Income Losses Following First Births and Part-Time Work*

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Abstract

Using linked Swiss administrative and survey data, we examine the earnings gap in yearly income and hourly wages experienced by mothers following the birth of their first child. Correcting for selection, the motherhood earnings gap in yearly income amounts to roughly 19'000 2016 Swiss francs, corresponding to 63.5% of the average earnings in our sample, a very high number in an international context. Controlling for experience and labor market attachment, the unexplained motherhood gap for full-time workers reduces to 20-25%, roughly the same magnitude as the decline in hourly wages experienced by full-time working moms. The yearly income penalty for part-time working moms is about double the full-time motherhood penalty. Although motherhood reduces hourly wages of full-time moms, we find a *premium* in wages associated with part-time work, casting doubt on part-time having an intrinsically detrimental effect on productivity in the context of the Swiss labor market. Nonetheless, for a group of occupations for which productivity is likely convex in hours worked, part-time experience has a negative impact on future wages. This is consistent with part-time work placing workers below a necessary threshold to compensate for human capital depreciation. Using a quasi-experiment in which new mothers' partners lost their job during pregnancy or the child's first year, we find a positive effect on the hourly wages of part-time working moms, consistent with statistical discrimination toward part-time but not full-time working moms.

JEL Codes: J22, J24, J7.

Keywords: Administrative data, Switzerland, motherhood penalty, part-time work, commitment, quasi-experiment, discrimination.

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1 Introduction

The impact of the birth of a first child on the mother's labor market performance and attachment is one of the most studied question in labor economics, going back to Mincer (1962a).[1] Despite the elimination of the educational gender gap (except in Science, Technology, Engineering and Mathematics – STEM – fields, Bertrand (2021)), and despite reductions in the gender pay gap (Blau and Khan (2017)), the birth of a first child remains a moment in which men's and women's labor market paths diverge (Kleven, Landais, and Søgaard (2019)).

Using linked administrative and survey data for Switzerland, spanning the period 1988-2016 and covering up to 19 years following childbirth, we document the long-term motherhood penalty experienced by mothers following the birth of their first child. We sought to characterize not only the overall income losses after a first birth but also how much of those losses correspond to different types of labor market attachment, with an emphasis on part-time work as well as the effect of motherhood on productivity (measured by hourly wages).

We control for selection primarily by using individual fixed effects. Results differ markedly relative to OLS in at least two dimensions. First, the estimated overall motherhood penalty is significantly smaller using fixed effects, and second, the evolution of yearly income following the first birth differs greatly as well. Using OLS estimates, mothers suffer a large negative shock to their income that endures through the end of our 19-year window while, when using fixed effects, income slowly recovers with women surpassing their income at first childbirth after 16 years (Figure 1). With the exception of the initial comparison of the overall motherhood penalty across estimation methodologies, we use fixed effects throughout the paper, either in levels or interacted with individual measures of experience, thus calculating individual-specific experience slopes for each mom in our data.

According to our estimates, the overall motherhood earnings gap amounts to roughly 19'000 2016 Swiss francs per year, corresponding to 63.5% of the average earnings in our sample, a very high number in an international comparison. This number represents an average income reduction over three types of labor market situations: full- and part-time work, as well as non-participation. Further controlling for experience and labor market attachment, the unexplained motherhood gap for full-time workers reduces to 20-30%, roughly the same magnitude as the decline in hourly wages experienced by full-time working moms. The yearly income penalty for part-time working moms is about double the full-time motherhood penalty. However, working part-time without children is associated with an even greater income loss, between 50 to 60%. Our estimates remain

[1] See Andrew, Bandiera, Costa-Dias, and Landais (2021) for a recent overview of current labor market gaps between women and men.

largely unchanged across a number of robustness checks.[2]

Switzerland is a country where women have a very high degree of labor market attachment which, to a large extent, they maintain through part-time work. Therefore, how motherhood impacts earnings through productivity (hourly wages) is also a question of interest as hourly wages may differ between full- and part-time work. Theoretically, we might imagine four mechanisms linking work reductions and hourly wages: 1. a negative impact on current productivity that is related to part-time employees' efficiency (Goldin (2014), Azmat, Hensvik, and Rosenqvist (2023)) 2. a long-term effect where part-time work experience accrues or deteriorates at a different rate than full-time experience, impacting future productivity (Blundell, Dias, Goll, and Meghir (2021)), 3. the effect of working part-time on companies' incentives to invest in the worker, possibly leading to higher current wages for part-timers as the worker does not "pay" for specific on-the-job training but contributing to the dynamic losses from lower experience mentioned in 2. (Mincer (1962b), Becker (1993)), and 4. discrimination against mothers (Correll, Benard, and Paik (2007)) due possibly to perceived or actual lower work commitment and reliability, discrimination found at the time of hiring in Becker, Fernandes, and Weichselbaumer (2019) for part-time positions in Switzerland but not for full-time employment.

These four mechanisms imply that reductions in hours worked have the potential to affect both short- and long-term outcomes. Mechanisms 1. and 3. would have opposite effects on hourly wages, with 4. representing an additional negative contribution to short-term outcomes. Mechanisms 2. and 3. would negatively impact the rate of accumulation of experience or human capital. Discrimination could also contribute to slower wage growth if forms of direct discrimination (such as taste-based or statistical discrimination) put workers at a disadvantage in future job opportunities resulting in systemic discrimination (Bohren, Hull, and Imas (2023), Kline, Rose, and Walters (2022)). In addition, the precise way in which part-time work impacts productivity is likely to be heterogeneous, depending on particular skills and occupations.

Although motherhood reduces hourly wages of full-time moms, we find a *premium* in wages associated with part-time work, casting doubt on part-time having an intrinsically detrimental effect on productivity, or at least a very large one. Higher hourly wages for part-time work is a regularity consistent with mechanism 3. above, which could offset the productivity losses of mechanism 1 (if any). A regularity consistently present across specifications and samples is the higher return to years of full-time experience on current earnings

[2]Those include focusing on the middle cohorts in our data – more likely to have accurate information on birth order and more years for each individual worker, restricting the years after birth to a shorter time-horizon, considering different measures of labor market experience, further checking for selection by employing linear methods over sub-samples with positive earnings where specifications in logs are also ran, as well as rerunning the main tables while additionally including non-mothers, as mentioned below.

or hourly wages relative to the corresponding returns from part-time experience. Further, for a group of occupations likely to display convex returns to hours worked, we find *detrimental* effects of part-time experience on hourly wages – consistent with part-time work placing workers below a minimum working hours threshold to compensate for human capital depreciation, as illustrated by a simple model. Relying on a quasi-experiment recording instances where a new mother's partner lost their job during pregnancy or the child's first year, we find a positive effect on hourly wages of part-time working moms. This and the fact that hourly wages of full-time moms are unaffected is consistent with firms statistically discriminating against part-time moms. Overall, our data are consistent with mechanisms 2. lower value of part-time experience relative to full-time work, 3. higher hourly wages for part-time work resulting from lack of firm-specific investments in part-time workers, and 4. discrimination but not 1. lower productivity from part-time work.

The paper proceeds as follows. In the next section, we review the literature. Section 3 presents a simple model to illustrate the different forces connecting part-time work and the inter-temporal path of wages. In Section 4, we describe our data sources and present descriptive statistics of our linked data sets. The quantitative analysis and results are described in section 5. Section 6 presents policy recommendations and concludes.

2 Literature Review

Families, and particularly mothers as the main caregiver, adjust to the presence of children in a variety of ways. Working part-time is one such adjustment that has received considerable attention in the literature.[3] Manning and Petrongolo (2008), for example, show that women working part-time in the UK receive lower hourly wages compared to their full-time counterparts but that this gap reflects both the different characteristics of full- and part-time workers as well as of the jobs they work in. Fernández-Kranz and Rodríguez-Planas (2011) relate the wage part-time penalty to whether workers have a permanent or a fixed-term contract in the Spanish labor market.

Since the switch into part-time work is common for mothers, the literatures on the motherhood penalty and the part-time penalty are frequently intertwined. Lundberg and Rose (2000) examine the relationship between parenthood, wages, and hours worked for married men and women in the US. For the UK, Paull (2008) documents a shift towards part-time work for women occurring with the first birth and enduring for ten years, with the gap in hours attenuating subsequently but still remaining once children have grown up. Wilde, Batchelder, and Ellwood (2010) argue that the postponement of first births and lower fertility of high skilled women is an endogenous response to mitigate the career

[3]Waldfogel (1998) provides an early overview of research on the "Family Gap" in earnings.

cost of children. Fitzenberger, Sommerfeld, and Steffes (2013) examine the effects on employment from postponing a first birth; they document significant negative effects from the birth of the first child on subsequent employment, the strongest of which are experienced by middle-educated women in the oldest age-cohort examined. Relying on Spanish administrative data, Fernández-Kranz, Lacuesta, and Rodríguez-Planas (2013) decompose the motherhood penalty into different components (lower earnings track possibly associated with part-time work or lower accumulation of experience or transitions into lower paying jobs). Using the German Socio-Economic Panel (GSOEP), Fitzenberger, Sommerfeld, and Steffes (2013) propose a causal identification of the effects of first-birth on employment, finding strong negative effects upon birth which, although mitigated over time, do not fully vanish. Angelov, Johansson, and Lindhal (2016) find large maternity earnings and wage gender gaps, related to counterfactual relative incomes within the family. Kleven, Landais, and Søgaard (2019) use Danish administrative data and an event-study methodology to estimate motherhood gaps in earnings, hours, employment and hourly wages. They argue that the gaps are the result of culture and values, concerning labor market participation and the care of children, transmitted intergenerationally from mother to daughters.

Reduced hours and lost experience may lead part-time and motherhood penalties intensifying over time (Olivetti (2006), Adda, Dustmann, and Stevens (2017), Blundell, Dias, Goll, and Meghir (2021)). Additionally, attributes of some occupations might reward continuous presence at the workplace at a disproportionately higher rate relative to flexible work shifts (Goldin (2014), Azmat, Hensvik, and Rosenqvist (2023)), contributing to a decline in hourly wages for part-time workers. Further, employers may take childbirth and work reductions as a signal of lower worker quality or lower motivation and commitment (Spence (1978), Budig and England (2001)). Evidence of a motherhood penalty has additionally been found in the experimental literature on workplace discrimination (Correll, Benard, and Paik (2007), Becker, Fernandes, and Weichselbaumer (2019), the latter providing evidence on the Swiss labor market).

The literature on the motherhood (or child) penalty has connected the size of that penalty to how intensely traditional gender norms are valued, i.e., norms related to mothers caring for young children and thus partially or fully withdrawing from the labor market (Kleven, Landais, Posch, Steinhauer, and Zweimüller (2019), Kleven, Landais, and Mariante (2021)). Given Switzerland's language and cultural variation, we add to this literature by checking how our estimates of the child penalty vary along the language "border," separating the more conservative or traditional areas where German is spoken from the Romance language speaking areas (where either French, Italian, or Romansh are spoken). As expected, the motherhood penalty is higher on the German language side of

the border.

Our paper is more closely related to studies using administrative data (Fernández-Kranz, Lacuesta, and Rodríguez-Planas (2013), Fitzenberger, Sommerfeld, and Steffes (2013), Kleven, Landais, and Søgaard (2019)), identifying motherhood and part-time penalties over a mother's post first-child years. Given the high prevalence of part-time work among mothers in Switzerland, in an international context, we are particularly interested in disentangling the part-time contribution to the motherhood penalties in earnings and wages. Recent work by Anthony and Wunsch (2021) suggests that looking at the parent wage or earnings gap by comparing between the sexes might be an ill-thought exercise given the very weak overlap between male and female labor markets. We therefore focus on the labor market histories of mothers before and after the birth of their first child. We also checked whether including non-mothers in our sample affected our results by rerunning the main specifications on samples inclusive of all women in our data. As indicated below, our estimates remained largely unchanged.

3 A Simple Model

In this section, we introduce a simple model to illustrate how part-time work may affect yearly earnings as well as earnings' growth over time. Our goal is to combine the early insights of Mincer (1974) and Mincer and Polacheck (1974) — on the impact of work experience on future wages — with the potential convexity of hourly wages on time worked in a given period — as in Goldin (2014) — in order to understand which force matters the most for earnings losses from part-time work over time. Our model thus combines typical specifications of the interplay between work experience and human capital accumulation with a potential convex effect of part-time work on hourly wages.[4]

Our starting point is a competitive labor market where a worker is paid her marginal product. Worker i's productivity is a function of that worker's human capital at time t, h_{it}, and the worker's occupation rate $s_{it} \in [0, 1]$. (Full-time employment corresponds to $s_{it} = 1$.) As pointed out in Goldin (2014), for some "indivisible" professions, the continuity of the time spent at the workplace, or at least the time spent during particular business hours, is disproportionately rewarded. In these occupations, earnings are convex in the time spent at work whereas in others, where tasks are perfectly divisible (such as pharmacist, as in Goldin and Katz (2016)), earnings are linear in the hours effectively worked. In the current setting, we model the worker's productivity as the product of the worker's human capital times a function of her occupation rate – where the latter may be linear or convex in the intensity of work depending on the particular occupation considered.

[4]Blundell, Dias, Goll, and Meghir (2021) is a recent example of estimates of the impact of part-time work on future wages while incorporating the impact of training.

Let w_{it} denote the wage of worker i in period t and h_{it} be her human capital at time t. We assume that the worker's productivity (and wage) is as follows:

$$w_{it} = h_{it} g\left(s_{it}\right), \tag{1}$$

where $g(\cdot), g(\cdot)' > 0$, $g(\cdot)'' \geq 0$. If productivity depends on time continuity on the job, then $g\left(\cdot\right)$ is convex ($g(\cdot)'' > 0$). But if the job is perfectly scalable, so that output is proportional to the time spent on it, then it is a linear function ($g(\cdot)'' = 0$).

Human capital evolves over time as a function of the intensity of current work time as well as the depreciation rate. Naturally, the impact of work intensity and depreciation on human capital accumulation may be occupation specific. We assume that next period's human capital is as follows:

$$h_{i_{t+1}} = h_{it}(1 - \delta\left(s_{it}\right))\left(1 + s_{it}\right), \tag{2}$$

where $\delta(s_{it}) > 0$ is the human capital depreciation rate, possibly dependent on the intensity of work, and the term $(1 + s_{it})$ represents the contribution from current work to a worker's human capital in the following period. The product of the two factors multiplying h_{it} jointly defines the returns to experience. But for special cases (see below), this law of motion for human capital immediately implies scarring: at any one period, one's human capital depends on the intensity of work during the past history of employment. We also note the possibility that human capital may decline over time to the extent that the intensity of work s_{it} may be too low to offset the corresponding depreciation, $\delta\left(s_{it}\right)$. An increasing path of human capital over time requires that part-time work exceed a lower bound $\underline{s}$, with $\underline{s} \equiv \frac{1}{1-\delta} - 1$.[5]

For simplicity, let us assume that there are two values for δ depending on the intensity of work. Let $\delta_H > \delta_L > 0$, where δ_H is the depreciation rate of human capital for someone working part-time and the lower depreciation rate δ_L the corresponding rate for full-time workers:

$$\delta\left(s\right) = \begin{cases} \delta_L & s = 1 \\ \delta_H & s < 1 \end{cases}.$$

One question of interest in the current research is the role played by part-time work in the earnings losses of mothers. To this effect, we now calculate forward the human capital and wages of full- and part-time workers and compare their paths over time. For simplicity, we assume that part-time work stays constant over time, $s_{it} = s, \forall t \geq 0, s \in (0, 1)$. Therefore, workers either have a full-time occupation or, if working part-time, they do so at intensity

[5]In our empirical work below, we find instances where part-time experience negatively impacts wage growth, which we interpret as a consequence of work intensity falling below the threshold $\underline{s}$. Interestingly, and although we find hourly wages to be *higher* for part-time than for full-time workers, these occur in a range of "indivisible" occupations deemed to have a convex earnings structure, as in Goldin (2014).

s. Assuming that worker i is a full-time worker and j is the name of a part-timer, human capital in period $t+1$ is given by

$$\begin{aligned} h_{it+1} =& h_{it}\left(1-\delta_L\right)2 \\ h_{jt+1} =& h_{it}\left(1-\delta_H\right)\left(1+s\right). \end{aligned}$$

Working part-time therefore reduces future human capital both through a higher depreciation rate relative to full timers ($(1-\delta_L) > (1-\delta_H)$) as well as through a lower acquisition of on-the-job experience ($2 > (1+s)$).

Let us now consider the case when $g(\cdot)$ is convex and has the following functional form:

$$g\left(s\right) = s^2.$$

The next equation compares wages of full- and part-timers one period into the future assuming that their initial human capital is identical, $h_{it} = h_{jt} = h$.

$$\frac{w_{i,t+1}}{w_{j,t+1}} = \underbrace{\frac{\left(1-\delta_L\right)}{\left(1-\delta_H\right)}\frac{2}{1+s}}_{\substack{\text{dynamic effect} \\ \text{through experience}}} \quad \underbrace{\frac{1}{s^2}}_{\substack{\text{static effect} \\ \text{from convexity}}}$$

The first two factors originate in the law of motion for human capital and their effects were discussed above. The last factor shows how the current period valuation of the intensity of work impacts the relative wage of full- versus part-timers, ($1/s^2 > 1$). This is the Goldin-type, static effect. Were work intensity rewarded linearly, only the last factor would change (to $1/s$ instead of $1/s^2$). This, however, would leave the impact of human capital accumulation unaltered.

Projecting forward k periods, and taking logs, we obtain:

$$\begin{aligned} \ln w_{it+k} =& \ln(h) + k\ln(2(1-\delta_L)) \\ \ln w_{jt+k} =& [\ln(h) + 2\ln(s)] + k\ln((1+s)(1-\delta_H)) \end{aligned}$$

Log wages of full-timers start from a higher intercept ($\ln(h) > \ln(h) + 2\ln(s)$) and have a higher slope ($\ln(2(1-\delta_L)) > \ln((1+s)(1-\delta_H))$ than those of part-timers.

In the context of this model, preventing wages of full-timers from diverging from those of part-time workers would require two conditions: one, that there would be a common depreciation rate for human capital under both part- and full-time work, and two, that the intensity of work today not influence human capital tomorrow through on-the-job training/experience. In other words, human capital would have to evolve similarly regardless of whether one works full-time or part-time. One law of motion for human

capital that would satisfy these conditions would be as follows:

$$h_{it+1} = h_{it}(1-\delta)(1+\theta), \tag{3}$$

where:

$$\theta(s) = \begin{cases} c > 0 & s > 0 \\ 0 & s = 0 \end{cases}. \tag{4}$$

As a result, any strictly positive amount of work would result in the same contribution to human capital tomorrow. Under (3) and (4), wages would no longer diverge and grow at different rates over time. Instead, there would be a constant level difference between the wages of full- and part-time workers – wages of part-timers would equal the wages of full-timers multiplied by s^2 in every period – but there would no longer be a difference in growth rates. In eliminating the impact of part-time work on experience, the law-of-motion described by equations (3) and (4) retains only the Goldin-type static effect of part-time work on current wages.

One of our goals, as stated, is to investigate whether or not part-time is associated with lower hourly wages within a period as well as with permanently lower growth rate of wages of part-timers relative to full-timers. We proceed to quantify the labor market income losses following maternity and the static and dynamic contribution of part-time work toward those losses.

4 Data

Our approach relies on diverse administrative records and a quasi-experimental strategy.

First, we identify a sample of married mothers with first births from 1988 to 2016, as birth records from 1988 onward include mothers' IDs. The oldest women were 27 years of age in our first year of birth records – so some "first" births for our earliest cohort might actually be second parity births.[6]

Although mothers are the focus of the analysis in this paper, we perform robustness checks of our main results by including non-mothers in the data. Since non-mothers are never observed in birth records and we lacked population registers for most of the time span of our data, we relied on marriage records as a means of identifying non-mothers. In order to obtain comparable groups of mothers and non-mothers, we excluded unmarried women from the data. This also because the loss of observations from doing so was small: the number of individuals dropped as a result was just under 10%.

We link earned and social insurance income data from social security records for the years 1983 to 2016 such that we have a full 5 years of pre-birth income data for all women.

[6] As discussed below, our results are robust to retaining only the middle cohorts.

The 1997 cohort is the last cohort with a full 19 years of earnings following the first birth. All income is transformed into 2016 Swiss francs. For the subset of individuals who took part in the national labor market survey (SLFS) we also know occupation (3-digit ISCO codes), hours worked, and whether the individual had a part-time contract. We assume the last observed occupation holds over one's career.

For the administrative data, we also defined a proxy measure of part-time work which is a dummy variable taking value one if the individual's current annual earnings are less than 90% of peak earnings in the past 10 years. As can be seen in Table 9 in the Appendix, we developed this variable after varying both the length of the window of past earnings considered as well as the percent threshold of those earnings below which the worker would be considered to be working part-time. The reported values (a window of 10 years as well the threshold of 90%) were chosen to maximize the correlation of the resulting part-time proxy-variable and the actual self report of part-time work available from the SLFS sample. In the remainder of the paper, we employ a variety of alternative specifications to address the robustness of our results to this variable.

4.1 Descriptive Statistics

Table 1 provides descriptive statistics for the administrative dataset (top panel) as well as the SLFS subset (bottom panel), the latter comprising information on hours worked.[7] Average income (measured in 2016 Swiss francs), variable Yearly_Income_2016, is significantly higher in the SLFS subsample (50'462 2016 Swiss francs compared to 29'920 in the administrative data) as survey data typically under-sample the poor. Mothers are also older in the survey sample (37.7 versus 34.9 years of age respectively). According to our part-time proxy variable (PT_proxy), 40% of mothers work part-time in the population whereas 30% are not employed, resulting in 30% of moms in full-time employment. In the survey subsample, the fraction of moms who are not employed is lower, 10%.

In the subsample, where we have self-reported part-time work, 70% are working part-time (variable PT_self_r) whereas in the administrative data – and resorting to the proxy variable – 60% work part time (suggesting the proxy under-estimates part-time work). The fraction of moms in full-time employment is therefore 20%.

[7] Tables 1, 2, 3, 5, 6, 7 were made using Hlavac (2022)'s Stargazer routine.

Table 1: Descriptive Statistics – Administrative Data (top panel) and Survey Data (bottom panel)

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
age	13,913,168	34.9	6.9	20	30	40	56
PT_proxy	13,913,168	0.4	0.5	0	0	1	1
FTexp	13,913,168	3.4	2.7	0	1	5	25
PTexp	13,913,168	3.8	4.5	0	0	6	24
Yearly_Inc_2016	13,913,168	29,919.8	34,220.2	0.0	0.0	49,614.5	783,293.1
outofwork	13,913,168	0.3	0.5	0	0	1	1

The administrative data comprises 834'658 mothers.

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
PT_self_r	54,197	0.7	0.5	0.0	0.0	1.0	1.0
age	54,286	37.7	6.4	20	33	42	56
PT_proxy	54,286	0.6	0.5	0	0	1	1
FTexp	54,286	4.7	3.0	0	3	6	25
PTexp	54,286	5.5	5.1	0	1	9	24
Yearly_Inc_2016	54,286	45,414.2	38,476.5	0.0	19,623.6	62,003.4	709,895.1
outofwork	54,286	0.1	0.3	0	0	0	1

The survey sample comprises 29'825 mothers.

5 Analysis

5.1 The Motherhood Gap in Yearly Income

We begin our analysis by examining the absolute motherhood gap in yearly earnings using a simple OLS specification – including only age and year dummies. Results are shown in Table 2. The variable "mother" is an indicator variable that becomes one the year of the first birth and stays unchanged for the remainder of the "clock" years in this person's life; it is zero in the years preceding the first birth. The dependent variables Yearly_Inc_2016 and Yearly_Inc_2016_% denote yearly income measured in 2016 Swiss francs and the same variable scaled by the average income level in our sample, respectively. The average income loss from motherhood totals roughly 24'500 2016 Swiss francs. As shown in column (3), this corresponds to an income drop of 82% relative to the average yearly earnings in our moms sample. This estimate is directly comparable to others in the literature, for example in Kleven, Landais, and Søgaard (2019). In the latter, earnings losses following a first birth are at most 30% in the year following the birth of a first child but then decline over time, coming closer to 20% ten years later. The difference between our estimate and others in the literature likely reflects the very strong gender norms associating motherhood with part-time work in Switzerland.[8]

Table 2: Overall Motherhood Penalty in Yearly Earnings

	Dependent variable:			
	incompl.ego.2016		incompl.ego.2016.div	
	OLS	*panel linear*	*OLS*	*panel linear*
	ols levels	fe levels	ols pc	fe pc
	(1)	(2)	(3)	(4)
mother	$-24,525.990^{***}$	$-19,012.370^{***}$	-0.820^{***}	-0.635^{***}
	(25.270)	(19.564)	(0.001)	(0.001)
Constant	$19,069.050^{***}$		0.637^{***}	
	(195.041)		(0.007)	
Observations	13,913,168	13,913,168	13,913,168	13,913,168
R^2	0.080	0.107	0.080	0.107
Residual Std. Error (df = 13913102)	32,819.170		1.097	
Note:				*p<0.1; **p<0.05; ***p<0.01

Notes: Administrative data. All regressions include calendar year and age dummies. The dependent variable in columns (1) and (2) is yearly income in 2016 Swiss francs. In columns (3) and (4), it is yearly income in 2016 Swiss francs divided by the average income in our data.

OLS specifications may be biased by selection since mothers with different earnings capacities may adapt their work intensity accordingly. Whether higher earners are more or less likely to reduce their work intensity is, however, not clear as higher wages entail both income and substitution effects. Following a first-birth, the family experiences a significant

[8]According to data from the 2012 sample of the International Social Survey Program (ISSP) on Family and Changing Gender Roles, only 5.33% of Swiss respondents think that a mother of children in pre-school age should work full-time. This compares with an EU15 average of 17.1%. Similarly, only 11.47% of Swiss respondents think that women should work when their youngest child is at school, contrasting with the EU15 average of 47.05%

increase in its time use in connection with the newborn. Gender roles place most of this burden on the mother. One way to satisfy this increased demand for time is to reduce hours at work (and switch from a full- to a part-time job or to simply exit the labor market). The opportunity cost of reducing work is higher for those moms commanding high wages; however, high wages also allow moms to "buy" more time at home with their child and other related family chores at a moment when time is needed. Which of these effects dominates is the empirical question we now address.

In column (2), we present the fixed-effects estimate of the motherhood income gap (with identical controls as the OLS specification). This estimate is notably smaller – though still a sizable 19'000 2016 Swiss francs – corresponding to a 63.5% income drop relative to the moms' average yearly earnings (column 4). The fact that the fixed effects estimate is lower than the OLS result suggests less substantive income reductions are experienced by higher-income moms.

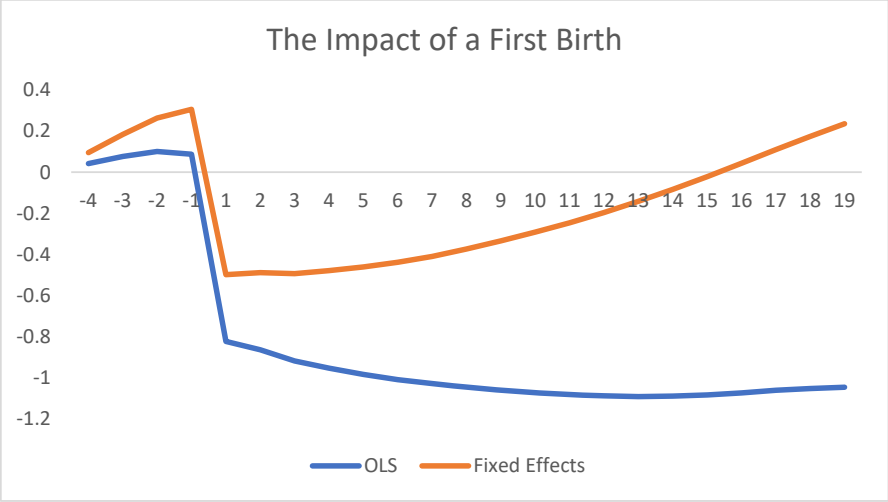

Figure 1: The Impact of a First-Birth on Yearly Income, OLS and Fixed Effect Estimates

In order to graphically illustrate the difference between OLS and fixed effect estimates, we present versions of the specifications in columns (3) and (4) but where the "mother" dummy variable is replaced with dummy variables for clock years. We omit year 0, the birth year of the first child, so that income losses are calculated relative to that year's income. Figure 1 plots the resulting coefficients.

As the picture illustrates, selection has a strong impact on results. OLS estimates show a large initial post-birth income loss, a loss that intensifies over the years until the 14th year after the first birth, and then stabilizes. The fixed-effects estimates tell a different story, suggesting the largest gap is directly after the birth of the first child, declining thereafter. According to fixed-effect estimates, moms start earning incomes in excess of the first-birth year roughly fifteen years later. The earnings dynamics of the fixed-effect estimates, with

income steadily increasing after the initial drop, point toward the consideration of a longer time interval post-birth in the estimation of birth-related penalties. Indeed, as discussed later, restricting the analysis to shorter time spans after birth – for example to 10 years instead of the 19, as portrayed in Figure 1 – results in an estimation of slightly larger income penalties in connection with motherhood, both under full- and part-time work. We come back to this point later when performing additional robustness checks.

As indicated earlier, one of the goals of this paper is to identify the contributions of work-related choices to the motherhood earnings gap. Reductions in work intensity, for example a switch into part-time work or dropping out of the labor force altogether, would naturally lead to lower earnings. Part-time work may also result in lower productivity, translated into lower hourly wages (a la Goldin (2014)). We investigate these different possibilities next.

As described in section 4, we lack information on actual hours worked except for a relatively small subsample where the administrative data overlaps with the Swiss Labor Market Survey. Hours data are important for several reasons. First, they would allow us to control for actual labor market experience and decompose experience into part-time or full-time working years. Second, they would allow us to study the effects of part-time work on productivity as measured by hourly wages. We proceed by resorting to our own part-time proxy variable – a dummy variable indicative of whether, for a particular working year, the corresponding individual worked part-time. Based on this proxy variable, we calculated two other variables corresponding to years of full-time work experience and years of part-time work experience. Since they rely on the proxy variable, they are also likely affected by measurement error. In contrast, our employment variable, based on administrative social security records, is relatively accurate, missing only informal employment – which is relatively rare in the Swiss labor market. We cumulatively add a person's years with positive earnings to calculate their corresponding total labor market experience which we label "years of experience" (abbreviated as "YExp" in the tables). To assess the impact of using our constructed measures of part- and full-time experience, we also run specifications where those are replaced by the measure of years of experience. Specifications where the different measures of full- and part-time work years are used are labeled "FT, PT" instead. Table 3 shows the impact of motherhood and full- and part-time work on yearly earnings.

Table 3: Motherhood Penalty – Yearly Income

	Dependent variable:								
	Yearly Income 2016 %							Log Yearly Income	
	panel linear	YExp	FT,PT	Lm status, YExp	Lm status, FT,PT	Lm status YExp Pos Y	Lm status FT,PT Pos Y	Lm status, YExp	Lm status, FT,PT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
mother	-0.635^{***}	-0.639^{***}	-0.705^{***}	-0.024^{***}	-0.196^{***}	0.016^{***}	-0.163^{***}	-0.178^{***}	-0.281^{***}
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
FTexp			0.174^{***}		0.121^{***}		0.147^{***}		0.148^{***}
			(0.0001)		(0.0001)		(0.0002)		(0.0002)
PTexp			0.006^{***}		0.024^{***}		0.034^{***}		0.083^{***}
			(0.0001)		(0.0001)		(0.0001)		(0.0002)
PT_proxy				-0.639^{***}	-0.681^{***}	-0.634^{***}	-0.676^{***}	-0.524^{***}	-0.548^{***}
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
outofwork				-1.576^{***}	-1.540^{***}				
				(0.001)	(0.001)				
yrsexperience		0.052^{***}		0.050^{***}		0.072^{***}		0.105^{***}	
		(0.0001)		(0.0001)		(0.0001)		(0.0002)	
mother:PT_proxy				-0.416^{***}	-0.209^{***}	-0.469^{***}	-0.262^{***}	-0.355^{***}	-0.235^{***}
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
mother:outofwork				-0.014^{***}	0.092^{***}				
				(0.001)	(0.001)				
Observations	13,913,168	13,913,168	13,913,168	13,913,168	13,913,168	9,881,888	9,881,888	9,881,888	9,881,888
R^2	0.107	0.128	0.216	0.488	0.514	0.384	0.432	0.252	0.263

*p<0.1; **p<0.05; ***p<0.01

Notes: Administrative data. The dependent variable in columns (1) through (7) is individual yearly income in 2016 Swiss francs divided by the average income in our data, whereas it is log of total yearly income in columns (8) and (9). "YExp" refers to regressions where the total number of years of labor market participation is used as our experience variable whereas "FT, PT" indicates that past experience was split into years of full- and part-time employment resorting to our part-time proxy variable. Lm status indicates regressions where measures of experience and labor market participation are included in the regressors (such as whether the person is working full- or part-time or has dropped out of the labor market). "PosY" indicates that the sample was restricted to data points where individuals worked and had positive income. Column (1) is our baseline model using only calendar year and age controls. Columns (2) and (3) add measures of labor market experience. Columns (4) and (5) add indicators of labor market status. Columns (6) and (7) repeat the specifications of columns (4) and (5) over a subsample of positive earners. Columns (8) and (9) repeat the specifications in columns (6) and (7) but where the dependent variable is now in logs – thus over the same subsample of positive earners.

The first column reproduces the fixed-effects estimate from column 4 in Table 2 for reference. Additional controls are progressively added in the following columns. Columns 2 adds full experience. One additional year in the labor market raises yearly earnings by 5.2% and the coefficient on the motherhood penalty becomes slightly higher, 63.9%. Column 3 incorporates experience through our proxy measures: FTexp measures the number of years the person worked full-time whereas PTexp keeps track of those years when our proxy variable, labeled PT_proxy, indicates that the person was working part-time. The returns to one year of full-time work are now 17.4% whereas those associated with part-time are only 0.6%. These numbers bracket the estimate from full experience from column 2 which is an average of the returns to full- and part-time experience. Comparing the two columns, we see that the estimated motherhood penalty is larger when the proxies for full- and part-time experience are used but relatively similar in magnitude and also quantitatively identical to the reference estimate (with no experience controls) from column 1.

We next add variables indicating the labor market status of individuals. In columns (4) and (5), we now include the part-time proxy variable as well as the "outofwork" indicator, together with interactions of the motherhood coefficient with the labor market status indicators. In columns 1 through 3, the motherhood coefficient measured the average effect of a first birth over all three different labor market status possibilities – full-time, part-time and out of work. The default type in columns (4) and (5) is now a childless, full-time worker. As expected, the estimated motherhood penalty is now much lower than before as a full-time working mom should mechanically see her income reduced the least compared to one that works part-time or is not working. In column 4, the motherhood penalty for a full-time working mom is estimated at 2.4% whereas it is close to 20% in column 5. Despite this quantitative difference, the coefficients on the labor market variables (e.g. the "outof work" and part-time proxy dummies) are similar across the two specifications. Further, a reassuring regularity that we find across estimation methods and samples is a stable income loss for part-time working moms irrespective of the experience variables actually used. Adding up the top coefficient in columns (4) and (5) to the coefficient on the interaction between the part-time proxy and the motherhood dummy (mother:PT_proxy), we obtain a global income reduction of 44% and 40.5%, respectively, for part-time working moms. Thus, despite the penalty for a full-time working mom being sensitive to the measures of labor market experience used, the combined penalty for a part-time working mom is a much more stable magnitude. The penalty associated with part-time work outside motherhood (thus for a woman who has not yet given birth to her first child) is a whopping 63.9% (column (4)) or 68.1% (column (5)), and this large income drop is also a persistent feature of our data concerning yearly income.

The linear regression specifications allow for a more direct comparison with estimates in

the recent literature (notably Kleven, Landais, and Søgaard (2019)) as well as maximizing sample size. However, given that income is typically log normally distributed, specifications in logs are potentially more accurate and equally employed in past research (e.g. Fernández-Kranz, Lacuesta, and Rodríguez-Planas (2013)). Specifications in logs require giving up observations where income is null. In order to understand the implications of changing the functional form separately from those resulting from restricting the sample to positive income levels, we repeat the specifications from columns (4) and (5) over the smaller sample of data points where individuals earned positive income. This also allows us to gauge the importance of selection potentially not fully captured by the individual fixed effects – as individuals who are working may differ in some systematic way from others that are not. In particular, the former could be more motivated and experience lower earnings losses in connection with pregnancy.[9]

Comparing results from columns (4) and (5) with those in (5) and (6), we see that the income penalty for full-time moms is slightly lower in the latter (from -2.4 and -19.6% to +1.6 and -16.3%). Returns to experience are also similar in magnitude but slightly higher over the subsample of positive income. These findings would be in line with the positive income subsample disproportionately retaining more motivated workers, even though the quantitative change to the estimated coefficients is small. The overall penalty for part-time working moms remains stable, increasing slightly in the smaller sample (from 44 and 40.5% in columns (4) and (5) respectively, to 45.3 and 42.5% in (6) and (7), respectively). The penalty for part-time work for a childless woman remains extremely high and virtually unchanged (at 63.4 and 67.6% in columns (6) and (7)). The overall numerical similarity of results across both samples suggests that selection brought about by the sample restriction – beyond what is captured by the fixed effect specification – is not a major concern.

Columns (8) and (9) present specifications with log yearly earnings as the dependent variable. The corresponding estimates are substantially different, seemingly the result of employing a different functional form (rather than sample selection). The income penalty for full-time working moms is now considerably larger, 17.8% in column (8) and 28.1% in (9). The penalty for part-time work outside motherhood is about 10pp smaller than previously estimated but still very large, ranging between 52.4 and 54.8% in the same columns. Working part-time as a mom is now associated with a higher earnings loss. The estimates of the overall penalty from motherhood for a part-time worker are now 53.3% (column (8)) and 51.6% (9).

Attempting to prod the impact of selection further, we re-estimate the previous specifications while using a more general formulation of fixed effects. In addition to estimat-

[9]The restriction to positive income results in a sample reduction of about 29% (from 13.9 to 9.9 million person x year observations).

ing a time-constant measure of heterogeneity, we now allow individual slopes to interact with the corresponding experience variables to generate fixed-effect individual slope estimators (FEIS).[10] When using the total years of labor market experience variable, one slope parameter per person is interacted with that variable to capture the impact of experience at the individual level. When decomposing experience into full- and part-time, two individual slope parameters are estimated. The previous (conventional) fixed-effects estimation results when imposing that the slope parameters are zero. Results are presented in Table 4.

Columns (1) and (3) in Table 4 reproduce the estimates in columns (4) and (5) of Table 3 for reference, whereas columns (5) and (7) reproduce the log specifications in columns (8) and (9) of Table 3. Even-numbered columns in Table 3 show the results of FEIS regressions run over the same specification and sample as the column preceding them. Column (2), for example, applies FEIS estimation to the otherwise identical specification of column (1), where the full sample – inclusive of zero income realizations – was used together with full labor market experience. Similarly, column (4) applies FEIS estimation to a linear specification over the entire sample where now full- and part-time measures of experience are used. (Columns (6) and (8) repeat this exercise for the log specification over the sample of positive income values.) A Hausman-like artificial regression test was applied to compare FEIS and conventional fixed-effects leading to the rejection of the null hypothesis of the consistency of fixed effects in all cases at a confidence level of 0.1%.[11] The rejection of consistency in FE estimates leads us to consider the FEIS models as our preferred specifications.

Comparing FEIS and FE specifications, we see that FEIS estimation tends to slightly increase the coefficient on the income penalty for full-time working mothers. Nonetheless, estimates of this component of the motherhood penalty are stable across FE and FEIS specifications, close to 20%, with those in logs being somewhat higher (26% in the FEIS estimate of column (8)). Concerning penalties from part-time work, FEIS estimates are generally lower than those from FE, both for women who are not yet mothers as well as for part-time working moms. Across specifications, the penalty for part-time outside motherhood is roughly 60% in linear FEIS specifications (columns (2) and (4)), and about 10pp lower in FEIS specifications in logs (51 and 46% in columns (6) and (8)). The estimate of the added penalty from part-time work for a mom is considerably lower in FEIS estimates, estimated at 23 and 16% in the linear specifications (columns (2) and (4), respectively), and at 21 and 13% in the log specifications (columns (6) and (8)).

[10] See Ruettenauer and Ludwig (2022) for an explanation of the feis routine in R.

[11] As described in Ruettenauer and Ludwig (2022), the R function feistest() "estimates the Mundlak specification (Mundlak (1978)) of the FEIS model and performs a Wald test on the coefficients of the individual-specific predicted values..."

Table 4: Motherhood Penalty – Yearly Income – Comparison of FE and FEIS Models

	Y%	Y%	Y%	Y%	Log Y	Log Y	Log Y	Log Y
Predictors	*FE YExp*	*FEIS YExp*	*FE FT, PT*	*FEIS FT, PT*	*FE YExp*	*FEIS YExp*	*FE FT, PT*	*FEIS FT, PT*
mother	-0.02 *** (-0.03 – -0.02)	-0.15 *** (-0.16 – -0.15)	-0.20 *** (-0.20 – -0.19)	-0.21 *** (-0.22 – -0.21)	-0.18 *** (-0.18 – -0.18)	-0.20 *** (-0.20 – -0.20)	-0.28 *** (-0.28 – -0.28)	-0.26 *** (-0.27 – -0.26)
PT proxy	-0.64 *** (-0.64 – -0.64)	-0.61 *** (-0.62 – -0.61)	-0.68 *** (-0.68 – -0.68)	-0.58 *** (-0.59 – -0.58)	-0.52 *** (-0.53 – -0.52)	-0.51 *** (-0.51 – -0.51)	-0.55 *** (-0.55 – -0.55)	-0.46 *** (-0.46 – -0.46)
outofwork	-1.58 *** (-1.58 – -1.57)	-1.42 *** (-1.42 – -1.42)	-1.54 *** (-1.54 – -1.54)	-1.35 *** (-1.35 – -1.35)				
yrsexperience	0.05 *** (0.05 – 0.05)				0.10 *** (0.10 – 0.10)			
mother * PT proxy	-0.42 *** (-0.42 – -0.41)	-0.23 *** (-0.23 – -0.22)	-0.21 *** (-0.21 – -0.21)	-0.16 *** (-0.16 – -0.15)	-0.35 *** (-0.36 – -0.35)	-0.21 *** (-0.22 – -0.21)	-0.24 *** (-0.24 – -0.23)	-0.13 *** (-0.13 – -0.12)
mother * outofwork	-0.01 *** (-0.02 – -0.01)	0.06 *** (0.06 – 0.06)	0.09 *** (0.09 – 0.09)	0.11 *** (0.11 – 0.12)				
FTexp			0.12 *** (0.12 – 0.12)				0.15 *** (0.15 – 0.15)	
PTexp			0.02 *** (0.02 – 0.02)				0.08 *** (0.08 – 0.08)	
Observations	13913168	13913168	13913168	13913168	9881888	9841494	9881888	9793224
R^2	0.488	NA	0.514	NA	0.252	NA	0.263	NA

** p<0.05 ** p<0.01 *** p<0.001*

Notes: Administrative data. The dependent variable in columns (1) through (4) is individual yearly income in 2016 Swiss francs divided by the average income in our data, whereas it is log of total yearly income in columns (5) through (8). "YExp" refers to regressions where the total number of years of labor market participation is used as our experience variable whereas "FT, PT" indicates that past experience was split into years of full- and part-time employment resorting to our part-time proxy variable. Columns (1), (3), (5) and (7) replicate FE specifications in columns (4), (5), (8) and (9) from Table 3, for reference. Even numbered columns repeat the FE specification of the preceding column using a FEIS specification based on the same experience measure (either YExp or FT, PT) for comparison.

In line with previous results, the overall income penalty for a part-time working mom remains quite stable across samples and specifications. It is 38 and 37% in the linear FEIS specifications (columns (2) and (4)), and 41 and 39% in the FEIS specifications in logs (columns (6) and (8)). While these estimates are similar to the linear FE estimates, they are considerably smaller than those from FE specifications when the left-hand side variable is in logs.

Overall, our data point to full-time working mothers experiencing an average income reduction of about 20 to 25% per year, an income loss that about doubles for part-time working moms, coming to a total yearly income drop of about 40% for the latter.[12][13]

5.2 Motherhood and Hourly Wages

Having examined the yearly earnings losses associated with motherhood and part-time work, we now address the question of whether becoming a mom and/or working part-time is associated with a loss in productivity as measured by hourly wages. As discussed, information on hours worked is only available in the SLFS subsample. Individuals answering this survey are followed for at most 7 consecutive periods. Given their short presence in the data, we resort to conventional FE methods – instead of FEIS.[14] As the impact on hourly wages is calculated in a much smaller sample and using the self-reported measure of part-time work, we take a number of intermediate steps to bridge the estimations for yearly income and those for hourly wages. These steps help disentangle the impact of the change in the sample as well as of the different part-time measures.

Results are presented in Table 5. The first two columns reproduce the log FE specifications from Table 3, columns (8) and (9), which we take as our starting point. Columns (3) and (4) repeat the same specifications over the smaller SLFS sample. All the penalties associated with motherhood (be it under full-time employment or as a part-time worker) as well as the penalty for working part-time outside motherhood are now considerably lower. For example, for a full-time working mom, the yearly income loss is now 7.6% when full experience is used, or 9.5% when experience is decomposed into part- or full-time, compared

[12] As robustness checks, we re-estimated all FEIS specifications under two different data restrictions (not shown): one retains only the middle cohorts in our data, likely to have more accurate information concerning first parity births as well as a more complete coverage of post-birth years, and the other dropping observations that took place more than 10 years after the first birth. As Figure 1 indicates, the first check is likely to result in lower child penalties as it focuses on more complete after-birth spells. On the other hand, the second check is likely to produce greater child penalties for the opposite reason. Both conjectures prove correct but the results remained quantitatively very similar.

[13] We also estimated the specifications in Table 4 using all the women in our data, thus including non-mothers as well. The overall motherhood penalty for part-time working moms stays mostly unchanged: the estimates for the earnings loss for full-time working moms are now a couple of percentage points higher while those for the added part-time penalty for moms turned out correspondingly lower.

[14] Using the latter would result in very significant loss of data. Nonetheless, the main result of this section, in particular the positive relationship between log wages and part-time work, is clearly validated by FEIS estimates as well (not shown).

Table 5: Motherhood Penalty – Hourly Wages

	Dependent variable:								
	Log Yearly Income							Log Hourly Wages	
	YExp	FT,PT	YExp sspl	FT,PT sspl	YExp PT_self_r	FT,PT_self_r	FT,PT_self_r	YExp PT_self_r	FT,PT_self_r occupation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
mother	−0.178***	−0.281***	−0.076***	−0.095***	−0.228***	−0.242***	−0.220***	−0.209***	−0.216***
	(0.001)	(0.001)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
PT_proxy	−0.524***	−0.548***	−0.345***	−0.332***					
	(0.001)	(0.001)	(0.015)	(0.015)					
PT_self_r					−0.204***	−0.192***	0.211***	0.203***	0.210***
					(0.015)	(0.015)	(0.016)	(0.016)	(0.016)
yrsexperience	0.105***		0.168***		0.172***			0.092***	
	(0.0002)		(0.014)		(0.015)			(0.015)	
FTexp		0.148***		0.191***		0.215***	0.123***		0.123***
		(0.0002)		(0.014)		(0.015)	(0.015)		(0.016)
PTexp		0.083***		0.142***		0.119***	0.053***		0.052***
		(0.0002)		(0.014)		(0.015)	(0.016)		(0.016)
mother:PT_proxy	−0.355***	−0.235***	−0.091***	−0.073***					
	(0.001)	(0.001)	(0.017)	(0.017)					
mother:PT_self_r					−0.030*	−0.011	0.113***	0.099***	0.110***
					(0.017)	(0.016)	(0.018)	(0.018)	(0.017)
Observations	9,881,888	9,881,888	50,513	50,513	50,456	50,456	50,456	50,456	50,456
R^2	0.252	0.263	0.164	0.169	0.078	0.101	0.067	0.056	0.085

*p<0.1; **p<0.05; ***p<0.01

Notes: Columns (1) and (2) rely on administrative data while columns (3) to (9) are run over survey data. The dependent variable in columns (1) through (6) is log of total yearly income whereas it is log of hourly wages in columns (7) through (9). YExp refers to regressions where the total number of years of labor market participation is used as our experience variable whereas "FT, PT" indicates that past experience was split into years of full- and part-time employment resorting to our part-time proxy variable. "sspl" indicates that the regression is run over the smaller survey dataset. "PT_self_r" refers to the self-report of whether an individual is working part-time, a variable available only in the survey dataset, and indicates that the regressions in those columns use that measure of part-time instead of the proxy-measure used over the administrative dataset. "Occupation" indicates the inclusion of occupation dummy variables in the corresponding specification.

to 17.8% and 28.1% in the first two columns, respectively. This drop in estimates of income losses across the board likely reflects the difference in sample composition, discussed above.

For continuity, columns (3) and (4) still use the part-time proxy variable constructed for the administrative sample. However, data from the SLFS contains the variable PT_self_r, a self-report on whether the respondent is working part-time. We therefore switch to this variable as the indicator of part-time in columns (5) and (6) while retaining the measures of past experience constructed earlier which take advantage of the full coverage of the working past of these workers from the administrative sample. Including the self-report of part time has important quantitative implications, as follows. The estimated income losses for full-time working moms increase (from 7.6 and 9.5% to 22.8 and 24.2%) while the losses from part-time work (together or outside motherhood) decline. The penalty to part-time work outside motherhood is now roughly 20% whereas the corresponding estimates from columns (3) and (4) were around 34%. Importantly, the additional income loss from part-time work for a mom basically disappears: it is 3% in column (5), but barely significant, and 1.1% in column (6), a statistically insignificant estimate. The changes produced when adopting the part-time self report variable suggest that the part-time proxy over-penalizes part-time work, both as a mother and otherwise, compared to the self-report variable, likely closer to a true measure of part-time work.

Yearly income losses experienced by full-time working moms should originate mostly in wage reductions since they keep their work hours constant. These productivity losses would capture potential compensating differentials associated with e.g. switching jobs toward more family-friendly companies. Since these moms are working full-time, productivity losses a la Goldin (2014), reflecting declines in productivity from spending less time at work (or not spending time at work during critical hours) should not be taking place. We would therefore expect an estimate of the motherhood penalty in hourly wages for full-time workers to roughly equal the corresponding number in terms of yearly income. This is indeed what we find in columns (7) and (8): the hourly wage losses for full-time working moms are estimated at 22 and 21%, respectively, and compare with yearly income reductions of 22.8 and 24.2% from the previous two columns.

Should part-time work lead to productivity losses, this would be captured by the PT_self_r variable and its interaction with motherhood. Our data, instead, reveal a striking *positive* and highly significant relationship between part-time work and hourly wages. Working part-time outside motherhood is associated with an increased of 20 to 21% in hourly wages. Part-time work together with motherhood is also positively related to the hourly wage although the effect is roughly halved, 10 to 11%. Our results are in sharp contrast with the literature (e.g. Goldin (2014) or Bütikofer *et al.* (2018)), although our estimates are average effects across occupations. It could be that, when controlling

for occupation, these effects become more nuanced or disappear.[15] The last column of Table 5 adds occupation dummies to the specification inclusive of full- and part-time work experience (as in column (7)), with virtually unchanged results.[16]

5.3 Occupations

In an attempt to prod further the impact of part-time work on productivity and the striking positive association found above, we grouped occupations into three categories, as follows. Following Goldin (2014), Bütikofer *et al.* (2018) and others, we created a group of high skilled occupations comprising categories 1 and 2 in the International Standard Classification of Occupations (ISCO) except for health care professionals, non-university teachers and Science, Technology, Engineering and Mathematics (STEM) related occupations. This category intended to capture occupations where productivity is convex in the time spent at work, thus more likely to display important negative effects from part-time work on hourly wages.[17] We labeled this group of occupations as "high-skill, cumulative." Our next category, labeled "high-skill non-cumulative" captured health care professionals, non-university teachers and occupations classified under STEM. Finally, our third and residual category, labeled "other," captured low and middle skill occupations.

Table 6 begins by replicating the last columns of the previous table, where dummy variables for each occupation were used. For simplicity, we show results for that specification only (relying on measures of full- and part-time experience).[18] Columns (2), (3), and (4) correspond to additional regressions per group of occupations, as described above. The positive impact of part-time work on hourly wages outside motherhood remains, with all the coefficients in the second row retaining strong statistical significance and varying around 20%. Part-time also continues to positively impact hourly wages in conjunction with motherhood (although these effects are statistically insignificant for the two most skilled groups of occupations as shown in the last row of the table). Therefore, we do not find direct detrimental effects of part-time work on productivity. However, one noticeable difference relative to the former estimates is the fact that, for the high-kill cumulative occupations, years of

[15] Other papers have uncovered small or null effects of part-time work on wages (see e.g. Beblo and Wolf (2002) or Goldin and Katz (2016).

[16] We also ran the specifications in Table 5 including non-mothers. Results remain virtually unchanged.

[17] Health care professionals, for example, were excluded since Goldin and Katz (2016) suggest that hourly wages in the medical profession are unaffected by part-time work.

[18] Because the part-time proxy variable is measured with error, we also reran the specifications in Table 6 replacing full- and part-time experience with years of labor market experience (not shown). As before, using labor market experience does not change the qualitative results and we see this as evidence that the previous results are not driven by the decomposition into full- and part-time experience based on the part-time proxy variable. In particular, and as before, the coefficient on years of labor market experience is bracketed by those on full- and part-time experience. Concerning high-skill and cumulative occupations, the coefficient of full-experience is now -22.7%, slightly less in absolute value than that of Table 6, but now statistically insignificant.

part-time experience have a *negative* and quantitatively large impact on hourly wages of -28.3%. Full-time experience, on the other hand, has a statistically insignificant effect.

Going back to the notation of our model from Section 3, one could interpret the coefficient on current part-time work outside motherhood as a reduced form estimate of the function $g(\cdot)$, mapping work intensity into wages. Additionally, the coefficients on full- and part-time experience could be interpreted as reduced form estimates of $(1-\delta_L)(2)$ and $(1-\delta_H)(1+s)$, respectively.

Our results have consistently shown that years of full-time experience have a greater impact on earnings and hourly wages than years of part-time experience, a finding in line with the literature and consistent with the assumed inequality $(1-\delta_L)(2) > (1-\delta_H)(1+s)$. As pointed out in Section 3, a necessary condition for an increasing path of human capital over time to materialize is that the intensity of work exceed a lower bound threshold $\underline{s}$, likely occupation specific. One interpretation of the negative coefficient on part-time experience is that, in these high-skill and "cumulative" occupations, part-time work puts workers below such a threshold, resulting in a decline of human capital over time.

The evidence that full-time experience raises future income and hourly wages by more than part-time experience (evidence which is also true for the occupations in column (2) of Table 6) is consistent with standard models of human capital accumulation as well as with versions of those models that incorporate the effects of on-the-job training. The latter, when on-the-job training results in productivity gains that are firm specific, deliver the additional prediction that workers bear part of the costs of training in the form of lower salaries, with subsequent increases in productivity and wages once the training period is completed. To the extent that companies do not extend on-the-job training to part-time workers, one would observe higher hourly wages for part-time workers relative to full-timers for some periods, together with future lower wage growth for part-timers. Lower wage growth from lower human capital in view of the absence of on-the-job training reinforces the conventional effect of part-time workers acquiring less experience than full-timers, even absent on-the-job training. Overall, therefore, our results on income and particularly those on hourly wages – higher for part-time workers than for full-timers – validate the human capital accumulation model with on-the-job training.

Table 6: Motherhood Penalty – Hourly Wages – Results by Groups of Occupations

	Dependent variable:			
	logw			
	occupation dummies	hs cumm	hs ncum	other
	(1)	(2)	(3)	(4)
mother	−0.216***	−0.123***	−0.079	−0.265***
	(0.013)	(0.027)	(0.050)	(0.016)
PT.ego	0.210***	0.223***	0.178***	0.203***
	(0.016)	(0.035)	(0.065)	(0.020)
FTexp	0.123***	−0.226	0.275***	0.077***
	(0.016)	(0.139)	(0.090)	(0.017)
PTexp	0.052***	−0.283**	0.182**	0.014
	(0.016)	(0.139)	(0.090)	(0.017)
mother:PT_self_r	0.110***	0.038	0.084	0.141***
	(0.017)	(0.037)	(0.071)	(0.021)
Observations	50,456	9,066	4,336	37,054
R^2	0.085	0.108	0.089	0.069

*p<0.1; **p<0.05; ***p<0.01

Notes: All regressions run on survey data. The dependent variable is log of hourly wages. Column (1) reproduces the last column of Table 5. Columns (2) through (4) are run over subsets of survey data corresponding to specific occupation groups. "hs cumm" refers to high skill occupations where hourly pay is deemed convex in the intensity of work (see text for details), "hs ncumm" refers to high skilled occupations deemed to have constant hourly wages irrespective of whether work is full- or part-time, and "other" is a residual group of occupations comprising middle and low skill occupations.

5.4 The Value of Commitment

There are many reasons why women may experience lower yearly earnings and hourly wages in connection with motherhood. Women may switch into lower paying jobs which nonetheless offer improved possibilities to balance work and child related responsibilities, the lower pay amounting to a compensating differential for the convenience. There could be also a productivity reduction from mothers of small children due to e.g. greater absenteeism from looking after sick children at very young ages or other child related chores. While these are plausible explanations for the motherhood penalty, it is also possible that mothers are subject to discrimination. Indeed, employer concerns with absenteeism or potential lack of commitment from mothers as employees (as their priorities may align more strongly with family and less with the company's goals) may lead to statistical or other forms of discrimination. The experimental literature has provided evidence of mothers experiencing discrimination in hiring (see e.g. Correll, Benard, and Paik (2007) or Becker, Fernandes, and Weichselbaumer (2019), the latter providing direct empirical evidence for Switzerland).

In order to test whether commitment is part of the unexplained component of the motherhood penalty (not captured by foregone past experience or part-time work), we collected information on a quasi-experimental setup as follows. We identified women whose partner lost their job during the pregnancy of their first child or during that child's first-year. Women experiencing this strong negative income effect should come across to the employer as extremely committed and productive employees, potentially dispelling some of the concerns mentioned above and which are likely at the base of statistical discrimination. If that were the case, we would expect to see a positive impact on their hourly wage. Further, for those moms working part-time, we would also expect to see an increase in yearly income as they would potentially be able to increase hours worked. Table 7 shows our results.[19]

In addition to the variables already presented previously, we have now interactions of motherhood and this quasi-experimental situation, captured by the dummy variable "exper" which takes on the value one for moms affected by partner job loss as described above. The interaction "mother*exper" represents the additional effect on the log yearly income (or log wages) experienced by a full-time working mom whose partner loses their job. The triple product of motherhood, part-time work and the quasi-experiment (variable "mother*PT_self_r*exper") captures the additional effect of experiencing partner job loss for a part-time working mom.

We begin by noting that the coefficients on the variables unrelated to the experiment are identical to those obtained earlier (compare the coefficients in the first six rows of columns

[19]Moms subject to this quasi-experiment comprise 3% of the total sample used for those regressions.

(1) and (2) of Table 7 with the corresponding coefficients in columns (6) and (7) of Table 5, respectively), supporting the randomness of our quasi-experiment. Further, the fact that these coefficients are unaltered while we find changes in yearly income and hourly wages for part-time moms, as discussed next, suggests that the impact of partner job loss does not affect the mechanisms underlying the motherhood penalty (such as seeking more family compatible jobs), as captured by the coefficients on motherhood and its interaction with part-time work.

Table 7: Quasi Experiment: Partner Lost Job During Pregnancy/1st Year

	Dependent variable:	
	Log Yearly Income	Log Hourly Wages
	(1)	(2)
mother	-0.242^{***}	-0.219^{***}
	(0.013)	(0.013)
PT.ego	-0.192^{***}	0.211^{***}
	(0.015)	(0.016)
FTexp	0.215^{***}	0.123^{***}
	(0.015)	(0.015)
PTexp	0.119^{***}	0.053^{***}
	(0.015)	(0.016)
mother:PT_self_r	-0.012	0.112^{***}
	(0.016)	(0.018)
mother:exper	0.054	-0.126
	(0.214)	(0.228)
mother:PT_self_r:exper	0.228^{*}	0.272^{*}
	(0.138)	(0.147)
Observations	50,456	50,456
R^2	0.101	0.068

*p<0.1; **p<0.05; ***p<0.01

Notes: All regressions run on survey data. "exper" is a dummy variable taking the value one when a new mother's partner lost their job during pregnancy or the child's first year.

As for the concrete effects of partner job-loss, the yearly income of full-time working moms affected by the quasi-experiment does not change: the coefficient on "mother*exper" in column (1) is statistically insignificant. However, part-time working moms see a very sizeable and statistically significant increment in their yearly income of 22.8%. For these women, the additional income they generate essentially eliminates the motherhood penalty

in yearly income altogether.[20] Concerning hourly wages, column (2) shows once again no effect for full-time working moms while, for part-timers, there is a marginally significant and quantitatively large effect of 27.2% on their hourly wage. Under a statistical discrimination interpretation, the fact that only part-time moms experience an increment in their hourly wage suggests that it is only these moms that have a potential commitment gap to bridge before employers: the credibility of full-time working moms does not appear affected by the negative income effect that a partner's job loss at a critical moment entails.

Despite the very different approach and methodology, our findings are broadly consistent with those in Becker, Fernandes, and Weichselbaumer (2019). In an experimental setup (correspondence testing), that study did not find differences in callback rates across females at varying stages of their fertility cycle (communicated to employers by marital status, number and age of children) when applying to full-time jobs. The CVs of those job candidates portrayed a continuous employment history up to the time of job search, and employers seemed to find this reassuring evidence that job candidates were identically suitable despite being at varying risk of pregnancy or child chores. However, they reported sizeable differences in callback rates when job candidates at high risk of pregnancy (e.g. married and childless) applied to part-time positions (compared to single and childless applicants). The strong gender roles in Swiss society, linking motherhood and part-time work, were likely at the source of the resulting lower callback rates. In the context of employment, our results suggest that partner employment loss for pregnant women (or for new mothers of a child during the child's first year) may work as a commitment signal toward employers, resulting in a higher hourly age for those moms.

5.5 Motherhood and Yearly Income By Region

Switzerland is known for its linguistic and cultural diversity. The country has four official languages (German, French, Italian and Romansh), with German spoken by a large majority of the population (75%), French spoken by 20%, Italian by 4% and Romansh by 1%.[21] The language border, particularly the one separating German and Romance language speaking areas, has also been recognized as an important cultural divide. For example, Eugster, Lalive, Steinhauer, and Zweimüller (2017) document the significantly higher job search time (7 additional weeks) spent by unemployed workers looking for a new job in the Romance language part of the country compared to their German speaking counterparts, an increase of 22% in overall search time. Other aspects of this cultural diversity can be uncovered by examining the geographical distribution of vote shares on election outcomes on both sides of

[20] This is a manifestation of the *added worker effect* (AWE), the increase in earnings in response to the loss of employment of a partner. See e.g. Cammeraat, Jongen, and Koning (2023), Hevenstone, Kessler, and Luchsinger (2023), Halla, Schmieder, and Weber (2020).

[21] Numbers quoted from Eugster *et al.* (2017) based on the 2000 population census.

the "border." Of direct relevance to our paper, the *Child Penalty Atlas* of Kleven, Landais and Mariante (2021) documents how earnings and employment motherhood penalties are generally higher and in a quantitatively important way in the German speaking part of the Swiss language border. That side of the border was much less supportive of extending the suffrage to women as measure by the "yes" vote share in the 1971 referendum, an indicator of the cultural divide. Since our data has location indicators at the municipality level, we therefore calculate the child penalty on both sides of the language border: in the German speaking areas of Switzerland and elsewhere. Results are presented in Table 8.

Table 8: FEIS Models of Log Yearly Income and Language Regions

	Log Y					
	CH, YExp	GSPeak, YExp	NGSpeak,YExp	CH, Exp	GSpeak, Exp	NGSpeak, Exp
mother	-0.20 ***	-0.24 ***	-0.12 ***	-0.26 ***	-0.31 ***	-0.17 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
PT proxy	-0.51 ***	-0.49 ***	-0.56 ***	-0.46 ***	-0.45 ***	-0.52 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mother*PT proxy	-0.21 ***	-0.24 ***	-0.11 ***	-0.13 ***	-0.15 ***	-0.05 ***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
R^2	0.22	0.24	0.17	0.20	0.23	0.15
Num. obs.	9841494	6834630	2851495	9793224	6805089	2835049
Num. groups: id	746599	518213	215792	730509	508366	210310
RMSE	0.66	0.68	0.62	0.64	0.65	0.59

*** p < 0.001; ** p < 0.01; * p < 0.05

Notes: Administrative data. The dependent variable is log of total yearly income in all columns. "YExp" refers to regressions where the total number of years of labor market participation is used as our experience variable whereas "FT, PT" indicates that past experience was split into years of full- and part-time employment resorting to our part-time proxy variable. "CH" indicates that all of Switzerland's language areas are included in the dataset. "GSpeak" indicates that the dataset was restricted to German-speaking municipalities. "NGSpeak" indicates that the dataset was restricted to non-German speaking municipalities. All regressions use the FEIS methodology.

For brevity, we examine how estimates of the motherhood penalty change across the language border for the FEIS specifications with log yearly income as the dependent variable. Columns (1) and (4) of Table 8 replicate columns (6) and (8) of Table 4, for reference. Column (2) replicates the estimate of column (1) while restricting the sample to German speaking areas while column (3) similarly replicates column (1) but now over the non-German speaking areas. Columns (5) and (6) similarly repeat the specification of column (4) along the same geographic restrictions. The comparison of columns (1) and (2) shows that the yearly income reduction from motherhood is higher in German speaking areas (by an additional 4pp) relative to the Swiss average. The added penalty from working part-time as a mom is likewise higher in the German speaking region. On the other side of the language border, both these penalties are significantly lower: the motherhood penalty for a full-time working mom is 12%, 8pp lower than the national average, whereas the added loss from working part-time is 11%, a 10pp difference to the value for Switzerland as a whole. A similar pattern characterizes the estimates in columns (4) through (6).

6 Conclusion and Policy Implications

Our results show that, even after controlling for selection, Swiss mothers experience sizable yearly income losses upon the birth of their first child (and beyond). In our population data, the motherhood penalty for a full-time working mom amounts to a percentual income loss of about 20 to 25%, a percentage drop that roughly doubles for a part-time working mother. Despite the scale of these income losses, the income penalty from working part-time outside motherhood is even larger, often 5 to 10 percentage points greater than the one experienced by part-time working moms (Table 4).

The motherhood penalty in yearly income appears to come mostly from a corresponding penalty in hourly wages. Interestingly, and when focusing on a survey subsample of our data, we find a *premium* in hourly wages from working part-time – be it as a mom or otherwise. We therefore find no evidence that part-time work is intrinsically detrimental to productivity. Prodding further on the source of the motherhood penalty in hourly wages, our quasi-experiment suggests that employers do not perceive mothers as less committed or less productive workers. Under this interpretation, the drop in hourly wages associated with the birth of a first child would come from other adjustments (such as the acceptance of more convenient jobs in relation to family life).

In line with the booming literature linking the child penalty and culture, the yearly income losses associated with motherhood are highest in the German speaking parts of Switzerland, amounting to roughly double of the corresponding penalty in areas where Romance languages are spoken, for both full- and part-time working moms (Table 8).

Our analysis uncovers average penalties associated with work choices of mothers and their families. Our data cannot speak, however, to other relevant implications of these choices, namely the happiness and well-being of moms and their families. For policy consideration, one important concern raised by these numbers (and by those emanating from many other studies) is whether moms are truly aware of the impact of motherhood on their future labor market options, especially in case of divorce or separation. Absent commitment between parents concerning redistribution in case of divorce, the time spent with and looking after children generates no collateral or savings for the future; yet, it affects the future productivity of mothers negatively and intensely so. Moms may find themselves in a really difficult economic situation if having to provide for themselves at a future date without the support of their former partner.

References

Adda, J., C. Dustmann, and K. Stevens (2017): "The Career Costs of Children," *Journal of Political Economy*, 125(2), 293–337.

Andrew, A., O. Bandiera, M. Costa-Dias, and C. Landais (2021): "Women and Men at Work," *IFS Deaton Review of Inequalities*.

Angelov, N., P. Johansson, and E. Lindhal (2016): "Causal effects on employment after first birth — A dynamic treatment approach," *Journal of Labor Economics*, 34(3), 545–579.

Anthony, S., and C. Wunsch (2021): "The Gender Pay Gap Revisited with Big Data: Do Methodological Choices Matter?," *Centre for Economic Policy Research*, forthcoming.

Azmat, G., L. Hensvik, and O. Rosenqvist (2023): "Workplace Presenteeism, Job Substitutability and Gender Inequality," *Journal of Human Resources*, forthcoming.

Becker, G. S. (1993): *Human Capital*. Chicago: University of Chicago Press, 3rd edn.

Becker, S. O., A. Fernandes, and D. Weichselbaumer (2019): "Discrimination in hiring based on potential and realized fertility: Evidence from a large-scale field experiment," *Labour Economics*, 59, 139–152.

Bertrand, M. (2021): "Gender in the Twenty-First Century," *AEA Papers and Proceedings*, 110, 1–24.

Blau, F., and L. M. Khan (2017): "The Gender Wage Gap: Extent, Trends, and Explanations.," *Journal of Economic Literature*, 55(3).

Blundell, R., M. C. Dias, D. Goll, and C. Meghir (2021): "Wages, Experience, and Training of Women over the Life Cycle," *Journal of Labor Economics*, 39(S1), S275–S315.

Bohren, A., P. Hull, and A. Imas (2023): "Systemic Discrimination: Theory and Measurement," *Mimeo*.

Budig, M. J., and P. England (2001): "The Wage Penalty for Motherhood," *American Sociological Review*, 66(2), 204–225.

Cammeraat, E., E. Jongen, and P. Koning (2023): "The added-worker effect in the Netherlands before and during the Great Recession," *Rev Econ Household*, 21, 217–243.

Correll, S. J., S. Benard, and L. Paik (2007): "Getting a Job: Is There a Motherhood Penalty?," *American Journal of Sociology*, 112(5).

Eugster, B., R. Lalive, A. Steinhauer, and J. Zweimüller (2017): "Culture, Work Attitudes, and Job Search: Evidence from the Swiss Language Border," *Journal of the European Economic Association*, 15, 1056–1100.

Fernández-Kranz, D., A. Lacuesta, and N. Rodríguez-Planas (2013): "The Motherhood Earnings Dip: Evidence from Administrative Records," *The Journal of Human Resources*, 18(1), 169–197.

Fernández-Kranz, D., and N. Rodríguez-Planas (2011): "The part-time pay penalty in a segmented labor market," *Journal of Labour Economics*, 18, 591–606.

Fitzenberger, B., K. Sommerfeld, and S. Steffes (2013): "Causal effects on employment after first birth — A dynamic treatment approach," *Labour Economics*, 25, 49–62.

Goldin, C. (2014): "A Grand Gender Convergence: Its Last Chapter," *American Economic Review*, 104(4), 1191–1119.

Goldin, C., and L. F. Katz (2016): "A Most Egalitarian Profession: Pharmacy and the Evolution of a Family-Friendly Occupation," *Journal of Labor Economics*, 34(3), 705–745.

Halla, M., J. Schmieder, and A. Weber (2020): "Job Displacement, Family Dynamics, and Spousal Labor Supply," *American Economic Journal: Applied Economics*, 12, 253–87.

Hevenstone, D., D. Kessler, and L. Luchsinger (2023): "What limits intra-household insurance or the 'Added Worker Effect'?," *Socio-Economic Review*.

Hlavac, M. (2022): *stargazer: Well-Formatted Regression and Summary Statistics Tables.*Social Policy Institute, Bratislava, Slovakia, R package version 5.2.3.

Kleven, H., C. Landais, and G. L. Mariante (2021): "The Child Penalty Atlas," *Mimeo*.

Kleven, H., C. Landais, J. Posch, A. Steinhauer, and J. Zweimüller (2019): "Child Penalties across Countries: Evidence and Explanations," *AEA Papers and Proceedings*, 109, 122–126.

Kleven, H., C. Landais, and J. E. Søgaard (2019): "Children and Gender Inequality: Evidence from Denmark," *America Economic Journal: Applied Economics*.

Kline, P., E. Rose, and C. Walters (2022): "Systemic Discrimination Among Large US Employers," *Quarterly Journal of Economics*, pp. 1963–2036.

Lundberg, S., and E. Rose (2000): "Parenthood and the earnings of married men and women," *Labour Economics*, 7, 689–710.

Manning, A., and B. Petrongolo (2008): "The Part-Time Pay Penalty for Women in Britain*," *The Economic Journal*, 118(526), F28–F51.

Mincer, J. (1962a): *Labor force participation of married women: A study of labor supply*, vol. Aspects of labor economics. Princeton University Press.

——— (1962b): "On-the-Job Training:Costs, Returns, and Some Implications," *Journal of Political Economy*, pp. 50–79.

——— (1974): *Schooling, Experience, and Earnings*. Columbia University Press.

Mincer, J., and S. Polacheck (1974): "Family investments in human capital: Earnings of women," *Journal of Political Economy*, 82, 76–108.

Mundlak, Y. (1978): "On the Pooling of Time Series and Cross Section Data," *Econometrica*, 46, 69–85.

Olivetti, C. (2006): "Changes in women's hours of market work: The role of returns to experience," *Review of Economic Dynamics*, 9, 557–587.

Paull, G. (2008): "Children and Women's Hours of Work," *The Economic Journal*, 118, F8–F27.

Ruettenauer, T., and V. Ludwig (2022): "Fixed Effects Individual Slopes using feisr," `https://cran.r-project.org/web/packages/feisr/vignettes/feisr-vignette.html`, Accessed: 2022-01-22.

Spence, M. (1978): "Job Market Signaling," in *Uncertainty in Economics*, ed. by P. Diamond, and M. Rothschild, pp. 281–306. Academic Press.

Waldfogel, J. (1998): "Understanding the "Family Gap" in Pay for Women with Children," *Journal of Economic Perspectives*, 12(1), 137–156.

Wilde, E. T., L. Batchelder, and D. T. Ellwood (2010): "The Mommy Track Divides: The Impact of Childbearing on Wages of Women of Differing Skill Levels," *NBER Working Paper*, 16582.

7 Appendix

7.1 Proxy part-time variable

In designing our proxy measure of part-time employment we compared current income to some past income–choosing a threshold in how many years to look back for the individual's highest income, and the percent of the past income that a current income would be considered part-time work. Using a sub-sample from SAKE we have information on part-time work and hours. For this sub-sample, we created the proxy measure 207 different times, varying the window of the number of years over which we would look for the highest past income, and the percent income threshold we would consider part-time work. We then correlated this proxy measure with known part time work. As visible in table 9, the highest correlation is using .9 of the maximum (inflation adjusted) income, using the maximum available window–probably because most women reach their maximum hours in their early 20s before having children, whereafter the majority work part time. Not displayed here–with the estimates using the maximum window, we looked at 93, 95, and 97% income thresholds–which had declining correlations with true part-time work–so the final proxy measure uses the full available time window and the 90% threshold.

	percent threshold									
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	
	2	0.007	0.011	0.019	0.023	0.026	0.031	0.038	0.043	0.056
	3	0.016	0.029	0.043	0.052	0.062	0.075	0.083	0.090	0.104
	4	0.021	0.041	0.061	0.075	0.089	0.105	0.117	0.124	0.137
	5	0.028	0.053	0.077	0.094	0.111	0.129	0.143	0.152	0.165
	6	0.034	0.064	0.092	0.111	0.131	0.152	0.170	0.178	0.188
	7	0.041	0.074	0.105	0.127	0.149	0.171	0.191	0.200	0.209
	8	0.046	0.083	0.117	0.141	0.166	0.189	0.211	0.220	0.228
	9	0.051	0.090	0.127	0.153	0.180	0.206	0.229	0.238	0.245
	10	0.056	0.099	0.137	0.165	0.194	0.222	0.246	0.257	0.263
	11	0.060	0.106	0.146	0.177	0.208	0.238	0.264	0.275	0.281
	12	0.064	0.112	0.156	0.189	0.222	0.252	0.280	0.293	0.298
years	13	0.068	0.118	0.163	0.199	0.233	0.265	0.295	0.310	0.314
	14	0.070	0.123	0.170	0.208	0.243	0.278	0.309	0.325	0.331
	15	0.073	0.127	0.176	0.215	0.253	0.290	0.323	0.341	0.346
	16	0.076	0.131	0.180	0.221	0.261	0.301	0.336	0.355	0.361
	17	0.077	0.134	0.184	0.227	0.268	0.309	0.346	0.368	0.374
	18	0.078	0.136	0.186	0.231	0.274	0.317	0.356	0.379	0.385
	19	0.079	0.138	0.188	0.234	0.278	0.323	0.363	0.387	0.394
	20	0.080	0.139	0.190	0.237	0.282	0.328	0.369	0.394	0.401
	21	0.080	0.140	0.191	0.238	0.284	0.331	0.372	0.398	0.405
	22	0.080	0.141	0.192	0.238	0.284	0.332	0.373	0.399	0.407
	23	0.081	0.141	0.192	0.238	0.284	0.332	0.373	0.399	0.407
	24	0.081	0.141	0.192	0.239	0.285	0.332	0.373	0.400	0.407

Table 9: Motherhood gap, 1982 CHF