Job Flexibility and Household Labor Supply: Understanding Gender Gaps and the Child Wage Penalty

Minji Bang*

November 8, 2021
Click here for the latest version

Abstract

This paper investigates how occupational flexibility affects married couples' labor supply and the gender pay gap around childbirth. Using the NLSY79 data and Goldin's (2014) measure of occupational flexibility, I show that flexibility is a significant determinant of married couples' labor supply adjustments. When a husband's job exhibits low flexibility, couples are more likely to specialize with the wife dropping out of the labor market and the husband increasing hours worked. In contrast, couples with greater flexibility show less labor supply adjustment to childbirth. To analyze the relationship between occupational flexibility and family-friendly labor market policies, I develop and estimate a dynamic discrete choice model of couples' decision-making about labor supply and occupations. In the model, occupations are characterized by wage-hours schedules and flexibility levels. I find that increasing women's and men's own occupational flexibility increases labor force participation by 4 percentage points in the childbirth year. Interestingly, increasing husband's flexibility has a greater impact on the wife's labor adjustment than her own flexibility, augmenting her participation rate and working hours by 10 and 7 percentage points. Finally, I evaluate the effects of family-friendly policies providing temporary flexibility for couples experiencing a birth in the last two years. Policies that target women increase female labor supply and reduce the gender pay gap by 8% in the long run. However, when the benefits are offered to both spouses, the positive effects on the wife's labor supply are weakened, and the gender pay gap expands in the long run.

*Department of Economics, University of Pennsylvania. Email: mbang@sas.upenn.edu. I am grateful to my advisors Holger Sieg, Petra Todd, and Andrew Shephard for their invaluable guidance and support throughout my graduate studies. I have benefited from discussions with Francesco Agostinelli, Jere R. Behrman, Gorkem Bostanci, Hanming Fang, Hanbaek Lee, Margaux Luflade, Robert A. Miller, Andrew Postlewaite, Richard Prisinzano, and José-Víctor Ríos-Rull. I also thank seminar participants at University of Pennsylvania and Penn Wharton Budget Model. I acknowledge financial support from Maloof Family Dissertation Fellowship and Penn Wharton Budget Model.

1 Introduction

The dramatic narrowing of gender employment and pay gaps experienced in the United States and other developed countries in the 1980s has since slowed, with persistent gender differences remaining.[1] In particular, the gender pay gap between married men and women is large and expands over the life cycle.[2] Recent studies document that career disruption after childbirth explains a substantial part of the gender difference in labor market outcomes.[3] Others find that the time constraint that women face due to their dual roles in the home and the labor market contributes to the gender pay gap when there is a demand for long work hours.[4] This research suggests that the need to provide childcare leads households to specialize more, and often women become the ones who detach from the labor force. If jobs offered more flexible work arrangements, would we see less gender divergence after childbirth? What are the effects of workplace flexibility on household labor supply around childbirth and the gender pay gap?

The objectives of this paper are i) to investigate how men and women jointly choose labor supply and occupations around childbirth and how their choices are affected by flexibility, and ii) to evaluate how gender wage gaps and labor market adjustments can be influenced by policy interventions affecting workplace flexibility after childbirth. Specifically, I study whether and how own and spousal flexibility affect the household labor supply adjustment after childbirth within a dynamic model of the family. Occupational flexibility may affect maternal labor supply and earnings through two different channels. First, as pointed out by Goldin (2014) and Cortés and Pan (2019), women who are not able to work long hours earn less money per hour when the less flexible occupations disproportionately penalize shorter hours of work.[5] Second, when the husband faces a stricter flexibility constraint, e.g., difficulty to change working hours or work shifts, then households may find it optimal to load the childcare burden more onto the wife, leading to an uneven split of household labor supply. As a result, women are more likely to detach from the labor market and/or reduce their working hours even further after childbirth, resulting in lower labor earnings and future wages.

[1]See Altonji and Blank (1999), Blau and Kahn (2017), Cortés and Pan (2020) for a review.

[2]Among others, Barth et al. (2021) documents the dynamics of gender earnings differentials along the life cycle by education level.

[3]See Angelov et al. (2016); Kleven et al. (2019a,b).

[4]See Gicheva (2013); Goldin (2014); Cha and Weeden (2014); Cortés and Pan (2019); Bertrand et al. (2010).

[5]Relatedly, jobs with higher flexibility tend to offer lower wages per hour (Wiswall and Zafar, 2017; Adda et al., 2017).

Following Goldin (2014), I measure flexibility using work context and work activity characteristics from O*NET database. Using the American Time Use Survey, I show that the individuals with more flexible occupations tend to work fewer hours in total, are more likely to work outside of the typical 9-to-5 work shift, and are more likely to work from home. These different dimensions help individuals accommodate increased childcare needs after childbirth together with their market work. In particular, both husbands and wives can balance work and childcare more, resulting in a less gendered division of labor within the household.

I start by documenting the empirical relationship between occupational flexibility and married couples' labor adjustment around childbirth using the household panel data from the National Longitudinal Survey of Youth 1979 (NLSY79). Based on the flexibility measure, I divide occupations in the NLSY79 into two equal-size groups: high flexibility and low flexibility. Using an event study design, I show that both own and spousal occupational flexibility measured at the year before the first childbirth significantly affects the married couple's labor adjustment, conditional on the household's observable characteristics. Wives with more occupational flexibility restore their pre-birth hours of work faster, and husbands with less flexibility increase their labor supply more after the childbirth. Importantly, wives with husbands working in less flexible occupations reduce their labor supply more at both the extensive and intensive margins.

I also examine relationship between flexibility and wages and earnings. I fit the annual earnings and hourly wages on the total annual working hours, controlling for other observable characteristics affecting wages. The result exhibits clear trade-offs between flexibility and wages in two different margins. First, the less flexible occupations offer higher wages on average. When the husband works in a less flexible occupation, there is an income effect from his higher earnings making the wife more likely to drop from the labor force. Second, the less flexible occupations offer higher returns to additional hours. Specifically, the slope in the hourly wage curve is steeper for the less flexible occupations.[6] When part-time positions compensate each hour by lower rates, workers may find it harder to switch to part-time positions.

To analyze the effects of policies affecting workplace flexibility, I develop and estimate a new dynamic household model with labor supply and occupational choice. In the unitary household model, husbands and wives make annual decisions with regard to occupational sector and labor supply (from a discrete set of hours options). Occupations are

[6] This is the "convexity" in earnings that Goldin (2014) documented.

characterized by different hourly wage profiles and flexibilities. Changing occupation incurs a utility cost differently for men and women. The household has unitary preferences, and both occupational choice and extensive- and intensive-margin labor supply are modeled as discrete choices. Human capital is assumed to be general and accumulates based on the working hours. Part-time positions potentially accumulate lower experiences compared to full-time positions. Fertility is assumed to be exogenous and stochastic in the model, and households value the non-working hours spent at home differently when a young child is in the family.

Occupational flexibility is modeled through two channels. First, the flexibility in changing working hours is modeled through the gender-occupation-specific part-time wage penalty rates. In the model, a childbirth leads households to have a higher utility for hours at home. A spouse with a high part-time wage penalty finds it costly to reduce their hours worked; thus, the spouse with a relatively lower wage penalty adjusts the hours worked more. Second, other dimensions of flexibility, including flexible work shifts and/or flexible work locations, are captured through a gender-specific non-pecuniary benefit of holding a flexible occupation. To capture the high utilization of these flexibility dimensions after childbirth, I allow the valuation of those benefits to differ by the presence of children in the household.

I estimate the model using data from NLSY79 and the method of simulated moments. The key moments used in estimation are labor supply and occupational choice of husbands and wives around childbirth, observed wages and changes in wages according to different households' labor supply decisions. The estimated parameters show that husbands and wives without young children value their hours at home similarly, but women value them significantly more after childbirth. Occupational switching costs are larger for wives, leading to precautionary occupational sorting before birth. High flexibility occupations offer lower hourly wages on average, and wage gaps across occupations are larger for husbands. There is a large part-time wage penalty for working in part-time positions for both husbands and wives. The penalties are larger in less flexible occupations, particularly for husbands. Also, the non-pecuniary benefits of working in high flexibility occupations are positive, significant, and larger for husbands, both before and after childbirth.

Using the model estimates, I quantify the ceteris paribus effect of flexibility on married couples' labor supply. To disentangle the effects of flexibility and income, I exogenously change flexibility, i.e., part-time wage penalties and non-pecuniary benefits, holding baseline wages constant and allow households to re-optimize. First, I quantify the effect of one's own occupational flexibility. The results indicate that high flexibility makes men and women stay in the labor force more after the first birth by four percentage points compared to the low flexibility groups. Also, increasing men's flexibility makes men adjust more conditional on working after childbirth by four percentage points. Second, I assess the effect of change in spousal flexibility and find a larger impact compared to one's own flexibility changes. Switching a husband's occupation from low to high flexibility increases the wife's labor participation rate by ten percentage points and the wife's hours adjustment by seven percentage points. The larger effects of a husband's flexibility can be rationalized by the larger flexibility constraints faced by husbands. The model estimates indicate that husbands face larger part-time wage penalties and value the non-pecuniary benefit of the high flexibility occupation more than wives.

Finally, I consider two policy counterfactuals aimed at increasing workplace flexibility after childbirth: 1) removing the part-time wage penalty for two years after a childbirth ("Equal Pay" policy), and 2) equalizing the non-pecuniary benefit of flexibility for two years after a childbirth ("Equal Benefit" policy). The Equal Pay policy helps individuals in any occupation change their working hours, keeping their hourly wage constant. The Equal Benefit policy provides individuals in low flexibility occupations with the same non-pecuniary benefit observed in high flexibility occupations. In practice, this policy can be implemented as a telework policy or flexible work shift policy. Also, I analyze how the effects of the policies change when different spouses are targeted.

The results of the counterfactual policy simulations show that the policies improving job flexibility significantly increase married women's labor supply. When the policies target women, the Equal Pay (Benefit) policy increases the wife's hourly wage by 8% (6%) 10 years following the first childbirth. The results are driven by two different forces. First, the policies incentivize wives who otherwise would drop from the labor market to stay in part-time positions. The increased labor attachment in the initial period allows them to accumulate more human capital after childbirth. Second, the policies induce wives to work in the low flexibility occupation by making the occupation more attractive to women, even for those who do not experience any childbirth. Higher wages from the low flexibility occupation contributes to increased women's wages in general.

My model predicts that when the policies target only wives, the increases in wives' hourly wages reduce the gender pay gap (8% or 6%). However, when targeting both spouses, the policy also attracts more husbands to work in high-paying, low flexibility occupations, providing less incentive for women to work at all. Therefore, the positive effects on the female labor supply are weakened, and the gender pay gap expands in the long run by 1% or 9% depending on the policy. To sum up, my results suggest that increasing workplace flexibility would significantly reduce gender pay gaps in the long run. However, targeting both men and women widens the gender pay gap.

1.1 Related Literature and Contributions

There is an extensive literature investigating the consequences of childbearing on labor supply (see Angrist and Evans (1998), Fitzenberger et al. (2013)). Recent studies including Angelov et al. (2016) and Kleven et al. (2019a,b) document that mothers experience significant and persistent earnings and wage penalties after having a child. Others investigating various determinants of the child earnings penalty include wage discrimination and bargaining in the labor market (Albanesi and Olivetti, 2009; Gayle and Golan, 2012; Tô, 2018; Xiao, 2019), social norms (Bertrand et al., 2015, 2021), search behaviors (Le Barbanchon et al., 2020; Cortés et al., 2021), personality and intra-household bargaining (Flinn et al., 2018). Here, I highlight the three strands in the literature which are closely related to this paper.

First, my paper is related to the existing literature on the different sorting behavior of men and women into occupations/workplaces. Felfe (2012) shows that women adjust their working hours, work shifts, and the level of stress after childbirth, and the child wage penalty is explained partly by adjustments in these work conditions. Adda et al. (2017) develops a dynamic life cycle model of women with fertility and occupational choice to quantify the career cost of children. They find that women sort into occupations with more child-friendly amenities based on expected fertility, which contributes to the child earnings penalty. Instead of looking at differences across occupations, Hotz et al. (2017) focus on attributes of workplaces, and find that working in family-friendly workplaces delays mothers' skill progression in the long run.

I contribute to this literature by providing a framework that can be used to investigate mechanisms behind these findings within a joint household model. Previous studies take a single agent framework treating the spouse's characteristics as exogenous. In particular, the majority of studies have focused on the effects of the women's own occupational/workplace characteristics, whereas the husband's side is largely unexplored. The joint household framework enables us to examine the interdependence between spouses' occupational choices. Also, the framework allows studying the effects of spousal occupational characteristics on women's sorting into different occupations.

Second, this paper is also closely related to the existing literature on the effects of time flexibility and working hours on the gender pay gap. Goldin (2014) finds that there is a larger gender pay gap in occupations with low time flexibility. Goldin and Katz (2011) focus on pharmacists who have experienced an exogenous increase in their time flexibility and show that there is almost no gender wage gap in pharmacy. Cortés and Pan (2019) find that high-skilled women who have more access to substitutes for housework, proxied by an influx of low-skill immigration, increased their hours worked and the likelihood of working overtime. More interestingly, the paper finds that married women whose husbands work long hours increase their labor supply more in response to the inflows of the immigrant population. My paper is closest to Erosa et al. (forthcoming). Erosa et al. (forthcoming) takes a joint household framework of occupational choice and labor supply, and finds that household interactions propagate gender differences in occupational sorting, thereby hours worked and wages.

My work complements this literature by providing a life-cycle framework to assess the effects of workplace flexibility. The life-cycle effects of flexibility get amplified when households choose to specialize in non-market and market works from the earlier stage of their life cycle. Early stage career choices reinforce the comparative advantages in market work and non-market work within a household in later stages. I show that increasing workplace flexibility in earlier years of the life cycle, around first childbirth, leads to a substantial gain in work experience and reduces the gender wage gap in the long run.

Lastly, a recent growing body of papers has estimated the effects of policy interventions to increase women's labor supply around childbirth and to encourage men's participation in childcare. Some document the short-term positive effect of paid parental leave policies on women's labor supply (Rossin-Slater et al., 2013; Byker, 2016). However, recent papers show no significant effects of parental leave and child care subsidy policies on female labor supply and gender pay gap in the longer run. Bailey et al. (2019) finds little impact on increasing female labor attachment from the paid parental leave policy introduced in California in 2004. They even find negative effects on employment and wages for those treated in the long run. Kleven et al. (2020) finds essentially no impact from expansion of such policies in Austria. Others evaluate policies promoting fathers' engagement in childcare and reducing gender inequality in labor market outcomes (Ekberg et al., 2013; Patnaik, 2019).

My paper adds to this literature by suggesting another policy tool that can reduce the gender gap that arises after birth. Specifically, I consider policies that directly affect workplace flexibility, by providing subsidies to compensate the part-time wage penalties or by providing amenities that temporarily enable flexible time use in the workplace. The policy of interest in this paper is different from the paid parental leave policies as it promotes parents not to take those leaves but to maintain their work status as much as they can. I find a significant and substantial reduction in the gender pay gap both in the short term and in the long term. Also, I show how the policy effects differ by which spouses are targeted.

The rest of the paper is organized as follows. Section 2 discusses the data. Section 3 documents how household labor adjustments after childbirth relate to different job flexibility levels and the important trade-offs between job flexibility and earnings. Section 4 develops the joint household model. Section 5 discusses estimation and results. Section 7 presents the analysis of counterfactual policies. Section 8 concludes.

2 Data

2.1 NLSY79: A Household Panel

To study how households change their occupations and time allocations around childbirth, I need to track both spouses' labor supply and occupations pre- and post-birth periods. Also, to see whether the labor adjustments in the year of birth have long-term consequences on earnings and wages, I need to track them for a long period after the birth. The National Longitudinal Survey of Youth 1979 (NLSY79) is one of a few data sources in the US, which allows tracking both spouses' labor market characteristics for a long period. The NLSY79 has followed a nationally representative sample of youth since 1979, and most individuals in the sample had a childbirth observed during the sample period. If individuals get married, there is also detailed information about their spouses, including their occupations and wages.[7]

I restrict the sample to the married couples with a wife between ages 19 and 45 for high school graduates and those with some college or between ages 24 and 45 for college graduates or above. I exclude the periods when any of the spouses is in school. As the high

[7]Unfortunately, more recent NLSY data (NLSY97) do not provide spouses' occupation anymore.

school dropouts have significantly different child-bearing patterns and labor market outcomes, I exclude these individuals from the sample. Additionally, my analysis does not consider decision-marking after divorce, so I exclude observations after divorce. That is, I assume the divorce is a random shock and households who would experience divorces in the future behave similarly to households who do not experience divorce. Lastly, I exclude households with self-employment income observed in the sample period. The flexibility in self-employment jobs can be conceptually different from the flexibility in employer-employed jobs. Also, households with one or more spouses self-selects into self-employment can be substantially different in their time allocation around childbirth. As a result of the sample selection criteria, I have 89,837 household-year observations with 5,642 unique household observations. On average, each household is observed for 15 years.[8]

Table 1 reports relevant summary statistics of the sample. The average number of children in the households is 2.26, and the average age of having the first childbirth is about 23 for wives and 25 for husbands. Slightly less than half of husbands and wives are at least college graduates. Almost 30 percent of wives are not working, whereas almost 90 percent of husbands work. Conditional on working, husbands are mostly working in full-time positions working more than 2100 hours on average, whereas wives are working in part-time positions with average hours worked ranging from 1500 to 1700, which are increasing in age. The gender gap in years of experience expands over the life cycle, so does the gender gap in hourly wages.

2.2 O*NET: Measure of Occupational Time Flexibility

There are many different possible ways of constructing a measure of job flexibility. In this paper, I closely follow Goldin (2014) and use the same measure used in her paper. I use a much larger set of occupations, including lower-paying occupations, compared to the occupations considered in Goldin (2014). Indeed, the measure extrapolates well and nicely captures the flexibility of occupations not considered in the original paper.

An occupation-specific flexibility measure is constructed as the average of five normalized O*NET characteristics.[9] These characteristics are "Time pressure", "Contact with

[8] The years may not be continuous, as the NLSY79 changed their frequency from annual to biennial since 1997.

[9] The O*NET database provides detailed occupational information, including work activities and work

Table 1: Summary statistics

	Wife		Husband	
	Mean	Std	Mean	Std
Marriage and fertility				
Total number of children	2.26	(1.06)		
Age at first marriage	22.92	(4.88)	25.17	(5.14)
Age at first childbirth	27.07	(4.87)	28.95	(5.41)
Age at last childbirth	30.24	(5.23)	32.42	(5.90)
Education				
High school graduate	0.42	(0.49)	0.45	(0.50)
Some college	0.09	(0.29)	0.09	(0.28)
College graduate	0.36	(0.48)	0.34	(0.47)
Postgraduate	0.13	(0.34)	0.12	(0.33)
Prop not working, by age				
Age 25	0.28	(0.44)	0.12	(0.33)
Age 35	0.28	(0.45)	0.09	(0.28)
Age 45	0.27	(0.44)	0.13	(0.34)
Hours worked cond. on working, by age				
Age 25	1564.16	(683.61)	2121.87	(545.79)
Age 35	1646.34	(670.18)	2263.65	(501.82)
Age 45	1764.90	(619.79)	2264.66	(545.37)
Years of experience, by age				
Age 25	4.52	(2.11)	6.08	(2.32)
Age 35	10.08	(4.12)	13.77	(3.82)
Age 45	15.90	(6.33)	22.10	(5.33)
Hourly wages (in 1999 dollars) cond. on working, by age				
Age 25	10.59	(7.31)	13.49	(6.56)
Age 35	13.86	(9.29)	19.38	(11.79)
Age 45	16.03	(10.53)	24.70	(17.57)

NOTE: This table reports descriptive statistics of the household sample constructed from NLSY79 (1979-2016). The sample consists of married couples with wife's age between 19 and 45 (24 and 45) for high school graduates or some college (for college graduates or above). All individuals in the sample completed their schooling, and never experienced self-employment. The periods after any divorce are excluded. The sample has 5,642 unique household observations, and 89,837 household-year observations.

Table 2: Occupations by the flexibility measure

(1) Low Flexibility	(2) High Flexibility
Chief executives	Biological scientists
Producers and directors	IT consultants
Financial managers	Musicians
Licensed practical and licensed vocational nurses	Teachers and instructors
Physicians and surgeons	Computer programmers

NOTE: This table lists occupations based on the flexibility score constructed from O*NET databases. Occupations are from the NLSY79 sample. In column (1), occupations with relatively low flexibility are listed, and in column (2), occupations with relatively high flexibility are listed.

others", "Establishing and maintaining interpersonal relationships", "Structured vs. unstructured work", and "Freedom to make decisions."[10,11] Each characteristic is normalized with a mean of zero and a standard deviation of one within a set of occupations in NLSY79.[12] I use O*NET responses sourced by the incumbents. Then the flexibility measure is merged into NLSY79 data or ATUS data using a crosswalk between the Standard Occupational Classification system and Census occupational codes and calendar years.[13] I use multiple versions of O*NET Databases which have evolved over time.[14] For the crosswalk across different years of Census occupational codes, I use the harmonized occupation classification by Autor and Dorn (2013).

Table 2 shows the list of occupations sorted by the flexibility measure. Occupations such as chief executives and financial managers are among the least "flexible" occupations, whereas computer programmers and musicians are among the most "flexible" occupations. Although Goldin (2014) focuses on the flexibility of highly-educated workers, the measure also applies to lower-educated workers. Occupations held by highly-educated workers are generally less flexible; there is a fair amount of heterogeneity in flexibility conditional on education level. Appendix A provides summary statistics and additional discussion on the flexibility measure.

context, which are relevant to understanding occupational flexibility. Data is collected from a statistically random sample of workers who worked in the targeted occupations.

[10]See Goldin (2014) for an explanation of how each characteristic is related to time flexibility.

[11]For robustness check, I add/remove some other characteristics that are closely related to time flexibility, but most of the results are robust to these variations.

[12]This potentially gives different scales from Goldin (2014), but this process would not change the rank between occupations.

[13]Some Census occupations are matched to multiple O*NET SOC codes. In this case, I use an average flexibility score from all matched O*NET SOC codes.

[14]I use O*NET databases v5.0-v25.0.

2.3 ATUS: Describing the Flexibility Measure

To better understand which dimensions are captured in the flexibility measure, I investigate if individuals with high flexibility scores utilize their time differently. In particular, I select individuals with a child age less than 5 from the American Time Use Survey(ATUS) to see if the following are different for people working in more flexible occupations: 1) total working hours, 2) hours shifts within a day, and 3) working locations[15]. Table 3 summarizes the results. After controlling for various individual characteristics including age, education, race, and gender, individuals with a young child and with more "flexibility" in their occupation based on the flexibility measure tend to:

1. Work fewer hours per week (*ability to change working hours*).
2. Be more likely to work during hours that not in typical working hours (*ability to shift working hours within a day*).
3. Be more likely to work from home in the intensive margin (*ability to change their work location*).

In column (1), it is shown that the one standard deviation increase in the flexibility score is associated with about 1.7 hours lower working hours per week. In column (2), the same standard deviation increase in flexibility gives a 6.5 percentage point increase in the proportion of working hours, not in typical 9-to-6 working hours. As work shift typically depends on the total working hours, I also control for the total working hours per week. The last two columns present the relationship between flexibility and work-from-home (WFH) utilization. In column (4), I restrict the sample to individuals working in occupations with any work done at home and estimate the relationship between the flexibility and the intensive margin utilization of the work-from-home option. At the intensive margin, one standard deviation increase in flexibility score gives about 8.8 percentage point increase in the proportion of hours worked from home.[16]

The result shows that the flexibility measure is significantly correlated with multiple dimensions of flexibility. Although the measure's construction does not take into account actual time usage at all, it captures different ways of utilizing flexibility reasonably

[15] Appendix B provides description of the ATUS data and the sample selection criteria.

[16] In column (3), the relationship is not significant. This is because, for some occupations, the work-from-home arrangement is not actually an option. For example, for biological scientists, although the occupation may give flexible arrangements in terms of their time allocations, most of their tasks cannot be done at home.

Table 3: Different Dimensions of Flexibility in Flexibility Measure

	Working Hrs	Prop Hrs Not 9To6	Prop Hrs WFH	
	(1)	(2)	(3)	(4)
Flexibility Score	-1.717^{***}	0.065^{***}	0.002	0.088^{***}
	(0.351)	(0.007)	(0.008)	(0.026)
Ind. Char.	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Daily Working Hours		YES	YES	YES
Any WFH				YES
Observations	3,415	3,415	3,415	785

NOTE: The sample is constructed from ATUS (2003-2010) and includes individuals who are at least high school graduates, and age between 19 to 45 for high school graduates and 24 to 45 for college graduates. Individual characteristics include age, gender, race, and education levels.

well[17]. Time flexibility captured through reducing hours or shifting hours is consistent with flexibility concepts described in Mas and Pallais (2020) and Felfe (2012). The option of working from home is also highlighted in some recent papers about COVID-19 including Dingel and Neiman (2020) and Bick et al. (2020).[18] In Section 4, I incorporate these multiple dimensions of flexibility captured in the flexibility measure in the model through two different channels.

3 Findings from an Event Study Around Childbirth

When married couples have their first childbirth, the couples adjust their working hours significantly to accommodate increased childcare needs in the short run. Typically, husbands tend to work about the same hours or a little longer, whereas wives tend to quit their work or reduce their working hours substantially, at least temporarily. These immediate adjustments in labor supply often have long-run consequences in labor supply and earnings (Angelov et al., 2016; Kleven et al., 2019a,b). In this section, I document some interesting empirical facts about the relationship between occupational flexibility measured in one year before the first childbirth and labor supply decisions of the married couple after their first childbirth.

[17] Goldin (2014) associates the flexibility with a greater degree of substitutability among workers, and her choice of O*NET characteristics reflect this notion of flexibility.

[18] In Appendix A, I compare the flexibility measure with flexibility concepts other papers.

3.1 Event Study Design

I use an event-study specification based on Kleven et al. (2019b). I denote the outcome variable of interest as $y_{itg(j)}$ for household i, in occupation group g for spouse j at event time t. Event time t is indexed relative to one year before the first childbirth. The flexibility group $g(j)$ depends on the the spouse j's occupational flexibility, which is based on one year before the birth. Also, I control for the other spouse's occupational flexibility which is also based on the occupation a year before the first birth. This naturally restricts the sample to be married couples with both spouses working a year before their first childbirth. The outcome of interest y_{itg} includes the wife's hours worked conditional on working, wife's labor participation, husband's labor adjustment (combining intensive and extensive margins), wife's earnings, and wife's wages.

Different from the Kleven et al. (2019b)'s objective, the focus of the event-study exercise is to investigate if there is any difference in labor adjustment across flexibility groups. Thus, I regress the outcome variable y_{itg} on the event time dummies interacted with flexibility group dummies. Also, I include control variables that are used in Kleven et al. (2019a), such as age and calendar year indicators. The age indicators control for the life-cycle trends, and the calendar year indicators control for time trends. On top of that, I include other control variables to make the different flexibility groups as similar as possible in their pre-birth observable characteristics. These variables include education levels of both spouses and their interactions, spouse's age, and average earnings in pre-birth periods. Including these additional variables helps to control for the couple's pre-birth specialization based on education levels and earnings differences. I denote all the control variables as X_{itg}. The regression model can be written as follows:

$$y_{itg(j)} = \sum_{\tau \neq -1} \alpha_{g(j)\tau} \mathbb{I}(\tau = t) + f(X_{itg}) + \nu_{itg}.$$

I omit the event time dummy at $t = -1$, which makes the event time coefficients, $\alpha_{g(j)\tau}$, interpreted as the changes in the mean value of the outcome y at event time τ relative to the year before birth for the flexibility group g of spouse j. As the flexibility group g for spouse j is based on his/her occupation a year before the birth, the composition of individuals in each group does not change over time.[19] However, those individuals may

[19]I do not restrict the sample to be a balanced panel due to the limited number of observations in the data. However, I restrict the sample to be observed at least 2 years before their first childbirth and at least 4

drop from the labor force, reduce their working hours significantly, or switch to different occupations after birth. Thus, any difference in effects across different occupational flexibilities should be interpreted as an outcome of all the subsequent behavioral changes that households have made conditional on their occupational flexibility in the pre-birth period.

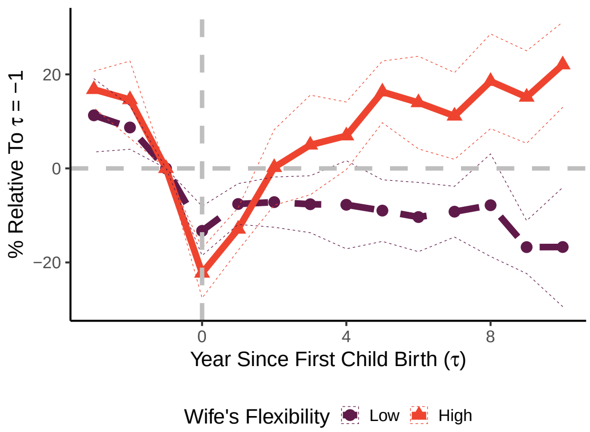
3.2 Labor Adjustment around Childbirth By Own/Spousal Flexibility

I present estimates that show differences in the impacts of children by the occupational flexibility in the pre-birth period. First, I study how the wife's own occupational flexibility is associated with the wife's labor supply after the first childbirth, controlling for the husband's flexibility. Figure 1 shows the results. Panel 1a shows the changes in intensive-margin labor supply and Panel 1b shows the changes in extensive-margin. The figure shows the significant difference in wife's intensive-margin labor adjustment across different flexibility levels. Wives with high occupational flexibility adjust their working hours more in the year of birth, conditional on working. This reflects the temporal flexibility that wives can utilize in the year of birth. Also, they restore their pre-birth hours worked after 2 years since childbirth. However, there are persistent drops in working hours for those who work in low flexibility occupations. In the birth year, the hours worked dropped by 10% for women in low flexibility, and it has stayed at that lower level since then. There is no statistical difference across different flexibility groups in terms of extensive-margin labor adjustment.

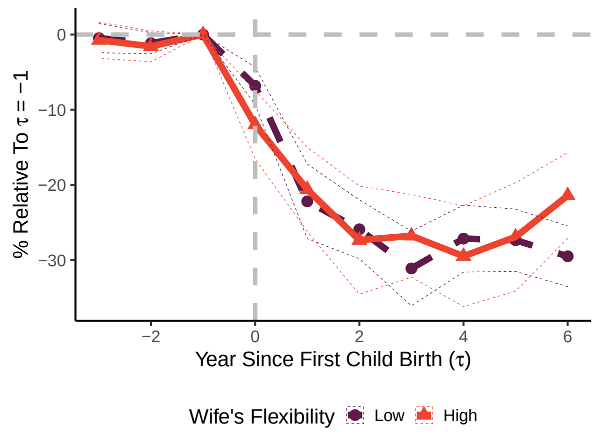
In addition to the effect of own flexibility, I document how spousal occupational flexibility affects one's labor adjustment. In particular, I show how the wife's labor adjustments differ by husband's occupational flexibility. The results are shown in Figure 2. Wives with husbands working in less flexible occupations drop their labor supply more, both in intensive and extensive margins. Panel 2a shows that the wife's hours worked conditional on working drops more when her husband works in less flexible occupations in the year of birth, but there are only marginal differences across groups afterward. Panel 2b shows more significant difference across groups. Wives with husbands working in less flexible occupations detach from the labor force more than those whose husbands work in more flexible occupations. This documents the important inter-dependency of husband's and wife's labor adjustment. When the husband faces stricter time constraints due to low

years after the birth.

Figure 1: Wife's Labor Adjustment By Wife's Flexibility



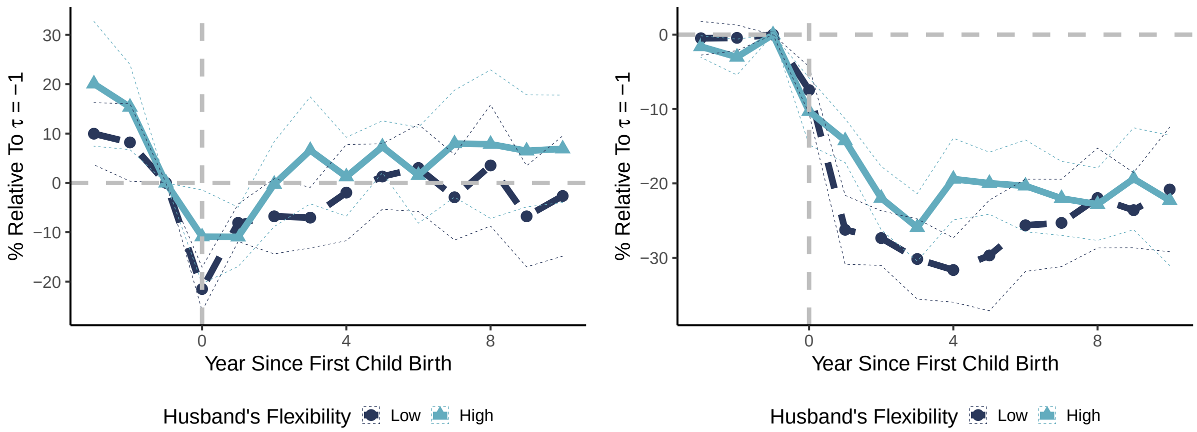
(a) Hours Worked Conditional on Working



(b) Labor Participation

NOTE: Panel (a) plots the percentage change in wives' hours worked conditional on working relative to hours worked one year before the first childbirth ($\tau = 0$). Panel (b) plots the percentage change in wives' labor participation conditional on working status one year before the first childbirth ($\tau = 0$). The sample is restricted to households with both spouses working one year before birth and observed at least 2 years before their first childbirth and at least 4 years after the birth. The solid line represents wives working in high flexibility occupations one year before birth, and the dashed line represents wives working in low flexibility occupations one year before birth. The control variables include wife's age, husband's age, year fixed effects, education levels of both spouses and their interactions, husband's flexibility score based on the occupation one year before birth, and average earnings of both spouses in pre-birth periods.

Figure 2: Wife's Labor Adjustment By Husband's Flexibility



(a) Hours Worked Conditional on Working

(b) Labor Participation

NOTE: Panel (a) plots the percentage change in wives' hours worked conditional on working relative to hours worked one year before the first childbirth ($\tau = 0$). Panel (b) plots the percentage change in wives' labor participation conditional on working status one year before the first childbirth ($\tau = 0$). The sample is restricted to households with both spouses working one year before birth and observed at least 2 years before their first childbirth and at least 4 years after the birth. The solid line represents wives with husbands working in high flexibility occupations one year before birth, and the dashed line represents wives with husbands working in low flexibility occupations one year before birth. The control variables include wife's age, husband's age, year fixed effects, education levels of both spouses and their interactions, wife's own flexibility score based on the occupation one year before birth, and average earnings of both spouses in pre-birth periods.

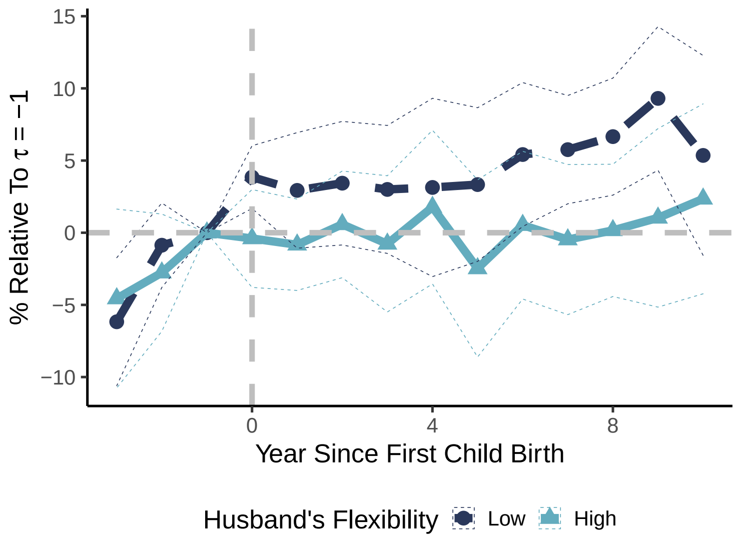
occupational flexibility, the wife needs to adjust her labor further to accommodate the childcare needs.

Lastly, I show how the husband's labor adjustment differ by his own occupational flexibility. Figure 3 shows that husbands in less flexible occupations increase their labor supply after the first childbirth[20]. Specifically, the hours worked increase about 4 percent in the year of birth compared to one year before the birth for husbands in low flexibility occupations. In contrast, the hours do not change for husbands in high flexibility occupations. The results may look counter-intuitive at first glance. Why and how do husbands in less flexible occupations adjust their labor more? The results suggest a few things. First, occupational flexibility may act as a constraint only when individuals seek to reduce their work time temporarily, but not when they want to increase their working hours. Second, there may be other effects confounding the relationship between occupational flexibility and labor supply. For example, when the husband works in a less flexible occupation, there is an income effect from his higher earnings making the wife more likely to drop

[20] As the majority of husbands keep their working status, here I combine the intensive and extensive margins, and plot the changes in unconditional hours worked.

from the labor force and the husband to work more hours to compensate for the loss in household income. This can be interpreted as the "subtracted worker effect" as opposed to the well-known "added worker effect." I elaborate on these issues further in Section 3.4.

Figure 3: Change in Husband's Labor Adjustment



NOTE: This figure plots the percentage change in husbands' hours worked, including zeros, relative to hours worked one year before the first childbirth ($\tau = 0$). The sample is restricted to households with both spouses working one year before birth and observed at least 2 years before their first childbirth and at least 4 years after the birth. The solid line represents husbands working in high flexibility occupations one year before birth, and the dashed line represents husbands working in low flexibility occupations one year before birth. The control variables include wife's age, husband's age, year fixed effects, education levels of both spouses and their interactions, wife's own flexibility score based on the occupation one year before birth, and average earnings of both spouses in pre-birth periods.

3.3 Child Wage Penalties By Spousal Flexibility

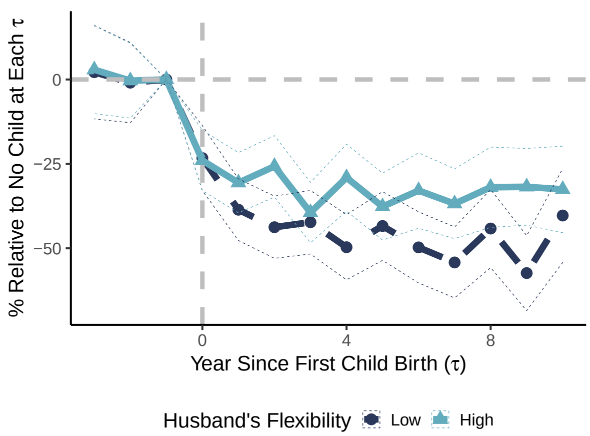
How does the difference in labor adjustment across flexibility groups affect the wives' long-term labor market outcomes? This section documents the persistent impacts on wives' earnings and wages from heterogeneous responses associated with jobs by different flexibilities. I first formally define the "child wage and earnings penalty" consistent with Kleven et al. (2019b). The child penalty $P_{g(j)\tau}$ is defined as the percentage loss of average earnings or wages at event time τ for flexibility group g of spouse j, relative to the average earnings or wages without the effect of childbirth. It can be formally written as:

$$P_{g(j)\tau} = \frac{\alpha_{g(j)\tau}}{\mathbb{E}(\tilde{y}_{ig(j)\tau}|\tau)},$$

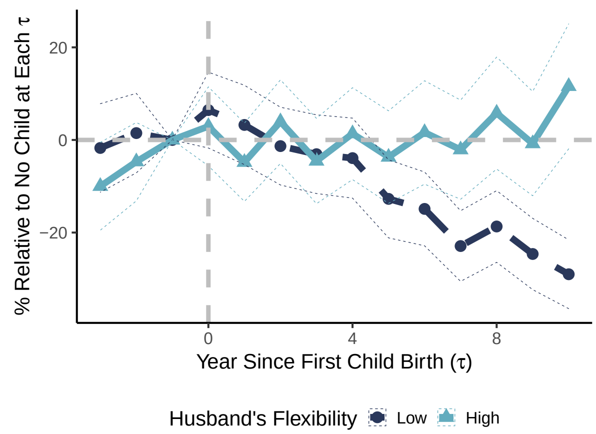
where $\mathbb{E}(\tilde{y}_{ig(j)\tau}|\tau)$ is the predicted earnings or wages without the contribution from the event time dummies conditional on the flexibility group $g(j)$. The results are summarised in Figure 4. As shown in the earlier section, wives with husbands whose work is less flexible reduce their labor supply. As a result, they experience larger earnings and wage penalties in the long run. As almost 30% of mothers drop from the labor force within 3 years since the first birth, the average earnings including zeros for those who do not work substantially drops, and wives who experience childbirth earn 40% lower earnings compared to the case when they would not have the child. More interestingly, When we decompose this into different occupational flexibility of husbands, wives with husbands working with less flexibility experience a much larger decrease in their earnings (44% decrease when averaged over after-birth periods) compared to those with husbands working in high flexibility occupations (32%). There is more than 10 percentage points difference in the child earnings penalty between the two groups.

Effects of childbirth on wife's wages presented in Figure 4b shows a more striking description of the heterogeneity across husband's flexibility levels. Here I restrict the sample to wives conditional on their working status. To be clear, I do not limit the sample to wives who have been continuously working after the birth; instead, I include wives who have dropped out from the labor force during the first few years since the birth and then returned to the labor force in a few years. The result show that wives with husbands in less flexible occupations receive much lower hourly wages in the long run. This can be interpreted in two different ways. First, the husband's low occupational flexibility may make the wife switch to more flexible occupations, which, on average, offer lower hourly wages. Second, when the husband works in a less flexible occupation, the wife adjusts her labor more initially and accumulates less human capital compared to the case when there was no child. This foregone human capital may contribute to the child wage penalty in the long run.

Figure 4: Child Wage/Earnings Penalty



(a) Wife's Annual Earnings



(b) Wife's Hourly Wages Conditional on Working

NOTE: Panel (a) plots the percentage loss of average earnings, including zeros, of wives at event time τ relative to the average earnings without the effect of childbirth. Panel (b) plots the percentage loss of average wages of working wives at event time τ relative to the average wages without the effect of childbirth. The sample is restricted to households with both spouses working one year before birth and observed at least 2 years before their first childbirth and at least 4 years after the birth. The solid line represents wives with husbands working in high flexibility occupations one year before birth, and the dashed line represents wives with husbands working in low flexibility occupations one year before birth. The control variables include wife's age, husband's age, year fixed effects, education levels of both spouses and their interactions, wife's own flexibility score based on the occupation one year before birth, and average earnings of both spouses in pre-birth periods.

3.4 Occupational Flexibility and Earnings

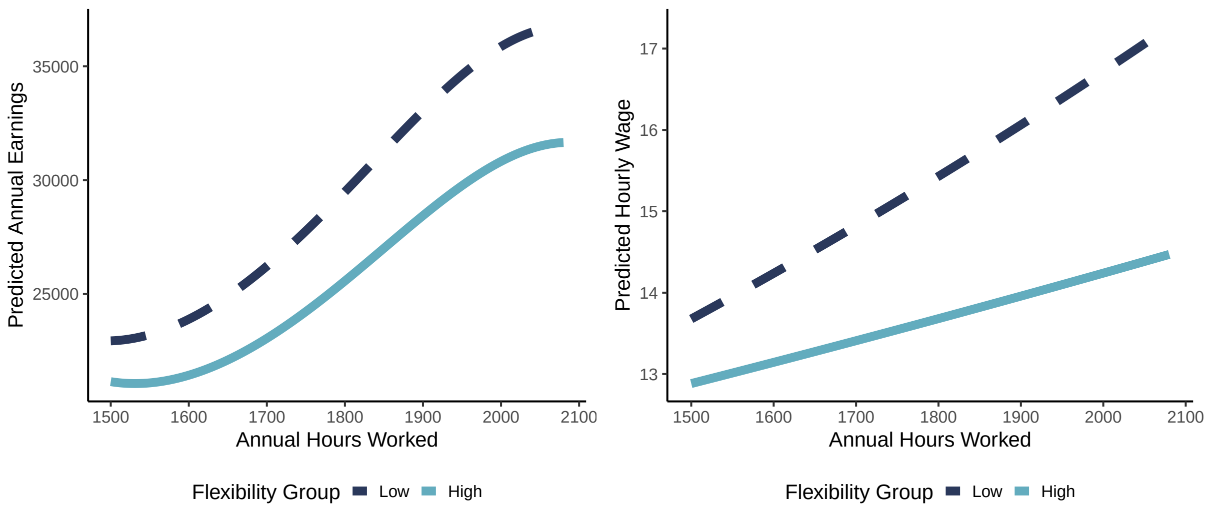
Finally, I examine the relationship between occupational flexibility, wages and earnings. I estimate the relationship between annual earnings and hourly wages of married men and theit total annual working hours using cubic splines and a linear model, respectively, controlling for other observable characteristics affecting wages. The observable characteristics include years of experience, calendar year fixed effects, and education levels. I only use the information on husbands because wives' earnings and wages are more vulnerable to selection issues. Figure 5 shows the clear trade-offs between flexibility and earnings through two different channels. First, workers in less flexible occupations earn more earnings and wages on average. Even conditional on experience and education level, the wage levels are substantially higher at any hours worked in less flexible occupations. A conventional compensating differential framework can be applied in this case. When workers value flexibility, workplaces offering less of the desirable amenity should compensate the worker more. Second, the returns to additional hours are higher in less flexible occupations, which is clearly shown in the difference in the slopes of the hourly wage curves. This result replicates the findings of Goldin (2014) and Gicheva (2013), but expanded to a broader category of occupations.

These relationships have important implications on household labor supply. First, when husbands work in a less flexible occupation, there is an income effect from their higher earnings making the wives more likely to drop out from the labor force. Second, when the inflexible occupations disproportionately penalize shorter hours of work, making changes in working hours becomes more costly. If the penalty is substantial enough, workers may find it optimal to drop out of the labor force entirely instead of receiving much lower wages than full-time positions. Additionally, in a household framework, the spouse with a relatively lower penalty on part-time positions will be the one to adjust his/her labor more.

3.5 Summary of Findings

In this section, I show that the labor adjustments around childbirth significantly differ across households with different occupational flexibilities. Specifically, I show that wives with high flexibility restore their pre-birth hours worked in 2 years after childbirth, but those with low flexibility cannot. More interestingly, wives with husbands in less flexi-

Figure 5: Trade-off between Flexibility and Earnings



(a) Earnings

(b) Hourly Wages

NOTE: Panel (a) plots the predicted annual earnings of married men, which are fitted on the total annual working hours using cubic splines. Panel (b) plots the predicted hourly wages of married men, which are fitted on the total annual working hours using a linear regression. Both models control for years of experience, year fixed effects, and education levels. The sample is restricted to married men who are working at least 1500 hours per year. The solid line represents married men working in high flexibility occupations, and the dashed line represents married men working in low flexibility occupations.

ble occupations are more likely to quit their jobs or reduce their work hours significantly more than those with husbands working with more flexibility. I also document that the husband's flexibility has long-run effects on the wife's earnings and wages. When husbands work in low flexibility occupations, wives face larger child wage penalties in the long run. Lastly, I replicate **??**'s result about the nonlinear relationship between earnings and working hours using NLSY79. The result finds that earnings are convexly increasing in hours worked. This highlights the clear trade-off between flexibility and earnings/wages.

4 A Dynamic Household Labor Supply and Occupational Choice

This section develops a dynamic model of occupational and labor supply choices within a household. In the model, each household has unitary preferences, and time is discrete and finite. Occupations are characterized by different wage offers and discrete flexibility levels. Each spouse gets a job offer from each occupation in every period. In every period, a household jointly chooses how many labor hours to supply in the labor market for each spouse and which occupation to work in. It is assumed that changing occupation is costly, and the cost is a constant utility cost across any occupational changes. Human capital is general, and households can accumulate it by working. The returns to work potentially differ when they work in part-time positions. Fertility is assumed to be exogenous in the model. The probability of having a new child depends on the wife's age and both spouses' education levels.[21]

Flexibility is modeled through two channels as 1) a non-pecuniary benefit from holding a flexible occupation and 2) occupation-specific part-time wage discount rates. The household starts with initial occupations, initial levels of human capital, and education levels. It is assumed that the schooling choices are completed before the wife turns age 25 (for 4 year college graduates or above) or 19 (for high school graduates or some college), and the education levels are fixed throughout the life cycle.[22]

4.1 Objectives

There are a few goals that the model aims to accomplish. The first objective is to identify and estimate the model parameters governing households behavior around childbirth. The model provides a framework to understand the mechanisms generating strong interrelationships between husband's and wife's labor supply and occupational choice that were shown in the reduced form evidence in earlier sections. With the estimated model, I am also able to evaluate counterfactual policies affecting household labor adjustment.

Second, the model aims to relieve concerns about the identification problem arising from the endogenous occupational choice. This is particularly important if one might be interested in a policy effect on household labor supply as the policy would change households sorting into occupations. Sorting into the initial occupation at age 19 or 24 will be assumed to be random, and the subsequent occupational choices are modeled as endogenous choices of the household, thus can be fully controlled.

Third, the model framework helps to disentangle the effects of flexibility from other confounding effects. In particular, the relationship between the flexibility and labor sup-

[21] I discuss the consequences of these assumptions and possible extensions in Section 4.8.

[22] In the data implementation, I only include individuals whose education level does not change after the starting age of 25 or 19.

ply documented in the previous section might be interpreted as arising from income effects. When the husband works in the inflexible occupation, it is shown that the wife withdraws from the labor force more, and the husband increases his hours worked. However, with the reduced-form exercise alone, I cannot distinguish if the observed relationship is the effect of flexibility or the effect of income. With the estimated model, the ceteris paribus effect from the flexibility margin can be evaluated.

4.2 Occupation Choice and Labor Supply

There are N occupations in the model and M discrete choices for hours of work. When either of the spouses switches his/her occupation, the new occupation starts from the next period, and households are subject to switching costs, which are modeled as fixed utility costs. It is assumed that individuals choose the occupations for the next period and take the occupation for the current period as given when they make labor supply decisions. This timing assumption isolates the effects of the current wage shock on the choices of working hours only.

Labor supply for each spouse can be one of the discrete working hours categories, $h_{ijt} \in \{0, h_1, h_2, ..., h_M\}$, where $h_l < \bar{H}$ and $\bar{H}$ is the total time endowment in a given period t. When individuals work 0 hours, i.e., not working, the total time endowment goes to leisure or non-working hours. In the model, leisure and non-working hours are indistinguishable, and I use the two terminologies interchangeably.[23] There are $N^2 * M^2$ mutually exclusive alternatives available to households, and households receive alternative-specific preference shocks drawn from Gumbel distributions. There is no non-voluntary layoff in the model, and temporal leaves with a job and non-working are treated identically.

4.3 Occupational Flexibility and Wage Structures

To capture the trade-off between occupational flexibility and compensation when choosing occupations, there are wage equations that differ by occupation. Specifically, different occupations offer different (1) baseline wages $\left(\beta_{0j}(o)\right)$, (2) wage premiums for college

[23] In the implementation, I set the number of occupations as two, the number of hours worked as four including the non-working option, and the total time endowment as 16 hours per day (= 5840 hours per year).

graduates $\left(\beta_{1j}(o)\right)$, and (3) returns to human capital $\left(\beta_{2j}(o), \beta_{3j}(o)\right)$. When individuals work in full-time positions, the wages are determined by an occupation-specific wage function, which gives the level difference in wages across occupations. Individuals are subject to idiosyncratic wage shocks, $\eta_{it} = (\eta_{imt}, \eta_{iwt})'$, which are independently and identically distributed across periods following a bivariate normal distribution with mean 0 and variance-covariance matrix Σ.

$$\textit{(Full-time wages)} \quad log(\tilde{w}_{ijt}) = \beta_{0j}(o_{ijt}) + \beta_{1j}(o_{ijt})E_{ij} + \beta_{2j}(o_{ijt})X_{ijt} + \beta_{3j}(o_{ijt})(X_{ijt})^2 + \eta_{ijt}$$
$$\eta_{it} \overset{iid}{\sim} N(0, \Sigma)$$

Importantly, the different dimensions of the flexibility are modeled in two different ways. First, the flexibility in changing total working hours year-to-year is captured through a gender-occupation-specific part-time wage discount function, $g_j(o, h)$, which discount full-time wages depending on the total hours of work. For example, if an occupation does not tolerate time flexibility, i.e., reducing working hours is heavily penalized, then the part-time hourly wage would be lower than the full-time hourly wage conditional on the education and human capital. Without loss of generality, I assume that h_M is the "full-time" working hours, and all other options, $\{h_1, h_2, ..., h_{M-1}\}$, are treated as "part-time" working hours. Notably, as I do not impose any restriction on $g_j(.)$, the "discount" rates can be estimated as negative numbers for some working hour options and for some occupations.

$$\textit{(Part-time wages)} \quad w_{ijt}(X_{ijt}, E_{ij}, o_{ijt}, h_{ijt}, \eta_{ijt}) = g_j(o_{ijt}, h_{ijt}) * \tilde{w}_j(X_{ijt}, E_{ij}, o_{ijt}, \eta_{ijt})$$

Second, the flexibility in other dimensions, including changing work location or changing work shift, are lumped and modeled as the non-pecuniary benefit of holding a more flexible occupation. Utilizing these other dimensions of flexibility does not necessarily change the total working hours, and usually, they are harder to observe in the data without detailed information on activity-level time and location. Thus, I take a less structural approach to model these types of flexibility by adding a non-pecuniary benefit in the utility specification. Also, I assume that the non-pecuniary benefit is separable from any other terms in the utility specification. In addition, individuals who face increased childcare needs due to a newborn child may utilize these dimensions of flexibility more by changing work shifts or work locations. Thus, I allow the utility from the non-pecuniary benefit to depend on whether the household has a young child or not.

$$\textit{(Non-pecuniary benefit)} \qquad \alpha_j(n_{it})\mathbb{I}(o_{ijt} = o_h)\mathbb{I}(h_{ijt} \neq 0) \tag{1}$$

4.4 Human Capital Accumulation

In the model, human capital is general, and it accumulates depending on the total hours worked in a given period. The next period human capital X_{ijt+1} for spouse j is a function of the current human capital level X_{ijt} and current period's labor supply h_{ijt} relative to the maximum possible labor supply H_M. Thus, when a spouse j working in a full-time position, $h_j = h_M$, he/she will accumulate one unit of human capital in the next period. However, when the spouse works in one of the part-time options, the gender-specific parameter $\rho_j > 0$ governs the rate of return of additional hours of work to the human capital. I assume that there is no human capital depreciation when individuals are not working.

$$X_{ijt+1} = X_{ijt} + \left(\frac{h_{ijt}}{h_M}\right)^{\rho_j}$$

4.5 Fertility Shocks, Childcare, and Non-labor income

Fertility is an exogenous shock where its probability depends on the wife's age and both spouses' education levels. This assumes that fertility shocks are random conditional on the observables.[24] When there is a young child in the household, the value of non-working hours changes for both spouses. In particular, when the age of the youngest child in the household (n_{it}) is less than 5, the value of leisure, γ_j for spouse j increases or decreases by $\bar{\gamma}_j$. If the estimated terms are positive, they motivate households to spend more time at home with their children.

[24]In the data, there's no substantial differences in fertility rates across different initial occupations.

$$\gamma_j(n_{it}) = \begin{cases} \gamma_j + \bar{\gamma}_j & if \quad 0 \leq n_{it} < 5 \\ \gamma_j & if \quad n_{it} \geq 5 \text{ or no child} \end{cases}$$

Households need to pay a fixed childcare cost, $K(n_{it}, h_{imt}, h_{iwt})$, which depends on the age of the youngest child and the labor supply of both spouses. These costs are computed outside of the model using PSID 1980-2010. The estimated costs reflect that when both spouses are working, the household needs to pay higher child care costs. Also, conditional on one spouse's work status, working in a full-time position requires higher child care costs. There is no saving allowed in this model. Instead, there is an exogenous non-labor income stream known to the household, $y_{it}(\cdot)$, as a function of both spouses' education levels.[25]

4.6 Utility Specification

The utility can be separated into three parts: 1) utilities from consumption and non-working hours, 2) utilities from non-pecuniary benefits and occupation switching costs, and 3) choice-specific shocks.

I use log utilities for the consumption and non-working hours, and utilities from spouses' non-working hours are separable in the utility specification. Utilities from the non-pecuniary benefit from the high flexibility occupation are specified as Equation 1. And the switching costs are assumed to be in utils, and they are gender-specific but symmetric across any occupational changes. The choice-specific preference shocks, ε_{it} follow a Gumbel distribution, and the scale parameter is normalized to identify all the other parameters in the utility specification. Future utilities are discounted by the discount parameter β, which is assumed to be fixed at a value of 0.96. As previously noted, I assume a unitary preference of the household. Putting everything together, the flow utility at time t can be written as follows:

[25] The dollar values are computed as the average non-labor income by different education groups from NLSY79.

Table 4: Notations in the Model

Notation	Explanation	Notation	Explanation
$\vec{h}_{it} = [h_{imt}, h_{iwt}]$	Hours worked	$\vec{o}_{it} = [o_{imt}, o_{iwt}]$	Occupations
$\vec{E}_i = [E_{im}, E_{iw}]$	Education levels	$\vec{X}_{it} = [X_{imt}, X_{iwt}]$	Human capitals
$\vec{\eta}_{it} = [\eta_{imt}, \eta_{iwt}]$	Wage shocks	$\vec{\varepsilon}_{it}$	Choice-specific preference shocks
n_{it}	Age of the youngest child	$K(\boldsymbol{.})$	Childcare cost
$y_{it}(\boldsymbol{.})$	non-labor income		

NOTE: This table summarizes the notations with descriptions of the key variables and functions in the model.

$$
\begin{aligned}
u(\Omega_{it}, \mathbf{h_{it}}, \mathbf{o_{it+1}}) = \gamma_c log(c_{it}) + \sum_{j=m,w} \gamma_j(n_{it}) log(l_{ijt}) \qquad & \textit{(Consumption and Leisure)} \\
+ \sum_{j=m,w} \alpha_j(n_{it}) \mathbb{I}(o_{ijt} = o_h) \mathbb{I}(h_{ijt} > 0) \qquad & \textit{(Non-pecuniary benefit)} \\
- \sum_{j=m,w} S_j \mathbb{I}(o_{ijt+1} \neq o_{ijt}) \qquad & \textit{(Occupation Switching Cost)} \\
+ \varepsilon_{it}(\mathbf{o_{it+1}}, \mathbf{h_{it}}) \qquad & \textit{(Choice-specific Preference Shocks)} \\
\text{where } \varepsilon_{it} \sim Gumbel(0,1) &
\end{aligned}
$$

4.7 Value Function

Here, I present the household model in a recursive format. Each component of the model is described in detail in the subsequent subsections. Let the subscript t denote the wife's age, m the husband, and w the wife. In every period $t = 1, 2, ..., T$, household i with spouse $j = m, w$ solves the following optimization problem given the state variables, $\Omega_{it} = \{\vec{o}_{it}, \vec{E}_i, \vec{X}_{it}, \vec{\eta}_{it}, \vec{\varepsilon}_{it}, n_{it}\}$. The notations used in the model are summarised in Table 4. The value function of the household i at wife's age t can be written as follow:

$$
\begin{aligned}
V_t(\Omega_{it}) = \max_{\vec{h}_{it}, \vec{o}_{it+1}} u(\Omega_{it}, \vec{h}_{it}, \vec{o}_{it+1}) + \beta \mathbb{E}\Big[V_{t+1}(\Omega_{it+1}) | \Omega_{it}, \vec{h}_{it}, \vec{o}_{it+1}\Big] \\
s.t. \quad c_{it} + K(n_{it}, \vec{E}_i, \vec{h}_{it}) = \sum_j h_{ijt} w_{ijt}(\Omega_{it}) + y_{it}(\vec{E}_i).
\end{aligned}
$$

4.8 Extensions

Finally, I discuss potential extensions of this paper incorporating some important dimensions abstracted in the current paper.

First, the model can be improved if a more explicit wage determination process is endogenized. It is important to note that all of the policy simulations documented above abstract any possible general equilibrium effects. If the policies are mandated, and employers have to offer these benefits to their workers who experience any childbirth, there would be changes in offered wages as the employers face much higher costs of hiring workers who can potentially ask for these benefits. But the prediction is not obvious in terms of how such policies would change gender differences in wage offers. If women become the main beneficiaries of these policies, then there can be a larger incentive for firms to screen women with a high probability of conception. This would exacerbate gender pay gaps. However, suppose the policies allow men to adjust their labor supply more upon childbirth and further increase women's labor supply. In that case, the policy may generate a more balanced division of labor within the households, and employers would not discriminate against women as men and women become more comparable to each other.

Second, fertility decisions would be affected by the policy counterfactuals. Again, the prediction on the effects of counterfactual policies on fertility is not deterministic. As these policies make the market work and housework more compatible, more couples may want to have children in response to the policy changes. However, as women accumulates more skills and their attachment to labor market strengthens, there is a larger opportunity cost for women to have additional child. Thus, a model with endogenous fertility would be a useful extension of the current paper.[26]

5 Estimation

The main part of the model is estimated using the Method of Simulated Moments (McFadden, 1989). The childcare costs, the exogenous fertility rates, and non-labor income amounts are computed outside of the model as a first step. I set the annual discount

[26] In particular, countries, including South Korea and Japan, experiencing significant drop in fertility rates in recent years may have particular interest in this direction.

factor β to 0.96, similar to other studies in the literature.[27]

5.1 Choice of Moments

I provide a broad description how each group of parameters are related to a set of moments selected in the estimation. In Table 5, I present a full set of moments used in the model by their broad categories, and which parameters of the model, broadly speaking, affect which set of the set of the moments. Although this section does not give a formal identification proofs, it provides intuitive descriptions how the model parameters can be estimated through the selected moments.

To match the observed distributions of hours worked, I use proportions of working hours in the discrete options by observable characteristics. These moments help to identify parameters related to the labor supply in the absence of children, $\gamma_c, \gamma_m, \gamma_w$. To capture the relative division of labor within the household, I use moments pertaining to the proportions of working hour options by spouse's working status. Lastly, the changes in the labor supply around childbirth can identify the changes in the values of non-working hours when there is a young child in the household.

Parameters related to occupational choices are also identified with a similar set of moments. First, given the wage differentials, proportion of individuals with high flexibility occupation would help to identify the value of non-pecuniary benefit in the absence of children. Given the base levels of non-pecuniary benefits and hours worked in previous period, the different drop-out rates from the labor force across occupations will be correlated to the changes in the non-pecuniary benefits. Lastly, average transition rates across occupations are closely related to the switching cost parameters.

The parameters governing the human capital accumulation, ρ_m, ρ_w, are identified through the future wage differentials across individuals who choose to work different working hours conditional on all other observable characteristics. In particular, I use changes in wages conditional on previous working options conditional on education and experience.

Occupation-specific full-time wage equations, $\vec{\beta}_j(o)$, are identified using indirect inferences. Using the simulated data, I run OLS regressions of log wages on experience and occupation by gender conditional on working full-time positions, and match the mo-

[27] Adda et al. (2017) estimate a discount factor within the model, and the estimated value is 0.96.

Table 5: List of Parameters & Moments

Categories	Moments	Related Parameters
Consumption, labor supply	• Proportions of working hour options by gender • Proportions of working hour options by gender, year since first birth • Proportions of working hour options by gender, spouse's working options • Transition rates between working hour options by gender • Transition rates between working hour options by gender, in the year of the first childbirth	$\gamma_c, \gamma_j, \bar{\gamma}_j$
Occupational Choice	• Proportions of occupations by gender • Proportions of occupations by gender, working options • Proportions of occupations by gender, year since first birth • Proportions of occupations by gender, spouse's occupations • Transition rates between occupations by gender • Transition rates between occupations by gender, in the year of the first childbirth	$\alpha_j(n), S_j$
Human capital process	• Correlation between current hours and future wages conditional on current observable characteristics • Average level of experience at final period by gender	ρ_j
Occupation-specific full-time wages	• OLS regression of log wages on education and occupation, by gender, full-time only • OLS regreession of log wages on experience and occupation, by gender, full-time only	$\beta_0(o), \beta_1(o)$ $\beta_2(o), \beta_3(o)$
Part-time wage discount rates	• Ratio between predicted part-time wages and predicted full-time wages conditional on education, occupation, and gender • Average accepted wages by occupation and working hour options	$g_j(o, h)$
Var-Cov of wage shocks	• Variance of residual wages after running OLS regression of log wages on education, experience, and occupation, by gender	Σ

NOTE: This table displays the full list of moments used in estimation with broad categories of the moments and parameters related to each set of moments. There are 240 moments used to estimate 39 parameters. Childcare costs and non-labor income are estimated outside of the model conditional on observable characteristics of households. The annual discount factor β is set to be 0.96.

ments with the OLS estimates from the true data.

The part-time wage discounts are also relying on the method of indirect inference.

First, I fit wages on observable characteristics using real and simulated data sets, and get predicted wages from those models. Then I compute ratios between the predicted part-time wages and the predicted full-time wages, and use these ratios as moments to calibrating the part-time wage discount functions, $g_j(h, o)$.

Lastly, the variances of the residual wage shocks, Σ, uses the variance of the residual wages after running gender-specific OLS regressions with log wages on education, experience, and occupation.

5.2 Implementation

I describe the solution of the model, the simulation of moments, the construction of the objective function, and the optimization method.

5.2.1 Solution

Because the model has a finite horizon, I solve the model backwards from the terminal period. At the terminal period, T, all wives are 45 years old, and the value of the next period, V_{T+1} is set to be 0. As the next period occupations do not play a role in the next period, no one would switch from the given occupation, $\vec{o}_T$ unless they have extremely positive preference shocks from such choices.

$$V_T = \max_{\vec{h}_T, \vec{o}_{T+1}} u_T(\Omega_T, \vec{h}_T, \vec{o}_{T+1}) \tag{2}$$

Then, in period $t = T - 1$, the household problem can be written as follows:

$$V_{T-1} = \max_{\vec{h}_{T-1}, \vec{o}_T} u_{T-1}(\Omega_{T-1}, \vec{h}_{T-1}, \vec{o}_T) + \beta \mathbb{E}[V_T(\Omega_T)|\Omega_{T-1}, \vec{h}_{T-1}, \vec{o}_T] \tag{3}$$

The expectation in the value of the next period is taken over both choice-specific preference shocks and the wage shocks in the terminal period for both spouses. In the model, $n_{it}, \vec{E}_i, \vec{o}_{it}$ are discrete and have only a few possible values; where as $\vec{X}_{it}, \vec{\eta}_{it}$ have either continuous domain or many possible values. Here, the objective is to evaluate the $\mathbb{E}V_T := Emax_T$ at each point in the state space. To reduce the computational burden, I select a subset of the state space values to evaluate the value functions along these continuous or pseudo-continuous state variables. Specifically, I use the following procedures:

1. Compute the choice-specifc values V_T^d at the subset of the state space. In particular, I use the following grid points for experience levels: $\tilde{X}_{ijt} = \{5, 7, 10, 13, 15, 20, 25, 35, 50\}$. For wage shocks, I use the sparse grids illustrated by Heiss and Winschel (2008). I denote these sets of grid points as $\tilde{X}_{ijT}$ and $\tilde{\eta}_{ijT}$, respectively.

2. Compute $\mathbb{E}_\varepsilon[V_T|\vec{\eta}_{iT}]$ at each values in $\tilde{\eta}_{ijT}$. As I assume that the choice-specific preference shock follows the Gumbel distribution, there is a closed-form solution for this expectation.

3. Approximate $\mathbb{E}_\eta[\mathbb{E}_\varepsilon[V_T|\vec{\eta}_{iT}]]$ using the sparse grid method by Heiss and winschel (2008). Note that the nodes, $\tilde{\eta}$ and the weights are computed using the nested rule for integral with Gaussian weight.

4. Now we have $Emax_T$ evaluated at each point in the $\tilde{X}$ values. Approximate the $Emax$ along full grid points of the experience levels using the method developed in Keane and Wolpin (1994, 1997, 2001); Keane et al. (2011). I use a polynomial regression of the third order for this approximation. The R-squared are well above the 0.99 in all periods.[28]

5.2.2 Simulation and Optimization

Given a set of parameter values, θ, the model produces the vector of simulated moments, $m(\theta)$. I use the simulation size of 20,000 households, and all the initial values of the initial state space are drawn from the empirical distributions in NLSY79 at wife's age 19 for high school graduates and at wife's age 24 for college graduates. There are 39 parameters in the model, and 240 moments are selected. The vector of moments are summarized in Table 5.

I use the simulated method of moments to estimate the model parameters. The estimates minimize the sum of squared distances between the data moments and the simulated moments. To normalize the different scales of the moments, I divide the distances by the values of the data moments.[29] To put formally, the parameters are estimated to minimize the following objective function:

[28]Using higher order polynomials does not improve the R-squared.

[29]I do not use a weighting matrix, for example, a diagonal matrix with the inverse of the standard deviations of the data moments. This is mainly due to the noisy estimates of some of the standard deviations. However, almost all parameters are estimated with reasonably small standard errors even under the inefficiency caused by missing an optimal weighting matrix.

$$\hat{\theta} = argmin_{\theta} \sum_{i=1}^{240} \left(\frac{\hat{m}_i - m_i(\theta)}{\hat{m}_i} \right)^2.$$

The standard errors of the parameter estimates are computed using the standard GMM formula. However, as pointed out by Lise and Robin (2017), the moments are not necessarily smooth functions of the parameters due to simulation errors. Thus, estimating standard errors using the numerical differentiation of the moments around the estimated values would be imprecise due to the non-smoothness. In this paper, I follow the procedures described in Lise and Robin (2017) to address this issue. I evaluate each moments at the equally-spaced grid points of each parameter θ_k around the estimated values fixing all other parameters at the estimated values. Then I fit each moment on the polynomial of degree 5 of the grid points around the estimated value, and I take the derivative of this polynomial at the estimated value as my estimate of the partial derivative of that moment by the k-th parameter evaluated at the estimated value.

6 Empirical Results

6.1 Parameter Estimates and Estimated Standard Errors

In this section, I present the model estimates. Table 6 shows the estimated parameters with their standard errors. Parameter estimates shows some interesting implications about household behavior. First, the coefficients on log leisure (or non-working hours) for husbands and wives in the absence of child are not statistically different from each other, implying that without a child, households value the leisure of husbands similarly to the leisure of wives. However, once the household has a young child at home, the couple values wife's leisure time significantly more than husband's leisure time. This reflects the productivity difference across gender in child care; mothers are good at taking care of child. This gender difference in parenting ability would contribute to the specialization within the household.

Second, the occupational switching cost estimates show that both husbands and wives face substantial switching costs when they change occupations. There are only a few people switching their occupations in the data. The magnitude for husbands ($S_m = 2.10$)

corresponds to about 8% of the consumption, i.e., households are willing to sacrifice their consumption by 8% for not having the occupation switching cost. Furthermore, the switching cost is much higher for wives. The results suggest that households find it very costly to switch their occupation. This would motivate households to adjust their occupational choice even before childbirth when the needs of holding a more flexible occupation become immediate.

The parameters governing the human capital accumulation processes, ρ_m, ρ_w, are larger than 1 and larger for wives. This implies that working in part-time positions does not accumulate the human capital at the same rate as working in full-time positions. For example, working in a full-time position gives one unit of human capital in the model, whereas working in a part-time position that requires half of the full-time working hours gives less than 0.5 units of human capital. Estimates of wage and variance parameters generally follow patterns documented in the literature.

I discuss the estimates for flexibility parameters in detail. There are two channels in the model through which occupational flexibility is captured. The first channel is through the part-time wage penalties. For both husbands and wives, the estimated part-time wage penalties are larger for low flexibility jobs. The penalty can be as large as up to 70% discount from the full-time hourly wages (for husbands working in part-time low). But even for the high flexibility occupations, there are substantial part-time wage penalties if the spouses work in part-time low positions.[30] Also, note that the difference in wage penalties across occupations is more prominent for husbands. Less flexible occupations penalize the part-time working hours more severely, particularly for husbands.

Finally, the estimates of non-pecuniary benefit values are larger when a young child is in the household. This is consistent with the hypothesis that occupational flexibility would be utilized more when the actual needs arise upon childbirth. Interestingly, the values are larger for husbands. The model rationalizes the large proportion of husbands working in high flexibility jobs despite the substantial wage gaps across occupations through higher amenity values for husbands.

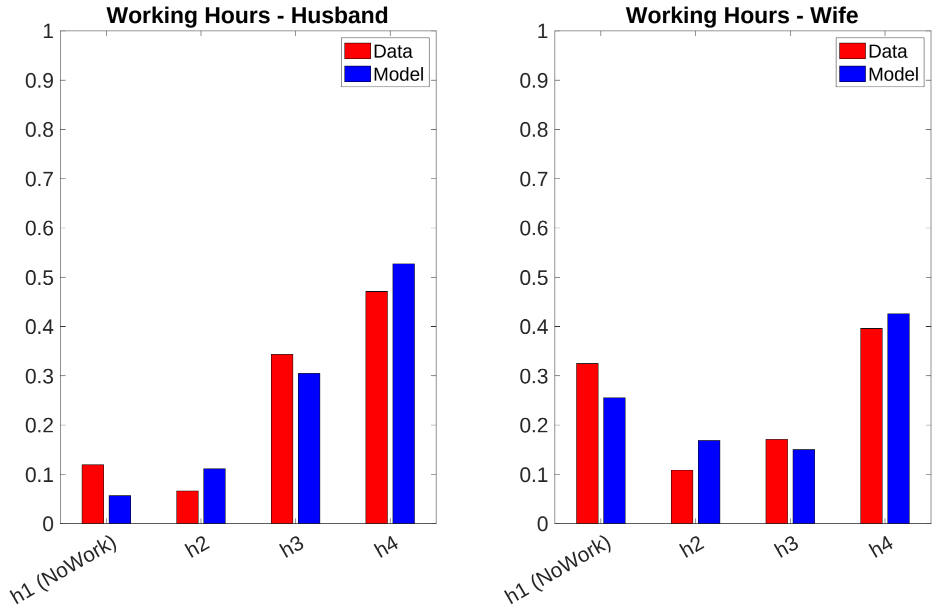
[30] This option is working about 1300 hours per year. Appendix C explains how working hour options and occupations are grouped into discrete choices in the model.

Table 6: Parameter Estimates

Param	Descriptions	Spouse	Value (S.E.)	
γ_c	coefficient on log consumption		1.95 (0.08)	
γ_m	coefficient on log leisure	Husband	0.94 (0.13)	
γ_w	coefficient on log leisure	Wife	0.85 (0.11)	
$\bar{\gamma_m}$	change in γ_m with child	Husband	1.82 (0.12)	
$\bar{\gamma_w}$	change in γ_w with child	Wife	3.28 (0.12)	
S_m	occupation switching cost	Husband	2.10 (0.22)	
S_w	occupation switching cost	Wife	5.49 (0.38)	
ρ_m	human capital accum. rates	Husband	1.20 (0.12)	
ρ_w	human capital accum. rates	Wife	5.51 (0.77)	
			High Flex	Low Flex
β_{0m}	intercepts in FT wage	Husband	1.80 (0.11)	2.13 (0.07)
β_{1m}	college premiums in FT wage	Husband	0.19 (0.09)	0.21 (0.04)
β_{2m}	returns to expr in FT wage	Husband	0.15 (0.02)	0.18 (0.01)
β_{3m}	returns to expr squared	Husband/100	-0.72 (0.06)	-0.67 (0.04)
β_{0w}	intercepts in FT wage	Wife	1.42 (0.09)	1.60 (0.04)
β_{1w}	college premiums in FT wage	Wife	0.26 (0.08)	0.30 (0.03)
β_{2w}	returns to expr in FT wage	Wife	0.12 (0.02)	0.18 (0.01)
β_{3w}	returns to expr squared/100	Wife	-0.51 (0.11)	-0.57 (0.04)
σ_m	s.d. of wage shocks	Husband	0.0049 (0.0083)	
σ_w	s.d. of wage shocks	Wife	0.0043 (0.0094)	
			High Flex	Low Flex
$\delta_m(h_1)$	wage penalty for **PT low**	Husband	0.31 (0.02)	0.72 (0.02)
$\delta_m(h_2)$	wage penalty for **PT high**	Husband	0.01 (0.01)	0.30 (0.01)
$\delta_w(h_1)$	wage penalty for **PT low**	Wife	0.30 (0.07)	0.61 (0.07)
$\delta_w(h_2)$	wage penalty for **PT high**	Wife	0.13 (0.04)	0.43 (0.04)
			No Child	Child
$\alpha_m(n)$	non-pecuniary benefit	Husband	0.42 (0.04)	0.77 (0.08)
$\alpha_w(n)$	non-pecuniary benefit	Wife	0.12 (0.04)	0.22 (0.05)

NOTE: This table reports the parameter estimates with their estimated standard errors. The first column provides the notation of the parameter, the second column provides a brief description of the parameter, the third column specifies the spouse that the parameter represents, and the fourth column reports the estimated value with the estimated standard error in the parenthesis. For the wage and flexibility parameters, the last column is divided into two sub-columns; each of them is for the different group of occupations exhibiting different flexibilities.

Figure 6: Model Fit - Work Status



NOTE: This figure plots the simulated distribution of working hour choices using estimated parameters (blue bars) and the distribution of hours worked observed in the data (red bars). Panel (a) shows the distribution for husbands, and panel (b) shows the distribution for wives. "h1" refers the not working option (zero hour), "h2" is part-time low, "h3" is part-time high, and "h4" is the full-time working options.

6.2 Goodness of Fit Analysis

Figure 6 and Tables 7, 8 present the simulated moments from the model against the data moments. The model fits the cross sectional distributions of discretized hours worked, occupations for each spouse, and the joint distributions of those reasonably well.

6.3 Quantifying the Effects of Flexibility

Next, I quantify the ceteris paribus effects of own and spousal flexibility on married couple's labor supply using the model estimates. One empirical challenge of this exercise is how to separately compute the effect of flexibility from confounding income effects. As shown in the earlier section, the event-study analyses cannot disentangle the two effects as the income is a function of flexibility in the data. To address this issue, I exogenously change flexibility in the model holding average offered wages constant and allow households to re-optimize. Specifically, changing flexibility involves two changes in the model: 1) changes in the value of the non-pecuniary benefit, and 2) changes in the slope of wage functions across different working options. To fix the average offered wages under differ-

Table 7: Joint Labor Supply

(a) Model					(b) Data				
	Wife					Wife			
Husband	NoWork	PT Low	PT High	FT	Husband	NoWork	PT Low	PT High	FT
NoWork	0.00	0.01	0.04	0.01	NoWork	0.04	0.02	0.03	0.01
PT Low	0.02	0.02	0.06	0.02	PT Low	0.02	0.01	0.02	0.01
PT High	0.11	0.08	0.10	0.05	PT High	0.10	0.09	0.18	0.05
FT	0.18	0.13	0.12	0.06	FT	0.12	0.09	0.15	0.06

NOTE: This table reports the joint distribution of working hour choices from the simulated data using estimated parameters (panel (a)) and the joint distribution of hours worked observed in the NLSY79 sample (panel (b)). Proportions of husbands working in each working hour option are presented in rows, and proportions of wives working in each option are presented in columns.

Table 8: Joint Occupational Choice

(a) Model			(b) Data		
	Wife			Wife	
Husband	Low	High	Husband	Low	High
Low	0.23	0.16	Low	0.25	0.18
High	0.22	0.39	High	0.24	0.33

NOTE: This table reports the joint distribution of occupational choices from the simulated data using estimated parameters (panel (a)) and the joint distribution of occupations observed in the NLSY79 sample (panel (b)). Proportions of husbands working in each occupation group are presented in rows, and proportions of wives are presented in columns.

ent flexibility levels, I evaluate the average wage of alternatives based on the wage levels in the baseline occupation, but differing the part-time wage penalties only. This isolates the income effects coming through higher wages of low flexibility occupations.

First, I quantify the effect of one's own occupational flexibility. In particular, the effects of own flexibility on labor adjustment at the time of birth are estimated. The result is shown in Table 9. First, I study how the wife's flexibility changes affect labor adjustment. In the baseline, 41% of wives working in the low flexibility occupations drop from the labor force, and there is 13% decrease in hours worked conditional on working in the year of their first childbirth. When the wife's flexibility is exogenously switched from low to high, the labor participation rates increase by 4 percentage points, but there is no significant change in hours worked conditional on working.

For husbands, the economic impact is much smaller because only a few husbands adjust their labor supply in the baseline. However, I do find an increase in husbands' labor adjustment in both extensive and intensive margins by 4 percentage points when switching husbands' flexibility from low to high. Also, the signs of the effects are different from the findings in the empirical facts. In section 3, husbands working in less flexible occupations increase their labor supply after childbirth. In contrast, from the quantitative analyses, those husbands reduce their labor supply more compared to the ones working in more flexible occupations. This implies the income effects confound the empirical relationship between flexibility and labor adjustment. When a husband working in low flexibility occupations, wife is more likely to quit her job or reduce her working hours, which in turn gives reduces household income. Thus the husbands working in low flexibility occupations increase their labor supply more to make up the foregone wages that the wives would have earned. However, when disentangling the effects of flexibility from the effects of income, I find that high flexibility makes husbands adjust more after the birth.

Second, I assess the effects of changes in spousal flexibility. In particular, I investigate how husband's fleixibility changes affect wife's labor adjustment after the birth. Table 10 shows a larger impact of spousal flexibility changes compared to one's own flexibility changes. In the baseline, 32% of wives stop working upon the first childbirth and for those who continue to work drops their hours worked by 17% when husbands working in low flexibility occupations. Switching a husband's occupation from low to high flexibility increases the wife's labor participation by 10 percentage points and the wife's hours worked by 7 percentage points. Interestingly, the effects of husband's flexibility is much

Table 9: Effects of Own Flexibility

Wife	Low Flex	High Flex	Diff in Percent When Moving To High
Changes in participation	-41%	-37%	+4 pp
Changes in hours of work	-13%	-13%	+0 pp
Husband	Low Flex	High Flex	Diff in Percent When Moving To High
Changes in participation	-5%	-1%	+4 pp
Changes in hours of work	+2%	+6%	+4 pp

NOTE: This table reports the ceteris paribus effects of own flexibility changes on labor adjustments after the first childbirth. The upper panel reports the effects for wives, and the lower panel reports the effects for husbands. Column 1 reports the percentage changes in labor participation rates and the hours worked when working in low flexible occupations. Column 2 reports the percentage changes in the same labor outcomes when own flexibility is exogenously changed to high, keeping everything else equal. Column 3 reports the difference in labor adjustments between column 1 and column 2.

Table 10: Effects of Spousal Flexibility

Wife	Husband in		Diff in Percent
	Low Flex	High Flex	When Husband Moving To High
Changes in participation	-32%	-22%	+10 pp
Changes in hours of work	-17%	-10%	+7 pp

NOTE: This table reports the ceteris paribus effects of spousal flexibility changes on wives' labor adjustments after the first childbirth. Column 1 reports the percentage changes in labor participation rates and the hours worked when working in low flexible occupations. Column 2 reports the percentage changes in the same labor outcomes when spousal flexibility is exogenously changed to high, keeping everything else equal. Column 3 reports the difference in labor adjustments between column 1 and column 2.

larger than the effects of wife's own flexibility. This larger effects can be rationalized by the larger flexibility constraints faced by husbands. The model estimates indicate that husbands face larger part-time wage penalties and value the non-pecuniary benefit of the high flexibility occupation more.

7 Policy Analysis: Flexibility and Parental Leave

What will happen if we make workplaces more flexible after childbirth? In this section, I use the estimated model to evaluate policy counterfactuals aimed at increasing workplace flexibility after childbirth. As I introduce the two different dimensions of flexibility in the model, I naturally consider two policies. One removes the part-time wage penalty temporarily after childbirth, called an "Equal Pay" policy. The other equalizes the non-pecuniary benefit of flexibility across different occupations temporarily after childbirth, and I call this policy as an "Equal Benefit" policy. I consider a benefit period of two years after any childbirth. Also, I analyze how the effects of the policies change when different spouses are targeted.

The Equal Pay policy helps individuals in any occupation change their working hours, keeping their hourly wage constant. This policy would affect wages in both occupations as there are positive part-time wage penalties in both occupations, although the magnitudes were much higher in low flexibility occupations. The Equal Benefit policy allows individuals in low flexibility occupations to enjoy the same non-pecuniary benefit as those in high flexibility occupations. In practice, this policy could perhaps be implemented as a telework policy or flexible work shift policy.

First, I evaluate the policy effects when the policies target women only. Panel (a) and (b) in Table 11 show the effects in short-run (one year after the birth) and in long-run, respectively. Table 12 show the effects in pre-birth periods. In the short run, both policies increase wives' labor participation substantially compared to the baseline case (9% increase for Equal Pay and 12% increase for Equal Benefit), and induce more wives to work in part-time positions. As both policies make the low flexibility occupation more attractive to wives, they self-select into the low flexibility occupation more. All of these changes contribute to the increase in hourly wages, although the increase in the hourly wage for Equal Pay is a mechanical result of the policy design.

More importantly, both policies also increase wives' hourly wages in the long run. After 10 years since the first childbirth, the average hourly wages of wives increase by 8% under Equal Pay policy and 6% under Equal Benefit policy. The results are driven by two different forces. First, the policies incentivize wives who otherwise would drop from the labor market to stay in part-time positions. The increased labor attachment in the initial period allows wives to accumulate more human capital after childbirth, and the increased human capital pays back later. Second, the policies induce wives to work in the low flexibility occupation by making the occupation more attractive to women, even for those who do not experience any childbirth. Higher wages from the low flexibility occupation contributes to increased women's wages in general.

The re-sorting into low flexibility occupations due to the policy change also affects wives in the pre-birth period and wives who end up not experiencing any birth through-

Table 11: Short- and Long-run Effects on Wife's Labor Adjustment and Wages

	(a) A year after birth			(b) 10 years after birth		
	Baseline	CF1 Equal Pay	CF2 Equal Benefit	Baseline	CF1 Equal Pay	CF2 Equal Benefit
Participation	0.62	0.67	0.69	0.75	0.76	0.76
		(8.91%)	(11.86%)		(1.83%)	(1.65%)
Hours of work cond. working	1475.43	1445.28	1501.30	1620.45	1629.23	1631.98
		(-2.04%)	(1.75%)		(0.54%)	(0.71%)
Hourly wage cond. working	6.34	8.42	6.66	9.67	10.44	10.29
		(32.81%)	(5.07%)		(7.91%)	(6.43%)
Prop of low flex	0.44	0.50	0.55	0.50	0.56	0.58
		(14.11%)	(25.14%)		(11.65%)	(15.65%)

NOTE: This table reports the effects of policy counterfactuals on women's labor market outcomes when the policy targets women only. Panel (a) reports the short-run effects evaluated one year after the first birth. Panel (b) reports the long-run effects evaluated 10 years after the first birth. For each panel, column 1 reports the outcomes in the baseline scenario where no policy is implemented, column 2 reports the outcomes with the "Equal Pay" policy implemented, and column 3 reports the outcomes with the "Equal Benefit" policy implemented. Row 1 reports the participation rates, row 2 reports the annual hours of work conditional on working, row 3 reports the hourly wages in 1999 dollars conditional on working, and row 4 reports the proportion of wives working in low flexibility occupations. The percentage changes from the baseline are reported in the parentheses.

out their lifetime. In the baseline, wives choose to work in high flexibility occupations partly due to precautionary motivations. There's a high cost of switching professions. Thus it may be too costly for them to switch their occupation at the same time when they have a child. When the precautionary motives are alleviated due to the increased benefit of working in low flexible occupations, wives will shift into low flexibility occupations in the pre-birth period.

Additionally, as fertility is stochastic in the model, all women, including those who end up not having any child, would face the same precautionary motives to hold high flexibility occupations. As a result, the impact of policy feeds through any women who expect to have children. Table 12 shows that under the Equal Pay (Benefit) policy, 8% (11%) increase in the proportion of women working in low flexibility occupations in the year before birth, which translates into a 3% (2%) increase in wives' hourly wages in the pre-birth period. Policy simulation also shows that the increases in wives' hourly wages directly translate into a reduction in the gender pay gap. Specifically, the Equal Pay (Benefit) policy reduces the gender pay gap by 8% (6%) on average between men and women 10 years after their first childbirth.

Table 12: Pre-birth Effects on Wife's Labor Adjustment and Wages

	A year before birth		
	Baseline	CF 1 Equal Pay	CF 2 Equal Benefit
Participation	0.90	0.91 (1.41%)	0.90 (0.52%)
Hours of work cond. working	1899.92	1922.99 (1.21%)	1906.25 (0.33%)
Hourly wage cond. working	7.59	7.83 (3.16%)	7.76 (2.24%)
Prop of low flex	0.49	0.53 (8.30%)	0.54 (11.02%)

NOTE: This table reports the effects of policy counterfactuals on women's pre-birth labor market outcomes when the policy targets women only. Pre-birth outcomes are measure at the one year before the first childbirth. Column 1 reports the outcomes in the baseline scenario where no policy is implemented, column 2 reports the outcomes with the "Equal Pay" policy implemented, and column 3 reports the outcomes with the "Equal Benefit" policy implemented. Row 1 reports the participation rates, row 2 reports the annual hours of work conditional on working, row 3 reports the hourly wages in 1999 dollars conditional on working, and row 4 reports the proportion of wives working in low flexibility occupations. The percentage changes from the baseline are reported in the parentheses.

Table 13: Short- and Long-run Effects on Wife's Labor Adjustment and Wages

	(a) A year after birth			(b) 10 years after birth		
	Baseline	CF1 Equal Pay	CF2 Equal Benefit	Baseline	CF1 Equal Pay	CF2 Equal Benefit
Participation	0.62	0.66	0.67	0.75	0.75	0.74
		(7.42%)	(8.15%)		(0.04%)	(-1.10%)
Hours of work cond. working	1475.43	1416.95	1447.71	1620.45	1610.64	1590.87
		(-3.96%)	(-1.88%)		(-0.61%)	(-1.83%)
Hourly wage cond. working	6.34	8.32	6.37	9.67	10.14	9.66
		(31.31%)	(0.57%)		(4.85%)	(-0.08%)
Prop of low flex	0.44	0.49	0.51	0.50	0.54	0.53
		(10.85%)	(17.21%)		(6.88%)	(5.23%)

NOTE: This table reports the effects of policy counterfactuals on women's labor market outcomes when the policy targets both men and women. Panel (a) reports the short-run effects evaluated one year after the first birth. Panel (b) reports the long-run effects evaluated 10 years after the first birth. For each panel, column 1 reports the outcomes in the baseline scenario where no policy is implemented, column 2 reports the outcomes with the "Equal Pay" policy implemented, and column 3 reports the outcomes with the "Equal Benefit" policy implemented. Row 1 reports the participation rates, row 2 reports the annual hours of work conditional on working, row 3 reports the hourly wages in 1999 dollars conditional on working, and row 4 reports the proportion of wives working in low flexibility occupations. The percentage changes from the baseline are reported in the parentheses.

Table 14: Effects on Husband's Labor Adjustment

	(a) A year before birth			(b) A year after birth		
	Baseline	CF 1 Equal Pay	CF 2 Equal Benefit	Baseline	CF 1 Equal Pay	CF 2 Equal Benefit
Participation	0.98	0.98	0.98	0.97	0.98	0.98
		(0.12%)	(0.41%)		(1.25%)	(1.72%)
Hours of work cond. working	2279.85	2288.34	2317.46	2201.92	1950.15	2257.35
		(0.37%)	(1.65%)		(-11.43%)	(2.52%)
Prop of low flex	0.47	0.54	0.67	0.44	0.52	0.69
		(13.55%)	(40.93%)		(17.12%)	(55.63%)

NOTE: This table reports the effects of policy counterfactuals on men's labor market outcomes when the policy targets both men and women. Panel (a) reports the pre-birth effects evaluated one year before the first birth. Panel (b) reports the post-birth effects evaluated one year after the first birth. For each panel, column 1 reports the outcomes in the baseline scenario where no policy is implemented, column 2 reports the outcomes with the "Equal Pay" policy implemented, and column 3 reports the outcomes with the "Equal Benefit" policy implemented. Row 1 reports the participation rates, row 2 reports the annual hours of work conditional on working, and row 3 reports the proportion of wives working in low flexibility occupations. The percentage changes from the baseline are reported in the parentheses.

However, when the polices target both spouses, the results suggest that there might be negative effects on the female labor supply and the gender pay gap. In Table 13, we can see that wives' labor supply can get negatively affected. Although the policies help wives stay in the labor force more initially after childbirth, in the long term, households may find it better to specialize more. This is because the same incentive of working in low flexibility occupations applies to husbands as well. Table 14 shows the changes in husband labor supply, occupational sorting under the policies. As shown in previous sections, husbands are the ones who face much larger flexibility constraints. When the benefits are given to husbands, they attract substantially more husbands to work in high-paying low flexible occupations (41-56% increase in proportion of husbands working in low flexibility occupations depending on the policy and the timing). The re-sorting effect is much larger for husbands than that for women, leaving less incentive for women to work at all. Therefore, the positive effects on the female labor supply are weakened, and eventually, the gender pay gap expands in the long run by 1% or 9% depending on the policy.

8 Conclusion

This paper studies the effects of occupational flexibility on married couples' labor supply adjustment around childbirth and the gender pay gap. Using an event study specification, I document that both own and spousal flexibility are significant labor supply determinants. Wives with high flexibility restore their pre-birth labor supply, but those with low flexibility cannot. Wives with husbands in less flexible occupations reduce their labor supply more after childbirth, and their husbands increase their labor supply. Also, there are significant trade-offs between occupational flexibility and wages: less flexible occupations offer higher wages and compensate for long hours of work more.

I develop and estimate a dynamic discrete choice household model of households with occupation choice and labor supply, where occupations are characterized by wages and flexibility levels (low or high) and fertility is stochastic. Flexibility is introduced through differences in part-time wage penalties and non-pecuniary benefits, and the model estimates show there is a significant difference across occupations on these flexibility dimensions. With the estimated model, I quantify the ceteris paribus effects of own and spousal flexibility by exogenously changing the flexibility margins in the model. Model estimates suggest that own flexibility promotes stronger labor market attachments for both men and women, and spousal flexibility has even bigger effects on wife's labor supply than own flexibility.

Finally, I consider two counterfactual policies which affect workplace flexibility temporarily after childbirth. Providing temporal flexibility significantly increases women's labor supply after childbirth. Also, the policies affect all women and substantially change the sorting into different occupations even in the pre-birth period. When the policies target only wives, they increase women's hourly wage by 6-8% 10 years after the first childbirth, and this directly translates into a reduction in gender pay gap. However, when the policies target both husbands and wives, the positive effects on female labor supply are weakened, and the gender pay expands in the long run.

The findings in this paper provide important implications for how we design workplace flexibility and family-friendly policies. The effects of policies providing temporal flexibility can be substantially larger in the long run than the effects of policies providing paid parental leave.[31] Additionally, increased parent's needs of the flexibility and decreased mother's labor supply after experiencing a recent pandemic give rise to a discussion of how jobs can be restructured to improve workplace flexibility. My work is among the first attempts to provide quantitative assessments of such workplace policies.

My research provides ample scope for future research. Possible extensions of the framework include modeling the wage determination process explicitly and modeling endogenous fertility decisions. The prediction on the effects of family-friendly workplace policies on the offered wages and fertility is not deterministic, thus calling for future empirical research.

[31] Bailey et al. (2019) and Kleven et al. (2020) find no impact or even negative long-run impacts on female labor supply of paid parental leave policies implemented in California and Austria, respectively.

References

ADDA, J., C. DUSTMANN, AND K. STEVENS (2017): "The Career Costs of Children," *Journal of Political Economy*, 125, 293–337.

ALBANESI, S. AND C. OLIVETTI (2009): "Home production, market production and the gender wage gap: Incentives and expectations," *Review of Economic Dynamics*, 12, 80–107.

ALTONJI, J. G. AND R. M. BLANK (1999): "Chapter 48 Race and gender in the labor market," in *Handbook of Labor Economics*, Elsevier, vol. 3, 3143–3259.

ANGELOV, N., P. JOHANSSON, AND E. LINDAHL (2016): "Parenthood and the Gender Gap in Pay," *Journal of Labor Economics*, 34, 545–579.

ANGRIST, J. D. AND W. N. EVANS (1998): "Children and Their Parents' Labor Supply: Evidence from Exogenous Variation in Family Size," *The American Economic Review*, 88, 450–477, publisher: American Economic Association.

AUTOR, D. AND D. DORN (2013): "The Growth of Low Skill Service Jobs and the Polarization of the U.S. Labor Market," *American Economic Review*, 103, 1553–1597.

BAILEY, M., T. BYKER, E. PATEL, AND S. RAMNATH (2019): "The Long-Term Effects of California's 2004 Paid Family Leave Act on Women's Careers: Evidence from U.S. Tax Data," Tech. Rep. w26416, National Bureau of Economic Research, Cambridge, MA.

BARTH, E., S. P. KERR, AND C. OLIVETTI (2021): "The dynamics of gender earnings differentials: Evidence from establishment data," *European Economic Review*, 134, 103713.

BERTRAND, M., P. CORTES, C. OLIVETTI, AND J. PAN (2021): "Social Norms, Labour Market Opportunities, and the Marriage Gap Between Skilled and Unskilled Women," *The Review of Economic Studies*, 88, 1936–1978.

BERTRAND, M., C. GOLDIN, AND L. F. KATZ (2010): "Dynamics of the Gender Gap for Young Professionals in the Financial and Corporate Sectors," *American Economic Journal: Applied Economics*, 2, 228–255.

BERTRAND, M., E. KAMENICA, AND J. PAN (2015): "Gender Identity and Relative Income within Households*," *The Quarterly Journal of Economics*, 130, 571–614.

BICK, A., A. BLANDIN, AND K. MERTENS (2020): "Work from Home Before and After the COVID-19 Outbreak," *Federal Reserve Bank of Dallas, Working Papers*, 71.

BLAU, F. D. AND L. M. KAHN (2017): "The Gender Wage Gap: Extent, Trends, and Explanations," *Journal of Economic Literature*, 55, 789–865.

BYKER, T. S. (2016): "Paid Parental Leave Laws in the United States: Does Short-Duration Leave Affect Women's Labor-Force Attachment?" *American Economic Review*, 106, 242–46.

CHA, Y. AND K. A. WEEDEN (2014): "Overwork and the Slow Convergence in the Gender Gap in Wages," *American Sociological Review*, 79, 457–484.

CORTÉS, P. AND J. PAN (2019): "When Time Binds: Substitutes for Household Production, Returns to Working Long Hours, and the Skilled Gender Wage Gap," *Journal of Labor Economics*, 37, 351–398.

——— (2020): "Children and the Remaining Gender Gaps in the Labor Market," Working Paper 27980, National Bureau of Economic Research.

CORTÉS, P., J. PAN, L. PILOSSOPH, AND B. ZAFAR (2021): "Gender Differences in Job Search and the Earnings Gap: Evidence from Business Majors," Working Paper 28820, National Bureau of Economic Research.

DINGEL, J. I. AND B. NEIMAN (2020): "How Many Jobs Can be Done at Home?" Working Paper 26948, National Bureau of Economic Research.

EKBERG, J., R. ERIKSSON, AND G. FRIEBEL (2013): "Parental leave — A policy evaluation of the Swedish "Daddy-Month" reform," *Journal of Public Economics*, 97, 131–143.

EROSA, A., L. FUSTER, G. KAMBOUROV, AND R. ROGERSON (forthcoming): "Hours, Occupations, and Gender Differences in Labor Market Outcomes," Tech. Rep. w23636, Cambridge, MA.

FELFE, C. (2012): "The motherhood wage gap: What about job amenities?" *Labour Economics*, 19, 59–67.

FITZENBERGER, B., K. SOMMERFELD, AND S. STEFFES (2013): "Causal effects on employment after first birth — A dynamic treatment approach," *Labour Economics*, 25, 49–62.

FLINN, C. J., P. E. TODD, AND W. ZHANG (2018): "Personality traits, intra-household allocation and the gender wage gap," *European Economic Review*, 109, 191–220, gender Differences in the Labor Market.

GAYLE, G.-L. AND L. GOLAN (2012): "Estimating a Dynamic Adverse-Selection Model: Labour-Force Experience and the Changing Gender Earnings Gap 1968-1997," *The Review of Economic Studies*, 79, 227–267.

GICHEVA, D. (2013): "Working Long Hours and Early Career Outcomes in the High-End Labor Market," *Journal of Labor Economics*, 31, 785–824, publisher: [The University of Chicago Press, Society of Labor Economists, NORC at the University of Chicago].

GOLDIN, C. (2014): "A Grand Gender Convergence: Its Last Chapter," *American Economic Review*, 104, 1091–1119.

GOLDIN, C. AND L. F. KATZ (2011): "The Cost of Workplace Flexibility for High-Powered Professionals," *The ANNALS of the American Academy of Political and Social Science*, 638, 45–67.

HEISS, F. AND V. WINSCHEL (2008): "Likelihood approximation by numerical integration on sparse grids," *Journal of Econometrics*, 144, 62–80.

HOTZ, V. J., P. JOHANSSON, AND A. KARIMI (2017): "Parenthood, Family Friendly Workplaces, and the Gender Gaps in Early Work Careers," Working Paper 24173, National Bureau of Economic Research.

KEANE, M. P., P. E. TODD, AND K. I. WOLPIN (2011): "The Structural Estimation of Behavioral Models: Discrete Choice Dynamic Programming Methods and Applications," in *Handbook of Labor Economics*, Elsevier, vol. 4, 331–461.

KEANE, M. P. AND K. I. WOLPIN (1994): "The Solution and Estimation of Discrete Choice Dynamic Programming Models by Simulation and Interpolation: Monte Carlo Evidence," *The Review of Economics and Statistics*, 76, 648–672.

——— (1997): "The Career Decisions of Young Men," *Journal of Political Economy*, 105, 473–522, publisher: The University of Chicago Press.

——— (2001): "The Effect of Parental Transfers and Borrowing Constraints on Educational Attainment," *International Economic Review*, 42, 1051–1103.

KLEVEN, H., C. LANDAIS, J. POSCH, A. STEINHAUER, AND J. ZWEIMÜLLER (2019a): "Child Penalties across Countries: Evidence and Explanations," *AEA Papers and Proceedings*, 109, 122–126.

——— (2020): "Do Family Policies Reduce Gender Inequality? Evidence from 60 Years of Policy Experimentation," Tech. Rep. w28082, National Bureau of Economic Research, Cambridge, MA.

KLEVEN, H., C. LANDAIS, AND J. E. SØGAARD (2019b): "Children and Gender Inequality: Evidence from Denmark," *American Economic Journal: Applied Economics*, 11, 181–209.

LE BARBANCHON, T., R. RATHELOT, AND A. ROULET (2020): "Gender Differences in Job Search: Trading off Commute against Wage*," *The Quarterly Journal of Economics*, 136, 381–426, _eprint: https://academic.oup.com/qje/article-pdf/136/1/381/35653390/qjaa033.pdf.

LISE, J. AND J.-M. ROBIN (2017): "The Macrodynamics of Sorting between Workers and Firms," *American Economic Review*, 107, 1104–1135.

MAS, A. AND A. PALLAIS (2020): "Alternative Work Arrangements," Working Paper 26605, National Bureau of Economic Research.

MCFADDEN, D. (1989): "A Method of Simulated Moments for Estimation of Discrete Response Models Without Numerical Integration," *Econometrica*, 57, 995–1026.

PATNAIK, A. (2019): "Reserving Time for Daddy: The Consequences of Fathers' Quotas," *Journal of Labor Economics*, 37, 1009–1059.

ROSSIN-SLATER, M., C. RUHM, AND J. WALDFOGEL (2013): "The Effects of California's Paid Family Leave Program on Mothers' Leave-Taking and Subsequent Labor Market Outcomes," *Journal of policy analysis and management : [the journal of the Association for Public Policy Analysis and Management]*, 32, 224–245.

TÔ, L. T. (2018): "The Signaling Role of Parental Leave," 75.

WISWALL, M. AND B. ZAFAR (2017): "Preference for the Workplace, Investment in Human Capital, and Gender*," *The Quarterly Journal of Economics*, 133, 457–507.

XIAO, P. (2019): "Wage and Employment Discrimination by Gender in Labor Market Equilibrium," 60.

Appendices

A A Measure for Occupational Flexibility

In this paper, I measure occupational flexibility following Goldin (2014) using O*NET database. Although I use the same variables available in the O*NET as Goldin (2014) does, there are a few differences to point out. First, I combine multiple vintages of O*NET database to properly capture the changes in the flexibility of a given occupation over time[32]. As I am using longitudinal data from NLSY79, properly capturing any time trend of a given occupation is essential. Second, I normalize each of the five O*NET characteristics using a different set of occupations from Goldin (2014). In Goldin (2014), each characteristic is normalized to have a mean of zero and a standard deviation of one using a set of occupations held by the sample of college graduates in the American Community Survey (ACS). In this paper, I expand the sample of occupations to be all the occupations held by the sample of individuals who are at least high school graduates, and the normalization is taken with this bigger set of occupations. Third, the match process between NLSY79 and O*NET is different from the match process between ACS and O*NET. The occupational codes available in NLSY79 and ACS, although they both use the Census Occupational Code system, are slightly different, and this makes minor differences in terms of merging each data with O*NET.

Figure A1 summarizes the difference in flexibility scores across age, education, and gender. As workers get promoted over time, age is negatively correlated to the flexibility score. Also, college graduates or above have lower flexibility scores on average compared to high school graduates or individuals with some college experience. Interestingly, women have lower flexibility scores compared to men on average. For individuals having no college degree, men's flexibility is far higher than women's. This is because even for those low educated women, occupations usually require more strict time schedules compared to men's occupations. (women work in services industries where men work in more flexible settings). But even individuals with a 4-year college degree, young women have lower flexibility compared to young men. This is because occupations which exclusively held by men (e.g., construction workers, production workers, electronic engineers) are more flexible at the beginning of the career path compared to occupations that are

[32] The time trend shows that the flexibility of a given occupation is quite stable over time

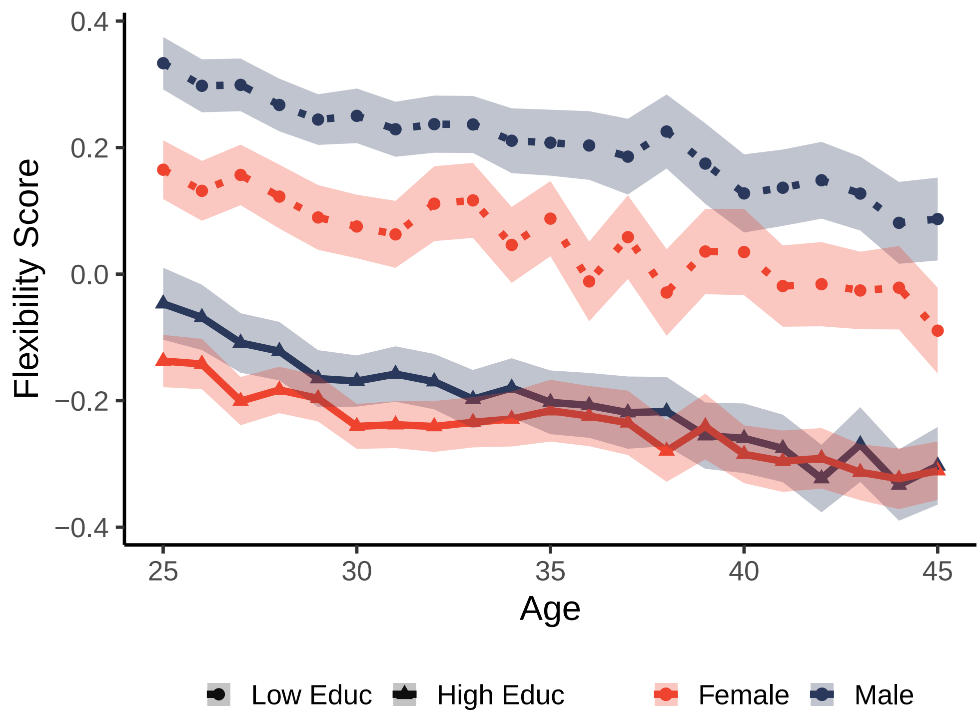


Figure A1: Flexibility Score by Age, Education, and Gender

exclusively held by women (e.g., secretaries, administrative assistants).

B Supplemental Data: American Time Use Survey

American Time Use Survey consists of a nationally representative sample of individuals and provides information on individual's time use within a day together with a contextual information. Relevant information includes how much hours worked during the day, what time of the day they work, and the location of work. Consistent with the main NLSY79 sample, I restrict the sample to individuals who are at least high school graduates, and age between 19 to 45 for high school graduates and 24 to 45 for college graduates. The sample period includes years from 2003 to 2010.

C Discretization of Labor Supply and Occupational Choices

In the estimation, all the occupations in the NLSY79 sample are divided into two equal-size groups ("high" and "low") based on the flexibility scores. Also, I use four options of hours worked: 1) not working, 2)"part-time low", 3)"part-time high", and 4)"full-time." As the distributions of working hours significantly differ by gender, I use different criteria for men and women to discretize continuous working hours. For men, I treat working less than 900 hours per year as non-working status, working more than or equal to 900 and less than 1700 as "part-time low", working more than or equal to 1700 and less than 2080 as "part-time high", and working more than or equal to 2080 as "full-time". For women, the threshold for the non-working status is 300 hours per year. The part-time low status refers to working more than or equal to 300 and less than 1000 hours, the part-time high status is working more than or equal to 1000 and less than 1800, and the full-time status is working more than or equal to 1800 hours per year.