which might be more appealing to women. For example, 181 CEOs from the largest US corporations have signed a *Business Roundtable Statement on the Purpose of a Corporation* (Business Roundtable, 2019) in which they commit to lead their companies in a way that benefits all stakeholders rather than just optimizes returns for their shareholders. When corporations adopt such a societal impact view, it is claimed to be advantageous for attracting, engaging, and retaining talent (Beal, et al., 2017), and perhaps especially women, cf. Fortin's (2008) conclusions.

Nevertheless, the labor market might not accommodate female personality traits fully yet. Hence, husbands may have higher labor market productivity than wives even when they have lower human capital levels. Alternatively, couples maximize their utility by dividing work such that the husband specializes in market work and the wife specializes in domestic work, even when their human capital levels dictate that the reverse would be optimal from a productivity perspective (absent gender roles).

5.3 Conclusive remarks

In sum, we have identified six drivers through which we believe gender roles can be driving our results of wives earning less than their husbands despite having higher human capital levels, and highly educated women but not men scaling down on their careers upon parenthood. We have argued that gender roles can 1) foster a preference within couples for adhering to a traditional division of labor; 2) make couples overestimate men's labor market potential relative to women's; 3) make women less productive in and/or derive less utility from market work relative to men because of how they have been socialized; 4) lead employers to consciously or unconsciously prefer hiring men over women; 5) make employers overestimate men's labor market productivity relative to women's; or 6) make women less productive in and/or derive less utility from market work relative to men because the labor market has not adapted to accommodate female personality traits. In the scenarios described, husbands will either hold or be believed to hold a comparative advantage in the labor market relative to their wives, or the couples will derive a larger joint marital utility from having the husband specialize in the labor market and the wife specialize in home production, despite the higher human capital investments of the wife.

The existing literature provides evidence of all drivers, and it is difficult to conclude which of these drivers best explain the labor market behavior of Danish men and women observed in our analyses.

Examining whether couple dynamics may be at play, we can mainly rely on the existing findings of Kleven et al. (2019) and Brenøe (2018). They also examine Danish administrative data and find family factors such as the mother's labor market outcomes and sibling composition to augment the gender conformity of Danish women's labor market behavior. Considering we use the same raw data as them, it is likely that our results are driven by the preference for adhering to traditional gender roles established

by Kleven et al. (2019) and Brenøe (2018). Furthermore, as discussed in section 4.1.4, the wives from our first analysis who have higher predicted earnings but lower actual earnings than their husbands had an average predicted earnings advantage of 21-42 percent. With such a large predicted earnings advantage, it seems unlikely that one or both spouses misjudge the husband to have the greatest labor market potential. This line of thought can also be applied to our results from analysis II given that 63% of the wives from cohort 1963 with master's degrees are married to husbands with lower educations than themselves. Finally, it is difficult to say from our data whether women may have been socialized to be less productive in and/or derive less utility from the labor market. Considering that analysis I showed an increase in female human capital investments over time, it seems as if women expect to be productive in the labor market when choosing their education, as otherwise it would not make sense for them to undertake these ambitious human capital investments. However, it may be that these perceptions change once women actually enter the labor market or particularly, as our data suggests, when the women have children.

In sum, if couple dynamics are driving our results, it seems most probable that these dynamics are either related to couples valuing traditional gender roles or women being less suited for the labor market than men.

Meanwhile, it is also possible that labor market dynamics, rather than couple dynamics, are driving our results. Considering how the earnings of highly educated men and women diverge following parenthood, it may be the case that employers value traditional gender roles. Considering that the highly educated men and women have very similar earnings trajectories up until the birth of their first child, our results could very well be driven by employers discriminating against mothers. However, this same finding could also be driven by employers imperfectly judging the respective productivity of men and women, estimating that of men to be greatest. Finally,

revisiting our sample sizes from analysis II reveals that there are more highly educated men than women in both event studies (1,571 men vs 658 women for the study of marriage and 2,065 men and 1,016 women for the study of parenthood). If this is representative and there are more highly educated men than women within the relevant fields of education, it could also be the case that these occupations are structured to cater to male personality traits rather than female traits, i.e. the labor market has not adapted to accommodate women. This would result in women deriving less utility from these occupations and could explain why we see the earnings of highly educated women dive sharply after parenthood, while those of men do not.

In sum, if labor market dynamics are driving our results, while difficult to say with certainty, it is possible that this takes place through employers having a conscious or unconscious preference for men over women or that the labor market does not cater to women yet. However, with most likelihood, all six drivers reviewed in this discussion section are impacting the labor market behavior of Danish men and women at the same time.

6. Implications and suggestions for further research

Our empirical results suggest that gender roles impact the labor market outcomes of Danish men and women such that women do not realize the labor market potential that their human capital investments would allow them to, had they been men. Instead, in around 1/3 of couples, spouses seem to divide their efforts between the labor market and the home in a way which is inefficient from a productivity perspective. Furthermore, women with high levels of human capital experience a sharp drop in earnings when they become parents, while comparable men do not.

While the concrete implications of our results depend on the underlying drivers, they indicate potential inefficiencies that can lead to suboptimal decisions for households,

companies, and society as a whole. An example of how the current situation may be suboptimal for society can be seen from an estimation of Danish women's net contribution to the national economy. This contribution is found to be negative despite the fact that Danish women obtain long educations (subsidized by the government). Danish women extract more than they contribute because they systematically take long parental leaves, scale down on their careers after having children, and tend to work in the lower paid public sector (Andersen, 2020). Moreover, Denmark is not realizing well-documented benefits from diversity in the workplaces (see e.g. Gompers & Kovvali, 2018; Turban, et al., 2019), and leadership positions that have high importance for societal prosperity could potentially have been filled by women better qualified than those men who currently hold them. In addition, there may be high opportunity costs associated with allocating education places to women rather than men (assuming there are a limited amount of spaces), if women do not yield the same subsequent return.

If the Danish labor market is truly impaired by inefficiencies such as those described above, an open question then remains: to what extent is it possible to change how gender roles impact the labor market outcomes of men and women?

An extensive amount of research has been conducted within this field, and the coming examples only constitute a small fraction of initiatives that have been found to have an effect.

If our results are driven by dynamics within couples themselves, emphasis should be placed on altering each spouse's need for adhering to gender roles and boosting women's confidence about their labor market potential. To do this, educational institutions and companies could for example highlight role-models of their minority-gender, since same-sex role models are shown to influence perceptions of what are appropriate jobs

for men and women (Marini & Brinton, 1984; Eccles & Hoffman, 1984). Parents could also consider having the father participate more in the parenting of daughters, since gender-specific parenting makes daughters act more gender conforming (Brenøe, 2018).

Furthermore, the government could remove the earmarking of mothers' parental leave which promotes mothers' specialization in home production and fathers' specialization in (and importance to) the labor market. Alternatively, they could also earmark an equal amount to fathers, since it has been found that when fathers take a larger share of the leave, the intra-household gender wage gap decreases (Steingrimsdottir & Vardardottir, 2014). Moreover, women should be better informed about their labor market potential given their human capital levels. This can be done through e.g. transparency laws, which have been shown to decrease gender wage gaps (Baker, et al., 2019; Bennedsen, et al., 2019).

If our results are instead driven by labor market dynamics, measures should be taken to reduce bias and the use of inaccurate statistical discrimination by employers. A first step would be to acknowledge gender bias, as only 3 percent of Danish men currently recognize the existence of a diversity bias problem (Poulsen, et al., 2019). To then reduce bias, employers could conduct diversity training at work, which has been proven a helpful tool (Bezrukova, et al., 2016). Employers could furthermore consider how they phrase job descriptions to make them more appealing to female personality traits and anonymize applications during hiring processes (see e.g. Goldin & Rouse, 2000). Accordingly, women could be trained to better describe and promote their qualifications, to avoid leaving employers with an information void that leads to statistical discrimination. Finally, fathers could take parental leave and thereby signal their co-commitment to childcare and domestic chores to the mother's employer, as this has been found to increase the employer's expectations to the mother's labor market productivity (Schober, 2014).

Once again, the initiatives discussed in this section are by no means an exhaustive list of things that could mitigate how gender roles hamper women's labor market outcomes, but they exemplify that change is indeed possible. If our results are causing true inefficiencies for society and households, policymakers should consider the implementation of some of the initiatives outlined above. However, further research is needed to confirm whether this is the case.

For example, it would be relevant to compare the benefits of spousal specialization to the benefits of a more equal division of labor in households. Research on spousal specialization related to parental leave has yielded ambiguous results, indicating that Becker's claim that specialization is necessarily optimal may not be true (see e.g. Johansson, 2010; Cools, et al., 2011; Ekberg, et al., 2013; Andersen, 2017). The same goes for examining the effects of shared versus specialized caregiver roles on children's development, since we know that gender-specialized parenting impacts the adult labor market outcomes of daughters (Brenøe, 2018). Finally, it could also be interesting to further investigate the importance of the primary caregiver's level of human capital on children's development. If it is very beneficial for a child that its primary caregiver has a high level of human capital, it may change the current assumption that it is always optimal to have the spouse with the highest level of human capital specialize in the labor market. These are all areas for further research that could add to the interpretation of our results and the associated policy implications.

7. Conclusion

Despite a reversal in the gender gap in education and a long history of family-friendly labor market policies, Denmark lags far behind its Scandinavian peers when it comes to gender parity (World Economic Forum, 2020). This is particularly the case

regarding women in leadership, where World Economic Forum ranks Denmark 102 out of 153 countries worldwide (Ibid).

Using full-population administrative data, we prove that men and women's different labor market behaviors cannot be explained by rational income maximization when taking only their respective human capital investments into consideration. Instead, their behavior seems better explained by the influence of traditional gender roles, where the husband is expected to be the breadwinner and the wife is expected to be the homemaker.

First, we find that more than two thirds of wives who have higher predicted earnings than their husband end up earning less than their husband.

We investigate couples with wives born in 1947, 1955, 1963, and 1971 when the wife is 40 years old. We predict the earnings of both spouses using OLS regressions. Our models are based only on the earnings of men within our specified cohorts and predict earnings as a function of educational background and labor market experience. We find that in all cohorts after 1955, a large majority of wives have higher predicted earnings than their husband. Of those, the share of wives with higher actual earnings than their husband has increased over time; the share rose by 3.7 percentage points from cohort 1955-1963, and 4.6 percentage points from cohort 1963-1971. Resultingly, 31.1 percent of wives from cohort 1971 with higher predicted earnings also had higher actual earnings than their husbands. This seemingly irrational earnings relationship of many couples is driven by a combination of wives underperforming their labor market potential and husbands overperforming theirs. In cohort 1947, wives with higher predicted but lower actual earnings than their husbands earn 48 percent less than they are predicted to while their husbands earn 30 percent more than they are predicted to. In cohort 1971, these wives earn closer to their predicted earnings and underperform their predicted earnings by 33 percent while their husbands overperform by 49 percent.

Second, we find that the earnings of highly educated women and men diverge sharply when they have their first child and do not converge within the following ten years. Meanwhile, highly educated individuals exhibit no immediate responses to getting married. A gender divergence in earnings is only visible a couple of years after marriage, at which point we cannot rule out the impact of children.

We define highly educated individuals as those with at least a master's degree in information and communications technologies, engineering, law, mathematics and statistics, or business, since these are the education fields that yielded the highest earnings in our predicted earnings model. We employ a quasi-experimental event study approach and exploit individual-level variation in timing of getting married and having one's first child, while controlling for lifecycle- and year trends. Upon parenthood, the earnings of highly educated women drop with almost 10 percent and an additional 4-5 percent the following year. This appears to be a smaller immediate effect than for women who have high school as their highest attained degree, since they experience an instant drop in earnings of 30 percent. However, the earnings of highly educated men rise steadily upon parenthood, amounting to a 15 percent earnings premium ten years after becoming a father. At this point in time, the earnings of highly educated women have only recovered to their original level. As a result, the earnings gap between highly educated men and women ten years after the birth of their first child is close to the same as that of poorly educated men and women.

Taken together, these findings demonstrate that the labor market behavior of Danish men and women is, by all appearances, under the influence of gender roles. This is the case even after controlling for differences in men and women's educational choices and means that the labor market may be losing out on female labor market potential. Married couples are not dividing their work such that the spouse best qualified for

market work devotes most effort to this. Furthermore, among those with the most productive education characteristics, women scale back substantially on their labor market efforts relative to their male peers following parenthood, as demonstrated in their earnings trajectories.

We have discussed potential explanations for this, including that gender roles 1) foster a preference within couples for adhering to a traditional division of labor; 2) make couples overestimate men's labor market potential relative to women's; 3) make women less productive and/or derive less utility from market work relative to men because of how they have been socialized; 4) lead employers to consciously or unconsciously prefer hiring men over women; 5) make employers overestimate men's labor market productivity relative to women's; or 6) make women less productive in and/or derive less utility from market work relative to men because the labor market has not adapted to accommodate female personality traits.

We do not attempt to make inferences about the total welfare implications of our findings. We simply highlight that men and women's different labor market choices cannot be solely attributed to income maximizing behavior without the presence of gender roles among couples or employers.

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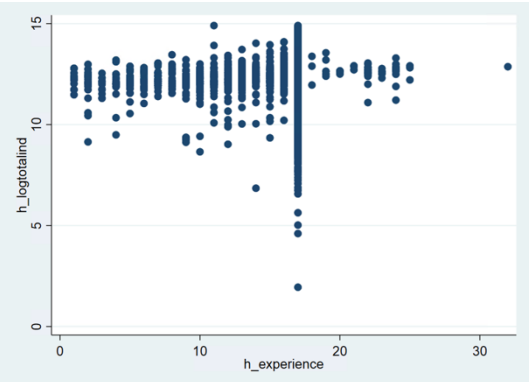
Appendix A: Testing OLS assumptions

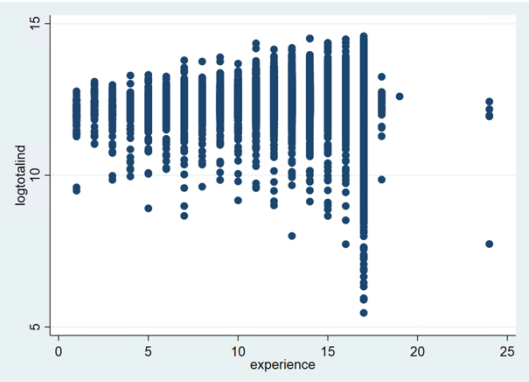
Checking for linearity

Scatterplots of the dependent variable, *ln(earnings)*, against the independent variable, *experience*.

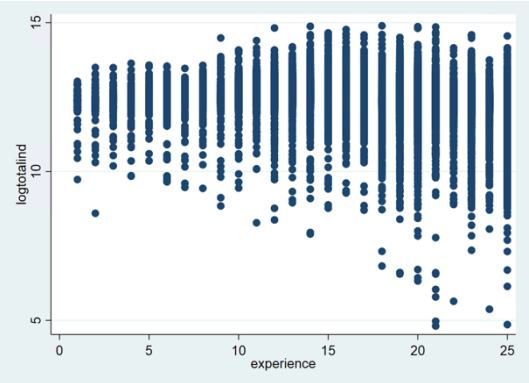
Cohort 1939



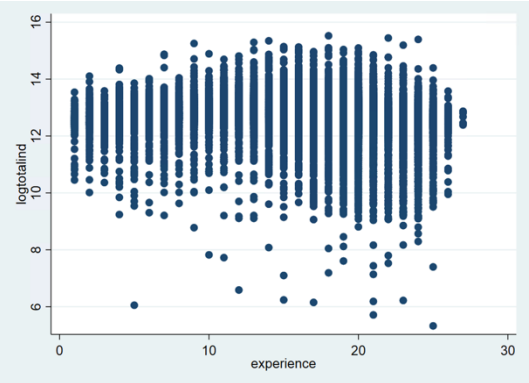
Cohort 1947



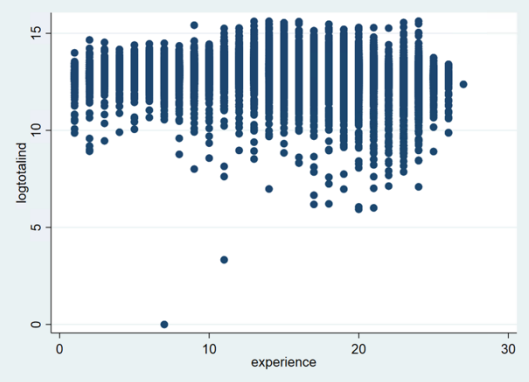
Cohort 1955



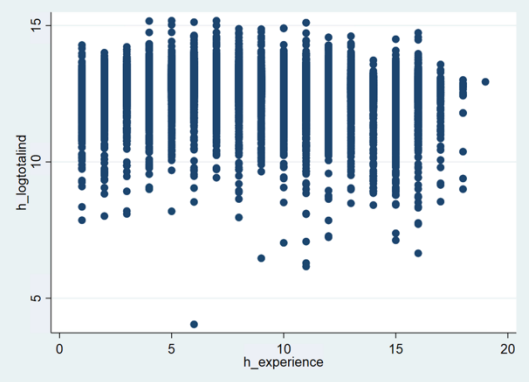
Cohort 1963



Cohort 1971

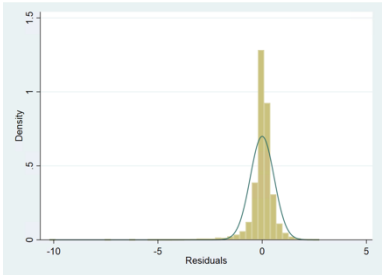


Cohort 1979

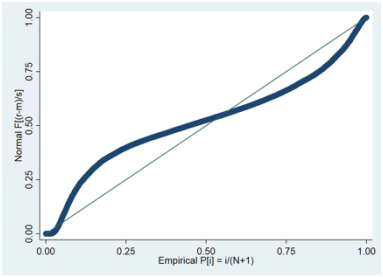


Checking for normality of residuals

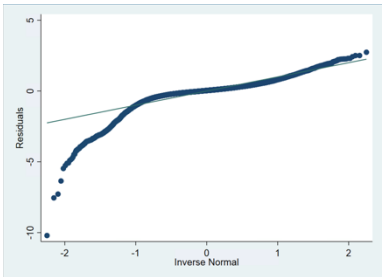
Cohort 1939



Histogram of residuals

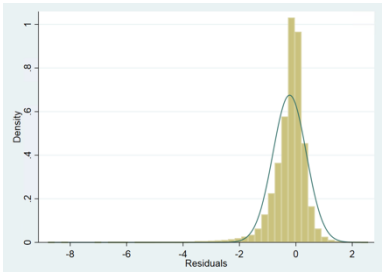


P-P plot

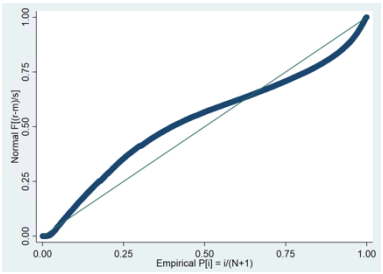


Q-Q plot

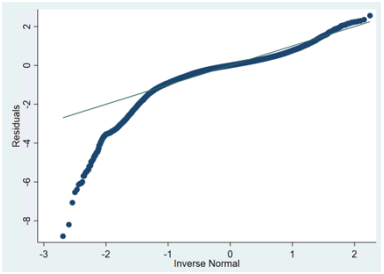
Cohort 1947



Histogram of residuals

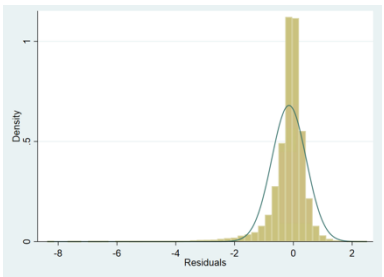


P-P plot

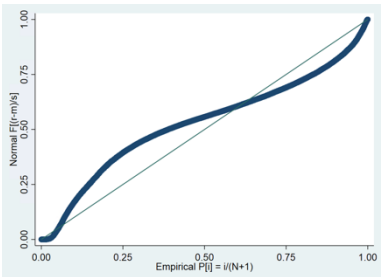


Q-Q plot

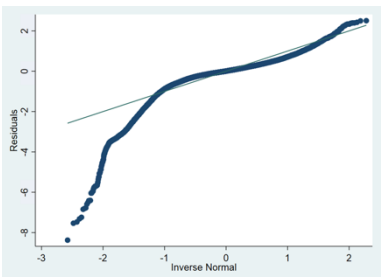
Cohort 1955



Histogram of residuals

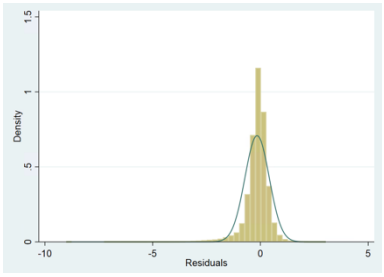


P-P plot

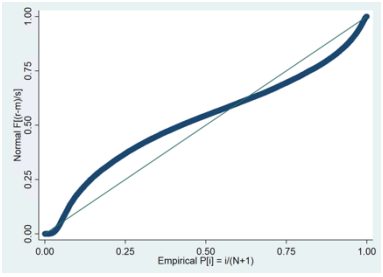


Q-Q plot

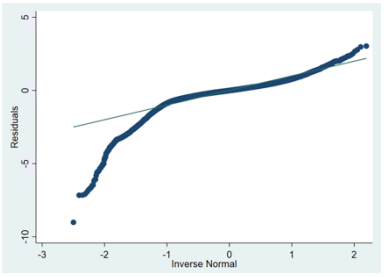
Cohort 1963



Histogram of residuals

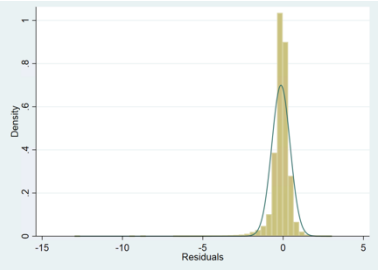


P-P plot

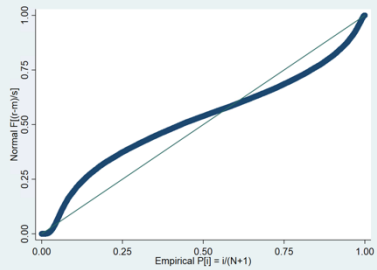


Q-Q plot

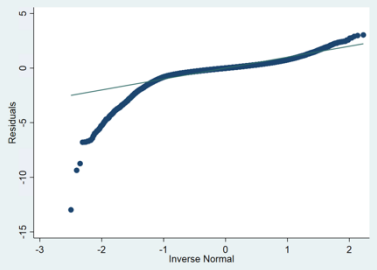
Cohort 1971



Histogram of residuals

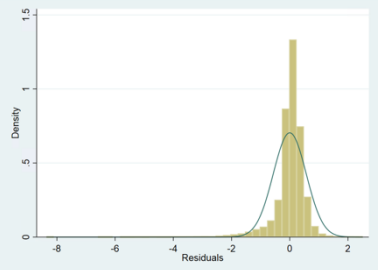


P-P plot

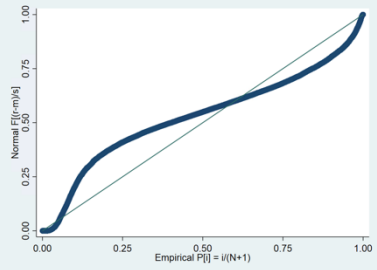


Q-Q plot

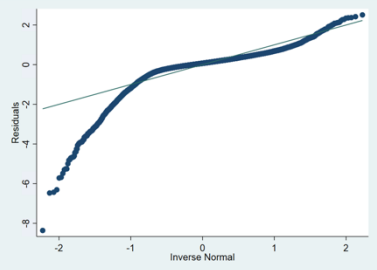
Cohort 1979



Histogram of residuals



P-P plot

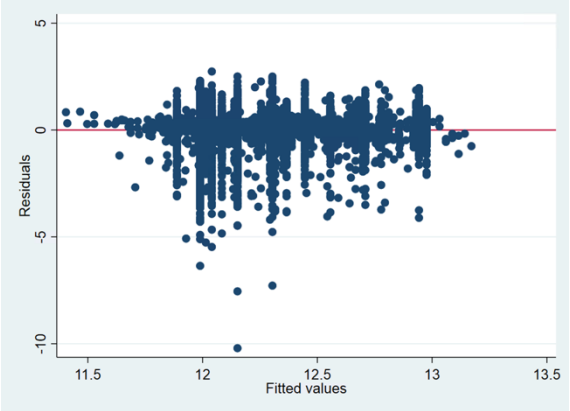


Q-Q plot

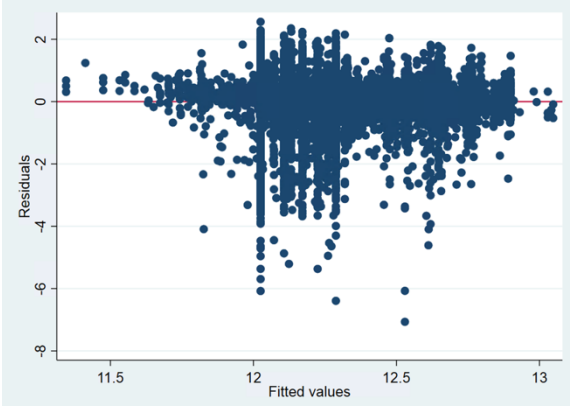
Checking for homoskedasticity

Scatterplots of the residuals against the fitted values for each of the regression models.

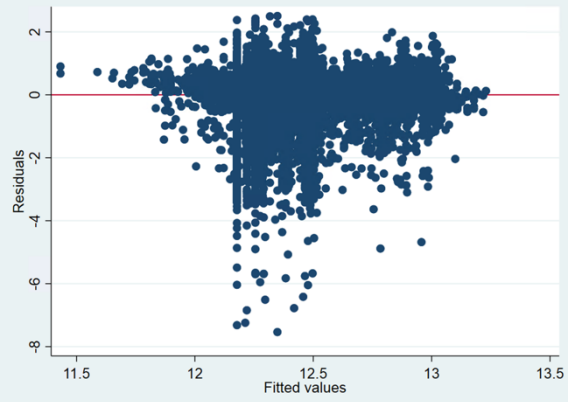
Cohort 1939



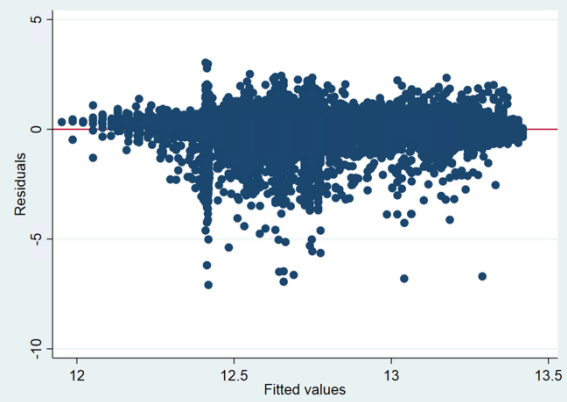
Cohort 1947



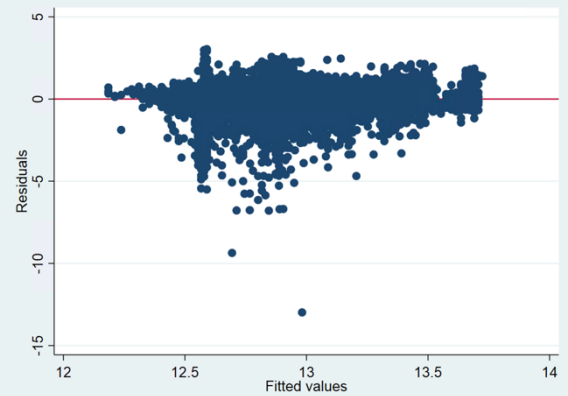
Cohort 1955



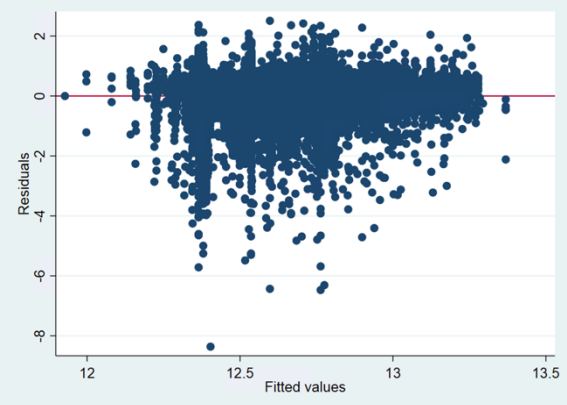
Cohort 1963



Cohort 1971



Cohort 1979



Checking for multicollinearity

Regression VIF values by cohort	**1939**	**1947**	**1955**	**1963**	**1971**	**1979**
Experience	22.60	44.18	39.81	39.02	37.83	35.85
Experience²	22.62	50.41	53.77	55.71	53.27	52.36
Level of education						
High school and vocational educations	20.70	11.24	9.57	8.38	9.08	11.39
Short higher education	3.92	3.34	3.63	4.02	5.21	5.60
Medium higher education	9.95	7.81	7.86	6.63	7.95	9.25
Long higher education	6.73	6.84	6.80	5.60	7.49	9.54
Ph.d. and research educations	1.13	1.61	1.82	1.86	2.00	1.51
Field of education						
1 Basic programmes & qualifications	29.91	17.05	14.94	21.64	12.52	11.15
21 Arts	2.06	1.90	1.69	1.92	1.97	2.01
22 Humanities (except languages)	1.15	1.33	1.37	1.40	1.47	1.50
23 Languages	1.06	1.40	1.36	1.30	1.43	1.44

Regression VIF values by cohort		**1939**	**1947**	**1955**	**1963**	**1971**	**1979**
30	Social sciences, journalism & information n.f.d. [10]	1.02	1.15	1.06	1.07	1.05	1.07
31	Social & behavioral sciences	1.15	1.51	1.59	2.14	2.10	2.16
32	Journalism & information	1.09	1.10	1.15	1.35	1.31	1.33
41	Business & administration	5.59	5.56	4.95	12.17	7.94	7.56
42	Law	1.54	1.54	1.46	1.60	1.52	1.55
50	Natural sciences, mathematics & statistics n.f.d.	1.10	1.45	1.52	1.43	1.41	1.32
51	Biological & related sciences	1.14	1.23	1.27	1.23	1.26	1.29
52	Environment	N/A	N/A	N/A	N/A	N/A	1.00
53	Physical sciences	1.03	1.29	1.30	1.31	1.23	1.27
54	Mathematics & statistics	1.01	1.10	1.08	1.08	1.13	1.11
61	Information & communication technologies	1.06	1.15	1.29	2.13	2.36	2.67
70	Engineering, manufacturing & construction n.f.d.	1.11	1.07	1.03	1.24	1.16	1.07
71	Engineering & engineering trades	7.36	7.42	8.89	18.15	10.47	9.39
72	Manufacturing & processing	2.07	2.58	1.98	4.28	3.00	2.38
73	Architecture & construction	4.01	4.59	4.61	7.53	4.32	4.93
80	Agriculture, forestry, fisheries & veterinary n.f.d.	N/A	N/A	N/A	1.00	N/A	1.00
81	Agriculture	1.73	1.76	2.70	4.58	2.51	2.44
82	Forestry	1.04	1.03	1.06	1.17	1.13	1.13
83	Fisheries	N/A	N/A	N/A	N/A	1.00	1.01
84	Veterinary	1.09	1.08	1.12	1.08	1.04	1.03
91	Health	1.87	2.08	1.98	2.17	1.76	1.92
92	Welfare	1.27	1.47	1.59	2.11	1.89	1.93
101	Personal services	1.43	1.46	1.56	2.03	1.69	1.85
103	Security services	1.40	1.80	2.07	2.35	1.82	2.01
104	Transport services	1.39	1.27	1.36	1.72	1.50	1.68
Mean VIF		**4.87**	**5.67**	**5.74**	**6.54**	**5.73**	**5.37**

[10] n.f.d. = not further defined

Appendix B: Regression results

The coefficients on *Level of education* should be interpreted relative to having a primary school ("folkeskole") education, while the coefficients on *Field of education* should be interpreted relative to having studied *Education* (ISCED 11).

Regression coefficients		**1939**	**1947**	**1955**	**1963**	**1971**	**1979**
Experience		0.0315*	0.0749*	0.0866*	0.0367*	0.0277*	0.0701*
Experience²		-0.0001	-0.0025*	-0.0027*	-0.0007*	-0.0003*	-0.0028*
Level of education							
High school & vocational educations		0.4566*	0.1996*	0.1329*	0.3377*	0.3325*	0.1436*
Short higher education		0.6706*	0.3481*	0.2748*	0.5413*	0.5591*	0.3487*
Medium higher education		0.8614*	0.5581*	0.5172*	0.7648*	0.7550*	0.3933*
Long higher education		1.0827*	0.6973*	0.6468*	0.9043*	0.9382*	0.6622*
Ph.d. & research educations		0.9121*	0.8376*	0.8595*	1.0912*	1.0312*	0.7812*
Field of education							
1	Basic programmes & qualifications	0.5342*	0.3265*	0.3558*	0.3603*	0.2161*	-0.1701*
21	Arts	0.3820*	0.3265*	0.2804*	0.1177*	0.0099	-0.2480*
22	Humanities (except languages)	-0.0678	-0.0982*	0.0061	-0.0827	-0.1400*	-0.4180*
23	Languages	0.1084	-0.0026	0.3560	0.0565	-0.0829*	-0.3445*
30	Social sciences, journalism & information not further defined	-0.1635	-0.0002	0.0712	0.0302	-0.0906	-0.2690*
31	Social & behavioral sciences	0.2734*	0.2133*	0.2917*	0.2691*	0.2429*	-0.0617*
32	Journalism & information	0.1537*	0.2000*	0.1541*	0.2551*	-0.0443	-0.1073*
41	Business & administration	0.3926*	0.3902*	0.3685*	0.3944*	0.3177*	0.1068*
42	Law	0.4050*	0.2577*	0.3720*	0.4601*	0.5046*	0.1147*
50	Natural sciences, mathematics & statistics not further defined	0.1533*	0.1612*	0.2250*	0.1700*	0.1172*	-0.0301
51	Biological & related sciences	0.2567*	0.0691	0.1506*	0.1076	-0.0041	-0.1693*
52	Environment	N/A	N/A	N/A	N/A	N/A	-0.6504*
53	Physical sciences	-0.0367	0.2267*	0.2205*	0.2550*	0.0020	-0.2331*

Regression coefficients		**1939**	**1947**	**1955**	**1963**	**1971**	**1979**
54	Mathematics & statistics	0.3172*	0.3309*	0.3709*	0.4971*	0.2901*	0.0938
61	Information & communication technologies	0.7194*	0.6426*	0.5849*	0.5223*	0.2952*	0.0814*
70	Engineering, manufacturing & construction not further defined	0.2403*	0.4101*	0.4414*	0.4365*	0.3577*	0.2119*
71	Engineering & engineering trades	0.1722*	0.2730*	0.2596*	0.2770*	0.1879*	0.0644*
72	Manufacturing & processing	0.1723*	0.2334*	0.2079*	0.1957*	0.0962*	-0.0392
73	Architecture & construction	0.1286*	0.2088*	0.1667*	0.1679*	0.0551*	-0.1015*
80	Agriculture, forestry, fisheries & veterinary not further defined	N/A	N/A	0.3635*	0.7150*	N/A	-2.883*
81	Agriculture	0.1025*	0.2261*	0.0598*	0.3005*	0.2760*	0.1243*
82	Forestry	-0.0245	0.0058	0.4406	0.1860*	0.1174*	-0.1789
83	Fisheries	N/A	N/A	N/A	N/A	0.1289*	-0.0254
84	Veterinary	0.2316*	0.2915*	0.3908*	0.2512*	0.1465	0.1481*
91	Health	0.4381*	0.4921*	-0.0528*	0.3541*	0.2145*	0.0916*
92	Welfare	-0.0608	-0.0799*	N/A	-0.0102	-0.0862*	-0.1118*
101	Personal services	-0.0235	0.1737*	0.1237*	0.1462*	0.1224*	-0.0692
103	Security services	0.1360*	0.2158*	0.2466*	0.2759*	0.2192*	0.1812*
104	Transport services	0.2269*	0.3210*	0.2669*	0.2397*	0.2016*	0.0430
Intercept		11.4804*	11.1530*	11.2661*	11.5884*	11.9114*	12.1172*
R^2		**0.1421**	**0.1244**	**0.1159**	**0.1455**	**0.1610**	**0.1341**

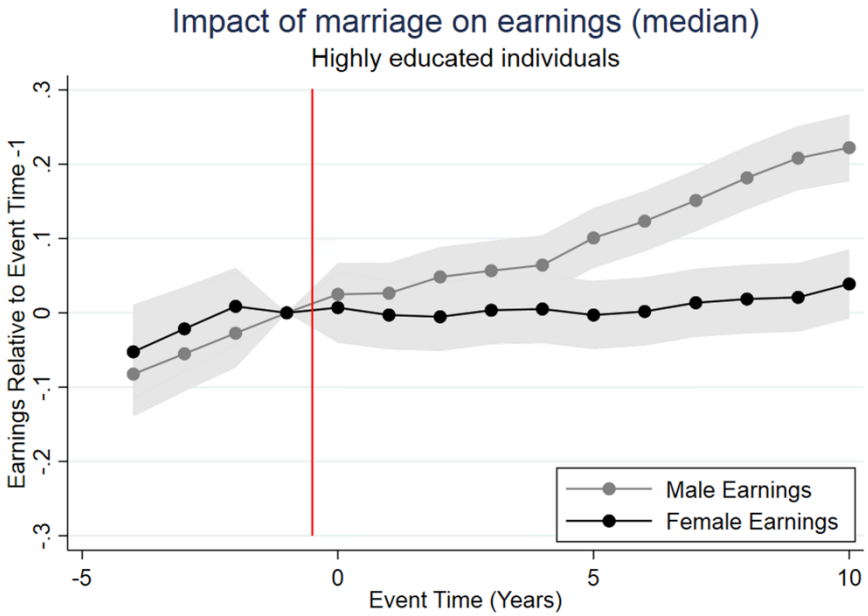
Appendix C: Field of education of husbands and wives

Field of education		Husbands				Wives			
		1947	*1955*	*1963*	*1971*	*1947*	*1955*	*1963*	*1971*
1	Basic programmes & qualifications	28.1%	24.3%	23.3%	17.5%	37.5%	41.4%	22.7%	13.7%
11	Education	3.6%	4.1%	1.8%	2.6%	4.6%	5.0%	3.2%	5.9%
21	Arts	2.3%	1.8%	1.5%	1.7%	0.6%	0.6%	1.0%	1.7%
22	Humanities (except languages)	0.3%	0.7%	0.4%	0.8%	0.1%	0.3%	0.4%	1.1%
23	Languages	0.4%	0.5%	0.3%	0.6%	1.7%	2.2%	2.3%	4.0%
30	Social sciences, journalism and information, n.f.d.[11]	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%	0.1%	0.1%
31	Social and behavioral sciences	0.5%	0.9%	1.1%	2.0%	0.2%	0.4%	0.9%	1.8%
32	Journalism and information	0.2%	0.5%	0.4%	0.6%	0.3%	0.7%	0.5%	0.6%
41	Business and administration	15.2%	13.0%	15.3%	19.5%	28.5%	16.2%	30.1%	29.2%
42	Law	0.7%	0.8%	0.7%	1.2%	0.3%	0.4%	0.8%	1.3%
50	Natural sciences, maths & statistics	0.1%	0.1%	0.2%	0.6%	0.0%	0.0%	0.1%	0.2%
51 -52	Biological and related sciences	0.3%	0.4%	0.4%	0.4%	0.2%	0.3%	0.6%	0.8%
53	Physical sciences	0.3%	0.4%	0.3%	0.5%	0.0%	0.1%	0.2%	0.2%
54	Mathematics & statistics	0.1%	0.2%	0.1%	0.2%	0.0%	0.0%	0.0%	0.2%
61	Information & communication technologies	0.3%	0.5%	1.2%	2.2%	0.1%	0.2%	0.6%	0.4%
70	Engineering, manufacturing & construction	0.3%	0.1%	0.4%	0.5%	0.0%	0.0%	0.0%	0.2%
71	Engineering and engineering trades	24.1%	25.2%	27.8%	26.0%	1.0%	1.1%	2.1%	2.6%
72	Manufacturing and processing	4.4%	2.9%	3.0%	3.8%	3.0%	0.8%	1.7%	2.2%
73	Architecture and construction	10.2%	11.3%	9.0%	8.0%	0.8%	1.3%	2.1%	2.0%
80 -81	Agriculture, forestry, fisheries & veterinary	1.8%	3.5%	4.8%	3.3%	0.1%	0.3%	0.9%	1.2%
82	Forestry	0.1%	0.1%	0.2%	0.3%	0.0%	0.0%	0.0%	0.0%
84	Fisheries & Veterinary	0.1%	0.2%	0.1%	0.1%	0.0%	0.1%	0.1%	0.3%
90 -91	Health and welfare, undefined	1.7%	2.6%	1.7%	1.8%	8.4%	11.5%	11.7%	11.7%
92	Welfare	1.2%	2.1%	1.7%	1.8%	9.4%	15.4%	13.7%	13.9%
101	Personal services	1.2%	1.2%	1.3%	1.2%	2.9%	1.4%	3.9%	4.2%
103	Security services	1.5%	2.0%	2.2%	1.9%	0.0%	0.1%	0.3%	0.3%
104	Transport services	0.8%	0.6%	0.8%	0.9%	0.0%	0.1%	0.1%	0.1%

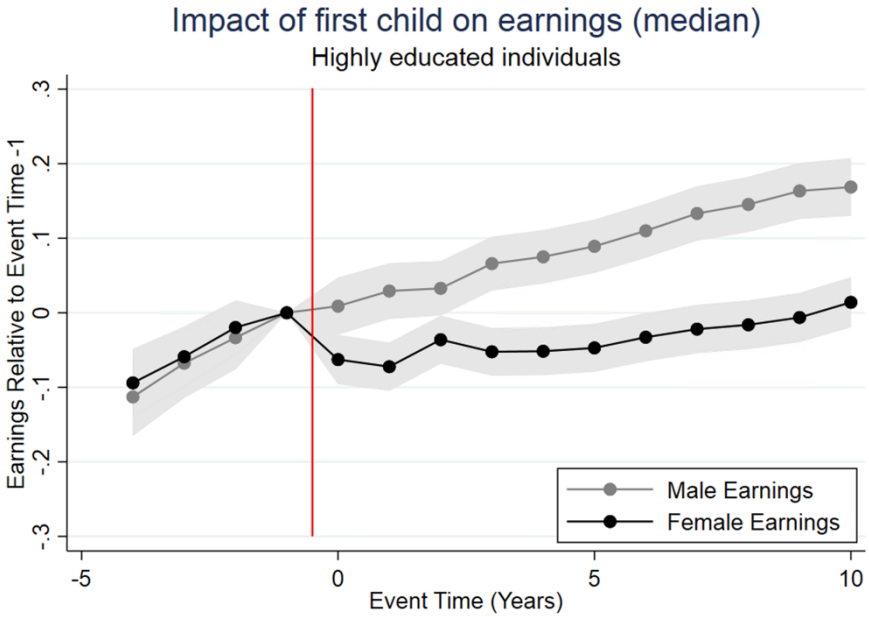
[11] n.f.d. = not further defined

Appendix D: Robustness check using medians

The figures below represent the same analysis as that described in section 4.2 but using median effects instead of means.

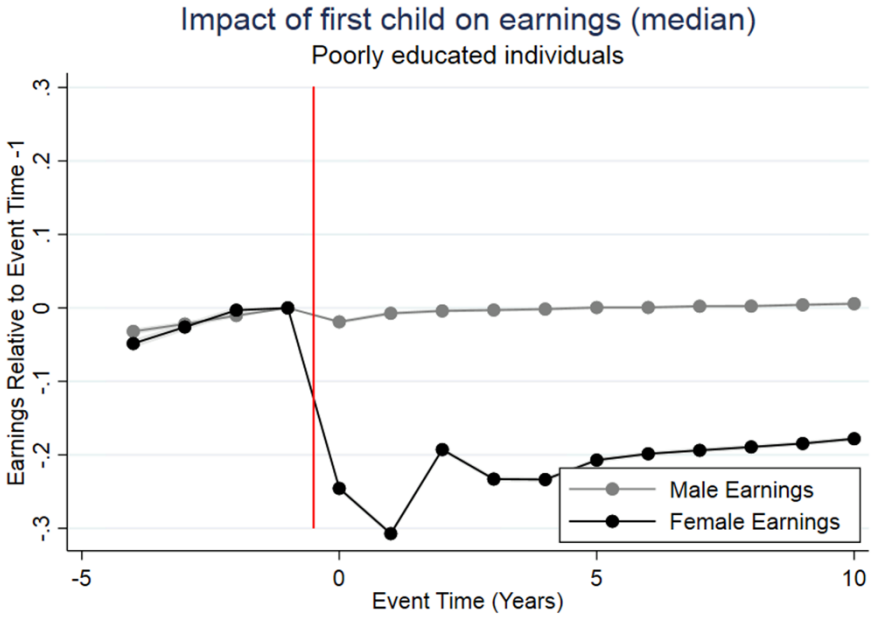


Impact of marriage on earnings of highly educated individuals, median



Impact of first child on earnings of highly educated individuals, median

Impact of marriage on earnings of poorly educated individuals, median



Impact of marriage on earnings of poorly educated individuals, median