The impact of peers on fathers' labour supply*

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Abstract

Child penalties in paid working hours are persistent. This paper studies peer effects on working hours using Dutch full-population administrative monthly microdata up to July 2024. We analyse peer effects using three unique peer-network layers: neighbours, colleagues and family. The identification strategy relies on an instrumental variable approach using information of peers-of-peers. Our research is the first to establish statistically significant long-run peer effects on fathers' working hours. We show that a one-hour change in the average paid working hours of peers affects a focal individual's working hours by 6 to 30 minutes. The results indicate that for both fathers and mothers, colleague peers are more important than neighbourhood or family peers.

Keywords: family peers, neighbour peers, colleague peers, paid working hours, peers-of-peers

JEL Codes: J22, D85, C26

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1 Introduction

The last few decades there has been a convergence in the economic roles of men and women in society. Governments, through equal employment and pay policies and childcare and parental leave policies, and firms, through diversity and inclusion strategies, have put effort into narrowing gender gaps in employment and wages (Blau and Kahn, 2017). However, despite efforts to close gender gaps in the labour market, they remain pervasive. The arrival of children is among the main causes of persistent gender gaps in the labour market (Kleven et al., 2019; Sieppi and Pehkonen, 2019). In addition, evidence shows that gender gaps are much larger in societies with less egalitarian gender and social norms, suggesting slow-moving changes in gender and social norms play a key role (Cortés and Pan, 2023).[1] At present, mechanisms underlying how norms change, especially for fathers, are poorly understood.

Social network theory posits that an individual's network affects gender role attitudes, which describe or prescribe the roles that men and women in households and society should have, through interactions with peers (Borgatti et al., 2009). Peer effects from role models shape attitudes and may affect fathers' decisions on labour supply because of imitation behaviour and conformity preferences (Bramoullé et al., 2020; Cialdini et al., 1990; Bernheim, 1994; Akerlof and Kranton, 2000). At present, the literature shows substantial peer effects on mothers' labour supply (Nicoletti et al., 2018; Welteke and Wrohlich, 2019; Cavapozzi et al., 2021). However, in many households, decisions on how much effort to invest in home production and labour market production, and how much of the housework to outsource, are made by both partners jointly. Therefore, a focus on what determines labour market decisions of fathers is important, yet mostly missing in the literature. In addition, a key question is which network affects fathers and mothers in particular. In this paper we analyse peer effects on fathers from peer neighbours, colleagues and family.

Fathers are impacted by their peers through three mechanisms. First, imitation behaviour predicts that individuals who observe that peers make labour supply decisions upon parenthood infer information about what is the 'right' or normal way to behave. Second, conformity preferences suggest that individuals get a disutility from deviating from what is normal or the 'right' thing to do. Third, a reduction in labour supply from peers can also have a purely informational value. For instance, receiving information on possibilities to (temporarily) work part-time or to take parental leave might be important

[1] In contrast, the role of biology turns out to be limited (Kleven et al., 2021; Andresen and Nix, 2022).

for fathers' labour supply decisions. Hence, observing peers reducing their labour supply after becoming a father may cause new fathers to do the same.

We analyse peer effects on first-time parents, including 107,665 fathers and 115,466 mothers, using monthly microdata on the entire population from Statistics Netherlands in the period 2006 to 2024. The data up to 2024 are important, considering the changes in gender role attitudes over the last decade, and enable us to get a better understanding of peer effects in recent times which current peer effects studies based on administrative lack. We study peer effects on the labour supply of individuals who became a parent between January 2012 and December 2020. Each parent is followed for 24 months before and 72 months after giving birth. A unique feature of the monthly administrative data is the detailed information on paid working hours, based on salaried employees' monthly income statements, which we use to operationalize labour supply.

We are interested in the impact of three different peer networks: the neighbourhood, firm and family. We focus on these three network layers as these are measured for most people (which is different for e.g. sport clubs or friends), are available with little measurement error in the full-population administrative data on working hours, and are likely to be places where people observe each other regularly. Indeed, compared to existing network data from small surveys on actual peer links characterised by sample selection and non-response bias, the administrative network data on potential peer links have three advantages: (i) covering all individuals as we use full-population register data, (ii) containing peers from three different network layers, and (iii) containing information on peers of a peer, i.e. indirect links. We study peer effects by network layer to examine which network layer matters most for each sex group.

To quantify peer effects, we follow Nicoletti et al. (2018) and Nicoletti et al. (2023) and apply an instrumental variable (IV) approach, which is based on the seminal work by Bramoullé et al. (2009) and De Giorgi et al. (2010). Estimation of peer effects is challenging because of the selection problem and the reflection problem (Manski, 1993; Angrist, 2014). The selection problem refers to endogenous network formation and states that groups are usually formed endogenously, i.e. people select themselves into certain groups (and not into other groups). The reflection problem is the issue that it is impossible to distinguish empirically between the effect that peers have on an individual and vice versa, i.e. an issue of reverse causality. In our approach, we use indirect network links, instrumenting a peer's outcome with the outcomes of the peers of the peer. We also control for the instrument at the individual level, i.e. the average working hours of the individual's peers based on the network layer that is used to define the peers of the peers. Ignor-

ing the instrument at the individual level would cause biased and inconsistent estimates (Von Hinke et al., 2019). In addition, we define 'homogenous' peers and peers-of-peers as same-sex and same-education individuals who gave birth before the focal individual. Our empirical approach overcomes the key identification challenges of estimating peer effects and allows us to estimate causal neighbour peer effects, colleague peer effects and family peer effects.

To give an example, consider the analysis of neighbour peer effects. Through non-random sorting across neighbourhoods, it is likely that unobserved characteristics are correlated across peers and the focal individual. We overcome this issue by instrumenting the average working hours of the focal individual's neighbour peers with the average working hours of the colleagues of the individual's neighbours. Similarly, we use the average working hours of the family of the individual's neighbours as an instrument. In addition, in order to avoid the reflection problem, we retain a peer who has a child before the focal individual and we retain the peers-of-peer who have a child before the peer. Taken together, we have six cross network layer peers-of-peers dimensions as instruments including, e.g., colleagues of neighbours, and family of colleagues.

Our results show statistically significant and long-run peer effects on both fathers and mothers. For both fathers and mothers, colleague peer effects on focal individuals are found to be the strongest, with the effect ranging between 18 to 30 minutes of a one-hour change in the average working hours of the colleague peers. The impacts of neighbour peers and family peers are slightly smaller, and a one-hour change in peers' working hours affect the focal individual by about 6 to 12 minutes. The results indicate that for both fathers and mothers, peer effects on working hours are comparable, but colleague peers are more important than neighbourhood peers and family peers.

The first contribution of our paper is to the literature on peer effects in the labour market, as our paper is the first to reveal statistically significant long-run peer effects on fathers' working hours. Nicoletti et al. (2018) show positive and statistically significant family peer effects on mothers' paid working hours using the neighbours of family peers as instrument. Their sample of analysis consists of mothers giving birth between 1997 and 2002 in Norway. Importantly, they find no statistically significant neighbour peer effect using the family of neighbour peers as instrument. As Nicoletti et al. (2018) observe annual working hours in four categories (0, 1-19, 20-29 and 30+ hours), a key strength of our analysis is the complete monthly paid working hours information preventing any (non-)random measurement error bias. A related but distinct literature is on peer effects on parental leave take-up. Carlsson and Reshid (2024), using a similar identification

strategy as our IV approach, analyse colleague peers using family of the focal individual's colleagues as instrument. Their sample consists of individuals giving birth between 2003 and 2014 in Sweden, and find positive colleague peer effects on the take-up of paid parental leave for both fathers and mothers. Other related research does not use information on peers-of-peers to define the instrument but instead use a policy change to overcome the key identification challenges. For example, Dahl et al. (2014) use a 1993 Norwegian parental leave reform affecting fathers and show positive and statistically significant colleague peer effects on parental leave take-up of fathers. In addition, Welteke and Wrohlich (2019) use the 2007 German reform of the parental-leave-benefit policy change as an instrument and show positive and statistically significant colleague peer effects on mothers' parental leave decisions. We contribute to this literature by showing the importance of each of the three network layers, neighbours, colleagues, and family, for peer effects on men and women using recent monthly data on paid working hours up to 2024.

The second contribution of our paper is to the broad literature on gender inequalities in the labour market. Gender inequalities are important to narrow because of efficiency reasons such as misallocation of female talent (Hsieh et al., 2019) and equity reasons considering women's higher poverty rates and higher financial dependence. Parenthood is a main driver, explained by traditional gender roles that refer to the gendered division of household production and labour-market production, and causes a so-called child penalty where mothers relative to fathers experience reduced earnings and labour force participation (Angelov et al., 2016; Kleven et al., 2019). Governmental policies on childcare and parental leave have been ineffective in closing the gap (Kleven et al., 2024), and they appear to deal with the consequences of persistent gender inequalities instead of addressing root causes. Instead, the slow-moving changes in gender and social norms appear to be a key reason for the persistency of gender gaps (Cortés and Pan, 2023). We contribute to this literature by showing the role of peer effects in labour supply of both men and women. Peer effects shape gender role attitudes, and an analysis of which network is causing peer effects on working hours is important to better understand the mechanisms underlying how expectations regarding how fathers and mothers should behave are updated.

2 Institutions

The institutional setting in The Netherlands is such it encourages parents to take leave around the birth of their child. Most of the leave taking stimulus is for the 'birth giving' mother. For the partner there are less generous leave arrangements. The next section describes recent leave policies and changes in these policies over time.

2.1 Parental Leave Policies in the Netherlands

The Netherlands offers a range of leave policies related to the arrival of children, with distinct provisions for mothers who give birth and their partners.

Mothers who give birth are entitled to maternity leave, which is fully paid (100%) and commences 4 to 6 weeks before the expected delivery date. Following childbirth, mothers receive an additional 10 weeks of paid leave, with a potential extension up to 12 weeks if fewer than 6 weeks of pre-birth leave were taken. Of the post-birth leave, 6 weeks must be taken immediately after delivery, while the remaining 4 weeks may be utilized within 30 weeks post-partum. In total, the mother is eligible for 16 weeks of maternity leave.

Partners are eligible for two days of partner leave, which includes leave on the day of birth. Only since January 2019, partners are eligible for one additional week of paid partner leave. Since July 1, 2020, partners are also entitled to 5 weeks of 'extended partner leave' in the first six months after the birth paid at 70% of their salary.

In addition to maternity and partner leave, all parents are eligible for unpaid parental leave totalling 26 weeks per child. This parental leave can used flexibly within the first eight years of the child's life. Between 2001 and 2022, these weeks were unpaid, and prior to 2001, no parental leave policy was in place.[2]

3 Data

We use monthly administrative microdata from Statistics Netherlands that cover the universe of employees in the Netherlands in the period January 2006 to June 2024. We analyse peer effects on paid working hours of individuals who became a parent for the first time, as the birth of the first child is often the key transition point in parent's flexibility needs and adjustments to their career. Specifically, we focus on partnered individuals aged

[2]We study the impact on individuals who became a parent between 2012 and 2020. The first nine weeks of paid parental leave were introduced for parents of children born after 2022. The first 9 weeks of this leave are compensated at 70% of the parent's salary, while the remaining 17 weeks are unpaid.

between 25 and 40 years who became a parent for the first time between January 2012 and December 2020. We use the data from 2006 up to 2024, as we analyse individuals at least 24 months before and 42 months after giving birth, and because we need information on individuals' peers and peers-of-peers. For individuals who gave birth before July 2018, we study impacts up to 72 months (6 years) after giving birth.

The main dataset is the Job and Wages register, which contains monthly data on earnings, actual working hours, type of contract (permanent, fixed-term or other), type of job (regular or other including flex and payrolling), based on income statements of salaried employees. All earnings and hours variables are deflated, expressed in 2015 euro, and winsorized such that outliers are set at the 1th and 99th value of the given variable.

We link the employment data to other datasets that cover individual and household characteristics and firm characteristics. The data that cover individual and household characteristics include a person's sex, exact birth date, country of birth, educational attainment, marital status (partnered or not) and regional home location. Home location is observed at the neighbourhood level (13,911 unique regions), municipality level (345 unique regions) and at the public employment service (PES) level (35 unique regions). In addition, these data contain information on the partner's characteristics and the presence and exact birth date of children in the household. As the educational attainment information is not observed for all individuals, we computed three groups following the International Standard Classification of Education (ISCED): high educated (ISCED 5-8, tertiary), low- or average-educated individuals (ISCED 1-4, lower and secondary), and missing educational attainment information. The firm characteristics we use include firm size and sector code at the two-digit Nomenclature statistique des activités économiques (NACE) Rév. 2 level.

We exclude individuals who, in the year before giving birth, are a registered self-employed individual, as we are interested in individuals' and peers' paid working hours and working hours are not measured for this group. Hence, we link our data to a dataset that contains the identifiers of all self-employed people, and exclude individuals for which is observed that they were self-employed in the year before becoming a parent.

3.1 Defining peers and peers-of-peers

For our identification strategy we use information on individuals' peers and individuals' peers-of-peers. Peers and peers-of-peers are measured in the year of first childbirth of the individual, i.e. January 1st of the given birth year. Consistent with the literature on peer effects (Nicoletti et al., 2018), we consider people to be peers of each other only if they

are 'homogenous', which is defined as the same sex and educational attainment group. To limit issues of reverse causality, peers are defined as same-sex individuals who became a parent one to four years before the individual. Similarly, peers-of-peers are defined as same-sex individuals who became a parent one to four years before the respective individual's peer, and at a maximum of five years before the individual. Effectively, this implies peers gave birth one to four years, and peers-of-peers gave birth two to five years, before the individual.

We use information from three different network layers: neighbourhoods, firms and family. Neighbour peers are defined as peers living in the same neighbourhood, where we use the neighbourhood classification of Statistics Netherlands. In the Netherlands, there are about 13,911 unique neighbourhoods, and a neighbourhood consists on average of 1,350 households. Colleague peers are defined as those working in the same firm. Family peers are broadly defined and include siblings, half-siblings, nieces/nephews, aunts/uncles, and family links by marriage such as step-brothers or brothers-in-law.

A similar strategy is used for indirect peers, i.e. peers-of-peers, where we use a cross-layer approach. Note, however, that we can observe if an individuals and its peers-of-peers live in the same neighbourhood or work at the same firm. This situation would cause an identification issue as peers-of-peers could influence the individual directly. Hence, we only retain peers-of-peers of individuals who are not employed at the same firm and who do not live in the same neighbourhood as the focal individual.

Table 1: Descriptive statistics on peers, peers-of-peers and key variables

	(1) Men Mean	(2) Men St. Dev.	(3) Men N	(4) Women Mean	(5) Women St. Dev.	(6) Women N
A: Peer information						
Number of neighbour peers (IN)	10.866	14.754	98,815	14.595	19.740	106,111
Number of colleague peers (IC)	52.194	121.404	74,041	57.273	123.753	86,515
Number of family peers (IF)	1.281	0.618	18,667	1.370	0.714	25,623
B: Peers-of-peers information						
Number of colleagues of neighbours (INC)	304.960	495.414	96,717	423.942	657.464	104,086
Number of family of neighbours (INF)	481.101	606.873	51,810	627.972	752.567	65,328
Number of neighbours of colleagues (ICN)	399.222	920.779	72,558	525.927	1152.630	85,201
Number of family of colleagues (ICF)	715.307	1185.134	37,806	794.601	1365.358	54,711
Number of neighbours of family (IFN)	43.293	90.903	15,526	54.521	101.620	21,216
Number of colleagues of family (IFC)	58.104	105.265	11,133	67.193	112.211	16,692
C: Key variables on monthly working hours information						
Hours worked of the individual (dependent variable)	161.760	27.788	107,665	147.673	32.539	115,466
Hours worked of neighbour peers (instrumented variable)	158.828	16.771	97,376	126.497	21.726	103,916
Hours worked of colleague peers (instrumented variable)	159.576	17.950	73,136	127.833	23.670	85,109
Hours worked of family peers (instrumented variable)	159.963	22.032	17,439	124.776	30.438	23,205
Hours worked of colleagues of neighbours (instrument)	158.291	12.114	95,926	125.865	16.952	103,180
Hours worked of family of neighbours (instrument)	159.903	18.398	49,734	122.656	23.207	62,372
Hours worked of neighbours of colleagues (instrument)	158.812	10.342	71,768	124.357	14.608	84,033
Hours worked of family of colleagues (instrument)	159.680	15.449	36,830	122.094	20.516	53,125
Hours worked of neighbours of family (instrument)	158.948	14.788	15,212	123.830	19.442	20,676
Hours worked of colleagues of family (instrument)	159.314	14.987	11,041	124.741	20.122	16,538
Hours worked of neighbour peers (individual IV)	158.521	17.228	96,139	126.188	21.814	102,522
Hours worked of colleague peers (individual IV)	159.219	17.728	71,612	127.475	23.394	83,765
Hours worked of family peers (individual IV)	159.902	22.331	15,392	125.095	30.006	20,464

Notes. The number of men equals 107,665 and the number of women equals 115,466. The hours worked of the focal individual is measured 12 months before the individual beace a parent. Sample means of hours worked of peers and peers-of-peers are provided for a focal individual conditional on peers and peers-of-peers being observed. For several individuals, peers and peers-of-peers are not observed, which is particularly the case using the family network layer. Hours worked of the focal individual and of the individual's peers vary by month since the individual became a parent. Hours worked of peers-of-peers are measured as the average of hours worked by peers-of-peers in the twelfth month after each peer-of-peer became a parent. The individual IV is measured as the average of hours worked of peers twelve months after the peer gave birth.

We define six groups of peers-of-peers. Table 1 shows the number of peers and number of peers-of-peers, on average, for each focal individual by network layer and by sex group. The average peers-of-peers are as follows: colleagues of the focal individual's neighbours (INC, 305 for men and 424 for women), family of the focal individual's neighbours (INF, 481 for men and 628 for women); neighbours of the focal individual's colleagues (ICN, 399 for men and 526 for women); family of the focal individual's colleagues (ICF, 715 for men and 794 for women); neighbours of the focal individual's family (IFN, 43 for men and 55 for women); colleagues of the focal individual's family (IFC, 58 for men and 67 for women).

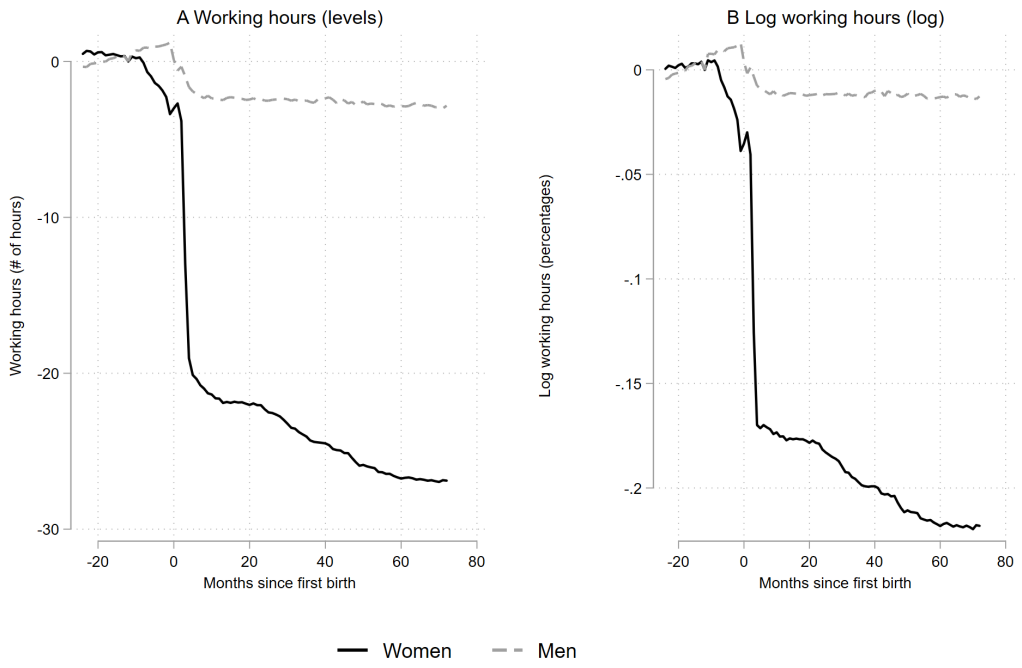
3.2 Key variables

Panel C of Table 1 provides information on each of the key variables. The key dependent variable is the individual's paid working hours. Paid working hours include all salaried hours including the working overtime hours that are paid at the same pay rate. Paid working hours reduce if a person starts working fewer hours (for example, transitioning from full-time employment to part-time employment) or if the person takes unpaid leave. The number of paid working hours is unaffected by paid leave and holidays.

Figure 1 shows the child penalty in paid working hours, which can be observed to be much stronger for women than men. For women, the penalty amounts to about 20 to 25 hours (17 to 22%). For men, this penalty is only 3 hours (1 to 2%). This finding suggests that our analysis of peer effects on men will have less power than our analysis of peer effects on women.

The key independent variables are the peers' working hours, the peers-of-peers' working hours and the 'individual IV'. The peers' working hours variable is time varying and reflects the average working hours of the focal individual's peer network, excluding the focal individual, in a given month of observation since the focal individual became a parent. We compute this variable by network layer and the working hours vary by month since childbirth of the focal individual. Hence, for each individual and each month since the individual's first birth, we have the average working hours of the individual's colleagues, neighbours and family. In our default analysis, peers who are non-employed and are observed to have missing working hours, are excluded from this average. Similarly, for individuals who have no observed peer or peer-of-peer, it is not possible to compute the average of the peers' working hours.

Figure 1: Child penalty in paid working hours



(a) Within change in paid working hours

Notes: Regression analysis of working hours on time since birth including controls and individual fixed effects. Each line represents a different regression. The twelfth month before first birth is the reference month of birth ($\tau = -12$). The number of observations equals 4,662,755 for men and 4,793,287 for women. All point estimates from three months since birth are highly statistically significant. Empirical model: $y_{i\tau t} = \gamma_{\tau t} + \lambda' X_{it} + \mu_i + \varepsilon_{i\tau t}$

The peers-of-peers' working hours are time constant and measured 12 months after the birth of the given peer-of-peer's oldest child. Similar to Nicoletti et al. (2018), we focus on 12 months after the peer-of-peer's birth to ensure reverse causality is not an issue. Consistent with Figure 1 this is around the time when the majority of the child penalty in paid working hours already occurred for both men and women. Again, we take the average, separately by network layer, as there are multiple peers-of-peers. Hence, each individual has six peer-of-peer average working hours, the first for example being the average working hours of the colleagues of the focal individual's neighbours (INC) measured based on the working hours of each peer-of-peer twelve months after the peer-of-peer became a parent.

The individual IV controls for the unobserved characteristics of the IV network (Nicoletti et al., 2018; Von Hinke et al., 2019). For example, using the hours worked of the

colleagues of the focal individual's neighbours as the instrumental variable, and where the instrumented variable reflects the average working hours of the focal individual's neighbour peers, the individual IV will be the average working hours of the focal individual's colleagues. This variable represents the average working hours of the individual's peers by network layer, based on the working hours of the peers twelve months after the peer gave birth.

The control variables are time constant and measured 12 months before the focal individual becomes a parent. We measure control variables 12 months before the birth to ensure these variables are not affected by the incidence of becoming a parent. We include control variables for: age groups ($[25, 30), [30, 35), [35, 40)$), born in the Netherlands, permanent contract, regular job, full-time employment, employment status (employed or not), monthly earnings (five groups based on quantiles), economic sector (two-digit), month of birth (ranging from January 2012 up to December 2020), and educational attainment (low- or average-educated, high educated, or missing). Similarly, we include covariates for the partner's information for age, born in the Netherlands, permanent contract, regular job, full-time employment, firm size, employment, wages. In addition, we include fixed effects for the individual's PES regional location measured twelve months before becoming a parent.

Table 2 shows sample means and the standard deviation for most of the control variables. From this table it is clear that there are slightly more women in our sample than men. This observation can be explained by our sample selections on age and being partnered: employed men tend to be older than employed women when becoming a parent.

Table 2: Descriptive statistics on key variables

	(1) Men Mean	(2) Men St. Dev.	(3) Women Mean	(4) Women St. Dev.
Female	0	0	1	0
≥ 25 and < 30 year	0.181	0.385	0.302	0.459
≥ 30 and < 35 year	0.506	0.500	0.517	0.500
$\geq$35 and < 40 year	0.313	0.464	0.182	0.385
Low educated	0.287	0.452	0.229	0.420
High educated	0.504	0.500	0.632	0.482
Unobserved educational attainment	0.210	0.407	0.139	0.346

Born in the Netherlands	0.710	0.454	0.727	0.445
Partner	1	0	1	0
Permanent contract	0.666	0.472	0.643	0.479
Regular employee	0.900	0.301	0.920	0.271
Full-time employed ($\geq$ 35 hours)	0.868	0.339	0.606	0.489
First quantile of firm size	0.224	0.417	0.171	0.377
Second quantile of firm size	0.212	0.409	0.180	0.384
Third quantile of firm size	0.194	0.396	0.204	0.403
Fourth quantile of firm size	0.177	0.382	0.225	0.417
Fifth quantile of firm size	0.192	0.394	0.219	0.414
Birth of first child in 2012	0.213	0.409	0.215	0.411
Birth of first child in 2013	0.168	0.374	0.175	0.380
Birth of first child in 2014	0.142	0.349	0.143	0.350
Birth of first child in 2015	0.115	0.319	0.118	0.322
Birth of first child in 2016	0.096	0.294	0.095	0.294
Birth of first child in 2017	0.079	0.270	0.078	0.268
Birth of first child in 2018	0.069	0.254	0.066	0.249
Birth of first child in 2019	0.061	0.240	0.058	0.233
Birth of first child in 2020	0.056	0.229	0.051	0.221

Notes. All variables are measured twelve months before giving birth. The number of male individuals equals 107,665 and the total number of female individuals equals 115,466.

4 Empirical Strategy

We are interested in the impact that peers have on individuals' labour supply. The empirical strategy is to quantify parameter δ of the model showed in 1, i.e. the effect of a focal individual's peers' average working hours ($\bar{y}_{d_1,-i}$) on the focal individual's working hours (y).

$$y_{i\tau} = \delta \bar{y}_{d_1,-i} + \eta' X_i + \alpha_r + \varepsilon_{i\tau} \tag{1}$$

where i and τ represent the individual and month since becoming a parent, respectively. In addition, d represents the network used (neighbours, colleagues or family), where d_1 refers to the network of distance-one links, i.e. the focal individual's peers. Parameter d_2

represents the network of distance-two, indirect links, i.e. the focal individual's peers-of-peers. X represents the vector of control variables that are time constant and measured a year before becoming a parent. α captures the regional fixed effects. Standard errors ε are clustered at the level of the PES regions.

The key identification challenge is that individuals' network formation is endogenous (Bramoullé et al., 2009). An example of this selection problem relates to unobserved characteristics that are correlated between a focal individual and its peers, because of non-random decisions on residential locations and workplaces. Hence, it is not random whether people are peers, and this identification challenge causes a bias in δ of equation 1. To overcome this issue and to quantify causal peer effects, we apply an instrumental variable approach, using indirect network links instrumenting a peer's outcome with the outcomes of the peers of the peers, in the spirit of Nicoletti et al. (2018).

We apply an IV estimator that instruments the average working hours of the individual's peers ($\bar{y}_{d_1,-i}$) with the average working hours of the individual's peers-of-peers ($\bar{y}_{d_2,-i}$). We use three unique network layers: neighbours, colleagues and family. The network used for d_1 and d_2 will never be the same ($d_1 \neq d_2$). For example, we will never use the colleagues of the focal individual's colleagues as the instrument. In this estimator, the individual's peers-of-peers should have an effect on the peers of the focal individual in terms of paid working hours; this is the first stage regression in the IV framework (and a test of the relevance condition) as showed in equation 2. The 'individual' IV, $\bar{y}_{d_1|d_2,-i}$, refers to the instrument at the individual level. That is, given the network layer that is used as the network layer of the peers-of-peers, d_2, the average of working hours of the individual's peers using this same network is included in the estimation of the first stage and second stage. Effectively, including the individual IV in the model is similar to including a network fixed effect.

An example of our approach would be an estimation of the impact of the individual's neighbour peers on the individual's working hours, where the peers-of-peers represent the colleagues of the individual's neighbours. In this situation, the individual IV is based on the individual's colleagues, and functions as a workplace fixed effect.

The first stage of the IV model is:

$$\bar{y}_{d_1,-i} = \rho \bar{y}_{d_2,-i} + \beta' X_i + \sigma_r + \gamma \bar{y}_{d_1|d_2,-i} + \varepsilon_{i\tau} \tag{2}$$

We estimate the first and second stage of the IV model by month since becoming a parent for the first time, and this ranges from 24 months before up to 72 months after the birth month. Standard errors ε are clustered at the level of the PES regions.

In addition, we estimate the models by sex group. As we analyse peer effects by all combinations of the three network layers, where the distance-one layer is not the same as the distance-two layer, there are six dimensions of peers-of-peers: colleagues of the individual's neighbours (INC), family of the individual's neighbours (INF); neighbours of the individual's colleagues (ICN); family of the individual's colleagues (ICF); neighbours of the individual's family (IFN); colleagues of the individual's family (IFC).

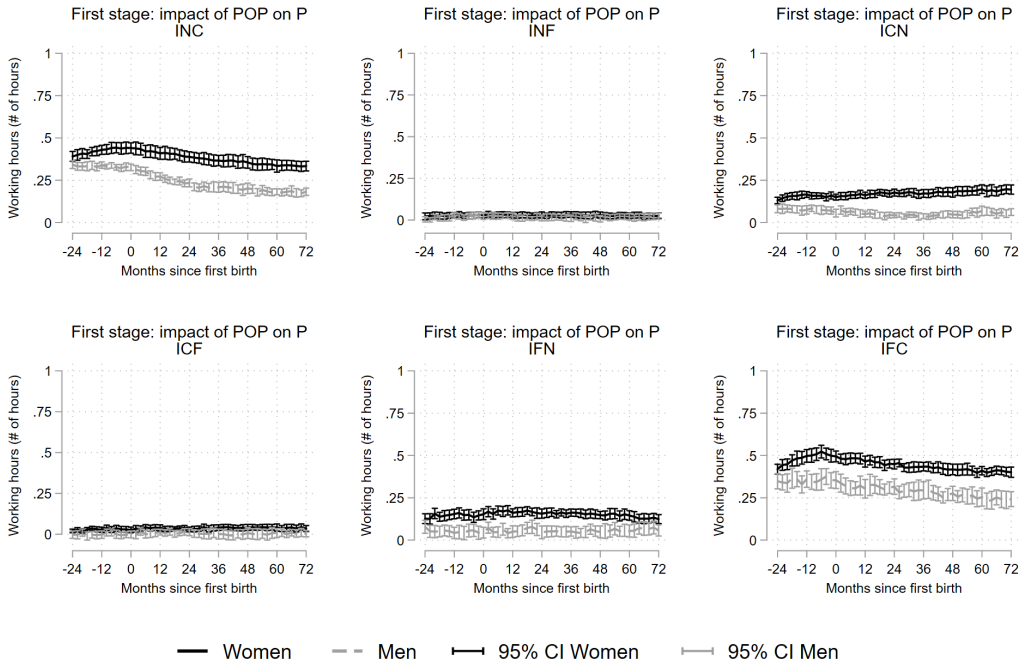
4.1 Instrument relevance

Figure 2 shows the impact of the instrument, i.e. the average working hours of the peers-of-peers, on the instrumented variable which is the average working hours of the peers. Subfigure 2a shows the impact in parameter estimates in levels, whereas subfigure 2b shows the F-Statistic. We run a separate regression for each month since first birth by sex group and by peers-of-peers dimension. The information in this figure is important to evaluate the first stage and relevance condition of our IV strategy.

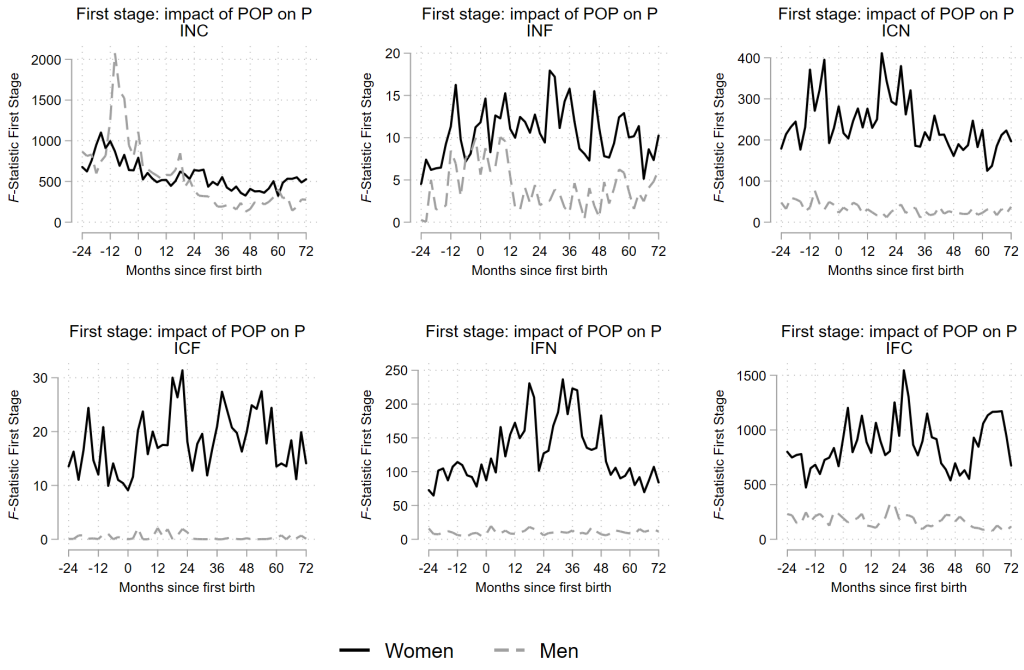
Figure 2 shows that the relevance condition is satisfied for both men and women in three dimensions of peers-of-peers: colleagues of the individual's neighbours (INC), neighbours of the focal individual's colleagues (ICN) and colleagues of the focal individual's family (IFC). For these subsets of indirect links based on network by network interactions, the F-Statistic is arguably high enough and the coefficients indicate a strong correlation between the instrumented variable and the instrument. Specifically, for the INC subgraph, if the average working hours of the colleagues of the focal individual's neighbours increase by one, the focal individual's neighbours experience an increase of about .35 hours for women and .25 hours for men, in month 72 after the focal individual's first birth.

For interactions with the family layer, the relevance condition of our strategy is for women and in particular men often not satisfied, considering the family of the individual's neighbours (INF), family of the focal individual's colleagues (ICF) and neighbours of the focal individual's family (IFN). This finding can be explained by the information provided in Table 1, which shows that defining peers based on the family layer is often unobserved, resulting in smaller sample sizes and less power in the application of our IV strategy. It is also clear from Figure 2 that our instrument is less relevant for our sample of men compared to our sample of women. One reason for this could be that men, compared to women, are less likely to change their paid working hours following the birth of their first child. Consequently, there is less between variation in the our instrumented variable and instrumental variable.

Figure 2: Impact of average hours of peers-of-peers (POP) on average hours of peers (P), First stage coefficients and F-Statistic



(a) First stage coefficients, with 95% confidence interval



(b) First stage F-Statistic

Notes: Analysis of the relevance condition (equation 2).

4.2 Instrument exogeneity

The validity of our IV approach relies on the exogeneity assumption. The exogeneity assumption in our context is that the working hours of peers-of-peers affect the individual's working hours not directly but only indirectly through the individual's peers. In this regard, the average working hours of the peers-of-peers should be uncorrelated to unobserved variables that affect the individual's working hours.

In addition, in our analysis, we analyse the peer effect controlling for many observables and including several fixed effects. An important example is that we include the 'individual IV', which represents the hours worked of the peers of an individual where the network layer of these peers are defined as the distance-two layer through which peers-of-peers are defined. This variable captures any unobserved correlation between the individual's network layer and the peer's network layer. For example, for the analysis of neighbour peer effects using the working hours of the colleagues of the individual's neighbours as the instrument, controlling for the individual's colleagues' average working hours controls for common unobservables that affect the working hours of the individual's colleagues and the colleagues of the individual's neighbours. Also note that reverse causality issues are taken care of by ensuring that peers and peers-of-peers become a parent at least one year before the individual, and peers-of-peers become a parent at least one year before peers.

A strategy to evaluate the exogeneity condition is to assess to what extent the instrument is correlated to individual characteristics. Figure 3 shows that the majority of individual characteristics is not significantly correlated to the instrument, or only weakly in economical terms. In addition, the F-Statistics that measure the joint significance of the individuals' characteristics and the individuals' partners' characteristics are relatively low.

Similar to Nicoletti et al. (2018), we acknowledge that our approach cannot overcome the identification issue which involves a situation where a peer-of-peer influences the individual through the individual's peer, but where the peer did not changed behaviour in terms of paid working hours. An identification issue would occur if results are caused by unobserved shocks that are occurring at the network layer level of peers-of-peers and affect the hours worked of the individual. As we exclude peers-of-peers who are employed at the same firm as the individual or peers-of-peers who live in the same neighbourhood as the individual, a key mechanism through which this problem could occur is taken care of.

Table 3: Regression of instrument on individual characteristics

	(1) INC	(2) INF	(3) ICN	(4) ICF	(5) IFN	(6) IFC
A: Men						
$\geq$ 25 and $<$ 30 year	-0.0383	0.3901	-0.2155	0.3537*	0.2547***	-0.0411
	(0.1460)	(0.2718)	(0.1758)	(0.1755)	(0.0804)	(0.0673)
$\geq$ 30 and $<$ 35 year	0.0490	0.5456**	0.1109	0.2126*	0.1180	0.0245
	(0.1470)	(0.2324)	(0.1097)	(0.1189)	(0.0699)	(0.0513)
Born in the Netherlands	-1.1551***	-0.7303***	-0.1849	0.0444	0.2006**	0.0137
	(0.1738)	(0.2343)	(0.1144)	(0.1663)	(0.0916)	(0.0455)
Permanent contract	-0.0561	0.1345	-0.2406*	0.1090	-0.0514	-0.0326
	(0.1322)	(0.1483)	(0.1290)	(0.1459)	(0.0662)	(0.0777)
Regular employee	0.5418**	0.0780	0.7238***	0.4408**	0.0053	0.0054
	(0.2483)	(0.3602)	(0.1682)	(0.1994)	(0.0772)	(0.0607)
Full-time employed ($\geq$ 35 hours)	0.4612***	-0.1035	0.4053**	0.2538	-0.1182	-0.0653
	(0.1460)	(0.2941)	(0.1662)	(0.2059)	(0.1150)	(0.0769)
N	107,665	107,665	107,665	107,665	107,665	107,665
F-Statistic	43.52	42.71	24.67	10.06	5.764	6.064
B: Women						
$\geq$ 25 and $<$ 30 year	-0.3602**	-0.0890	0.2953*	0.0013	0.3220	0.1407
	(0.1764)	(0.0785)	(0.1676)	(0.0877)	(0.2316)	(0.2125)
$\geq$ 30 and $<$ 35 year	0.0493	-0.0968	0.3319***	0.0457	0.5248**	0.2564
	(0.1296)	(0.0718)	(0.1095)	(0.1054)	(0.2217)	(0.1896)
Born in the Netherlands	0.6330***	-0.0448	0.3972**	0.2168***	-0.6837***	-0.1241
	(0.1631)	(0.0542)	(0.1872)	(0.0713)	(0.2120)	(0.1444)
Permanent contract	0.2048*	0.1209**	0.3462**	0.0832	0.4036**	0.4632***
	(0.1062)	(0.0582)	(0.1271)	(0.1158)	(0.1613)	(0.1134)
Regular employee	0.8592**	-0.0671	0.5137**	-0.3174**	-0.5801	0.3391
	(0.3694)	(0.1081)	(0.2145)	(0.1336)	(0.3682)	(0.3322)
Full-time employed ($\geq$ 35 hours)	-0.1267	-0.0185	0.1236	-0.1341*	-0.1927	0.2913*
	(0.1422)	(0.0556)	(0.0989)	(0.0750)	(0.1942)	(0.1436)
N	115,466	115,466	115,466	115,466	115,466	115,466
F-Statistic	14.97	6.680	52.96	34.79	18.86	23.93

Notes. This table shows a regression of the instrument, i.e. the average hours worked of peers-of-peers, on the focal individual's characteristics and the focal individual's partner's characteristics in the twelfth month before the individual became a parent. The F statistic measures the joint significance of the individual characteristics and individuals' partners' characteristics. Fixed effects included are: month of birth, educational attainment, home location (PES areas), 2-digit sector codes, firm size quantiles and a dummy variable whether the peers-of-peers information is missing (six indicator variables). We include dummies for missing peers-of-peers information as we set all missing key variables to zero.

5 Results - IV analysis

5.1 Main analysis

Figure 3 shows the impact of the average working hours of the focal individual's peers on the focal individual, across the six dimensions of peers-of-peers, by the month since first birth and by the individual's sex (men: Figure 3a; women: Figure 3b). Estimates are calculated using a separate regression for each month since birth. We are interested in: (i) how strong are peer effects on men, (ii) which peer network is most important for men, (iii) to what extent this is different compared to peer effects on women.

We control for individual characteristics, the individual's partner characteristics, and include various fixed effects including those for month of birth, PES regional location, and firm sector. In addition, to overcome the endogeneity bias caused non-random neighbourhood location and non-random employer outcomes, we include the instrument at the individual level. That is, the individual IV, which controls for the average working hours of the individual's peers for the network layer that used as the network layer of the peers-of-peers. For example, for the analysis of neighbour peer effects through colleagues of the focal individual's neighbours (INC), we also include the average working hours of the focal individual's colleagues. On the y-axis, the peer effect on the individual's working hours is shown, but note the difference in magnitudes on the y-axis across the six network-by-network dimensions.

Figure 3a shows statistically significant neighbour peer effects on men identified using the working hours of colleagues of the focal individual's neighbours as instrument (INC). Specifically, the results indicate that a one-hour increase in neighbour peers' working hours causes a 0.1 to 0.15 hour (six to nine minutes) increase in the individual's working hours. Note that this effect is found from about 36 to 48 months since first birth only. In addition, we find larger statistically significant peer effects from colleagues (ICN), which range between .25 and .75 of an hour. For example, between 6 and 18 months since childbirth, men increase their hours by about half an hour if their colleague peers increase their hours by one hour. The evidence on peer effects from family shows an effect of 0.1 to 0.2 of an hour, but only from 54 months since childbirth, similar in size to the estimated neighbour peer effects.

It is clear from Figure 3a that for men, the estimates based on the instrument where the family layer is used as the distance-two network (INF and ICF), produce highly inaccurate results and are not interpretable. This observation is explained by the relative

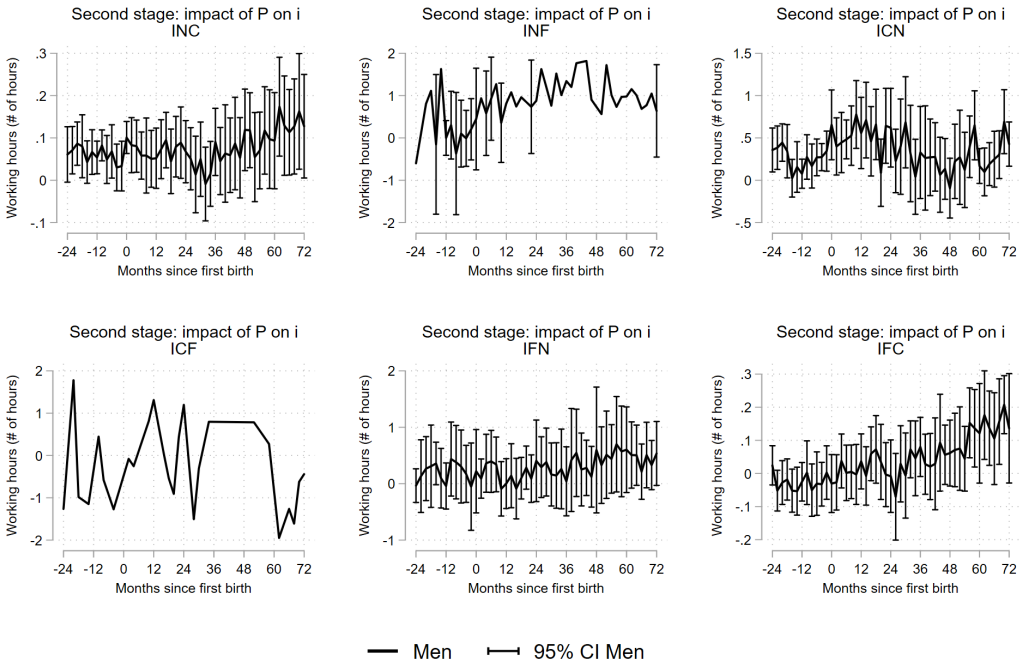
small sample sizes, as there are relatively few family peers-of-peers observed in our data.

The results for women are shown in Figure 3b. The results for women show statistically significant peer effects based on neighbour peers (0.05 to 0.15 hours, INC), colleague peers (0.3 to 0.4, ICN) and family peers (0.05 to 0.1, IFC, from about 5 years since first birth). From the width of the confidence intervals it is also clear that the IV strategy for women has more power than the IV strategy for men. This observation is consistent with the evidence in Figure 1 that shows more within variation in working hours for women than men. In addition, it aligns with the descriptives in Table 1 that show larger sample sizes for women than men.

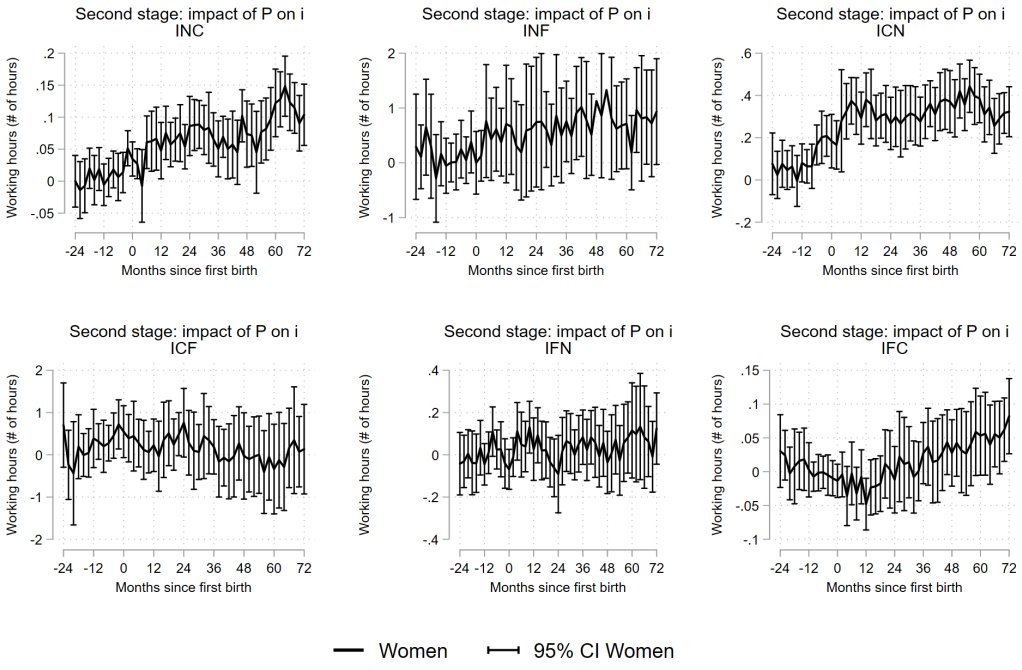
The closest paper to our study is by Nicoletti et al. (2018), who analyse peer effects on mothers' working hours in two ways. First, they find statistically significant family peer effects ranging between 0.35 and 0.45 in the period from two years up to six years since childbirth, using the hours worked of neighbours of the focal individual's family as instrument. Related to this evidence, we do not find a statistically significant family peer effect (IFN), potentially due to the relatively few family peers observed in our data. Other reasons why the results might differ include a different geographic context with different institutions and norms (Norway instead of the Netherlands), a different time period (individuals becoming a parent between 1997 and 2002 instead of between 2012 and 2020) and different working hours data (annual discrete working hours in four categories instead of monthly continuous working hours). Note, however, that we do observe significant family peer effects of about 0.05 to 0.1 using colleagues as the distance-two network layer. Second, Nicoletti et al. (2018) do not find significant neighbour peer effects using the family of the focal individual's neighbours as the instrument. Our results are consistent with this finding (INF). In contrast, we do observe neighbour peer effects using colleagues as the distance-two network layer (INC).

Taken together, the statistical significance and economical significance of peer effects on mothers is comparable to that of the peer effect on fathers. Interestingly, in terms of magnitudes, it appears colleague peer effects are stronger for men than women (observe difference in the scale of the y-axis across all subfigures). Notably, colleague peer effects are largest, followed by neighbour peer effects, and family peer effects.

Figure 3: IV results - Peer effects on the individual's working hours, Second stage coefficients



(a) Men



(b) Women

Notes: IV analysis coefficient estimates. Several confidence interval data points are suppressed if they are outside [-2,2], which occurs for the network-by-network dimensions with small sample sizes. Coefficients are estimated by sex group, by network-by-network dimension and by month since first birth. Standard errors are clustered by PES region.

5.2 Robustness checks

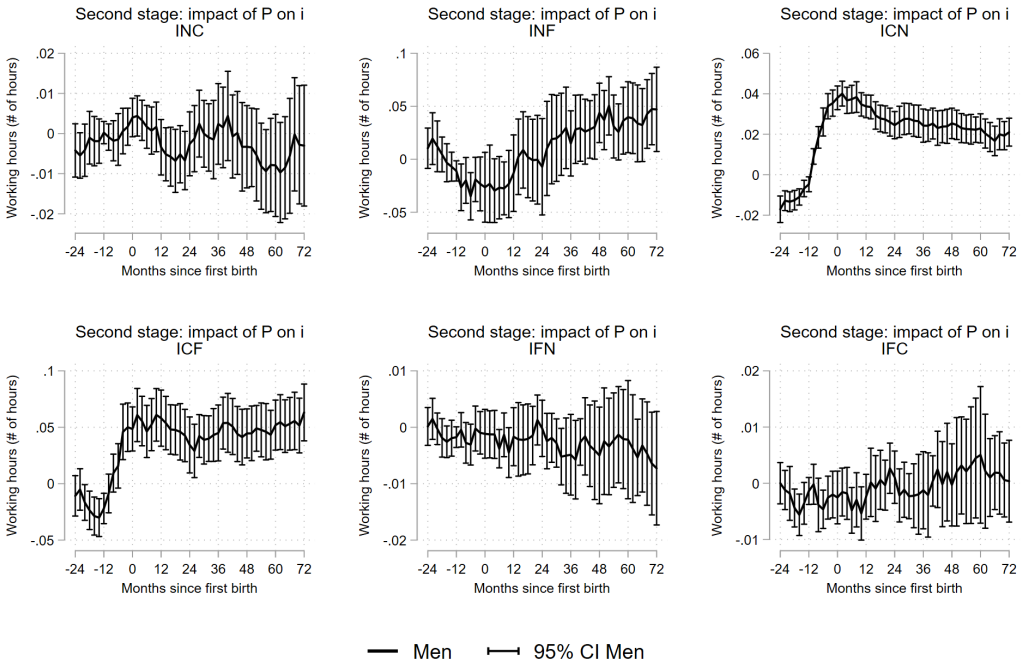
5.2.1 Imputing zeros for missing working hours information

For a large share of individuals, we do not observe peers and/or peers-of-peers. Consequently, these individuals are not included in our baseline analyses shown above. In this robustness check, we follow Nicoletti et al. (2018) and Nicoletti et al. (2023) and set the instruments to zero for individuals who are missing peer-of-peer information. The hours worked of peers, as well as the individual IVs, are also set to zero if these are missing. This data manipulation is justified if these individuals indeed have peers who do not work, or have no peers.

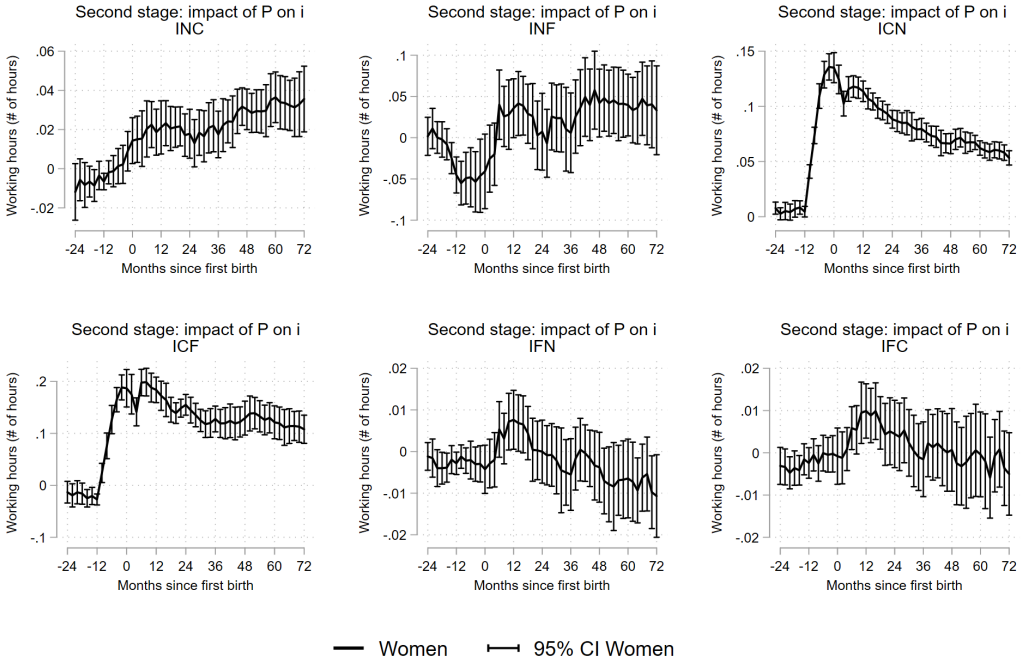
We argue that this manipulation is indeed justified given that we have data on the entire of population of salaried employees, and we exclude individuals who were self-employed in the year before giving birth. Consequently, we have complete information on all individuals except for those who only have self-employed peers or self-employed peers-of-peers. The latter is highly unlikely given the share of people in self-employment conditional on employment which is equals 13% in the Netherlands, and thus much lower than the share of people in salaried employment. In turn, this manipulation benefits the empirical analysis in two ways. First, it will increase the power as our estimation will not suffer from missing data points for one of the key variables. Second, it removes the issue of sample selection that was caused by missing peer and peer-of-peer information. Figure 4 shows the results for this robustness check.

The figure shows an increasing power of the analysis, which narrows the confidence intervals. Note, however, that the point estimates are smaller than our baseline evidence provided in Figure 3. Overall we find statistically significant neighbour peer effects and colleague peer effects for both men and women. In contrast, there is no evidence of statistically significant family peer effects. In terms of magnitudes, the peer effects for women appear larger than for men. Interestingly, for men, colleague peer effects are more important than neighbour peer effects soon after becoming a parent. In contrast, for women, both neighbour peer effects and colleague peer effects are statistically significant from around giving birth.

Figure 4: Peer effects including zeros for missing key variables, Second stage coefficients



(a) Men



(b) Women

Notes: See Figure 3 for notes.

5.3 Other robustness checks

We apply a number of other robustness checks:

- Retain high educated people only, see Figure A1. It is clear that the driving force behind our findings are the high educated workers, who are more likely to be employed.
- Retain non-high educated people only, see Figure A2.
- Retain people with missing educational information only, see Figure A3.
- Retain singles and younger/older individuals, see Figure A4. Results are robust.
- Retain individuals not employed in the public sector, see Figure A5. Results are robust.
- Include municipality fixed effects and cluster standard errors at the municipality level instead of at the public employment service level, see Figure A6. Results are robust.

6 Conclusion

Building on a substantial literature on gender inequalities and peer effects in the labour market, this paper analyses peer effects on individuals' working hours using full-population administrative network data. We examine peer effects from neighbours, colleagues and family for individuals who become a parent between 2012 and 2020 for a period of up to six years after childbirth. Our analysis is the first to show peer effects on fathers' paid working hours. In addition, a methodological innovation is to integrate three network layers in one paper, for both fathers and mothers, which allows us to evaluate which of the network layers is most relevant to peer effects on paid working hours.

Our main findings show significant neighbour peer effects, colleague peer effects and family peer effect on fathers and mothers. For both fathers and mothers, colleague peer effects appear the strongest. We find long-run effects of about 18 to 30 minutes on fathers and mothers of a one-hour change in average working hours of colleague peers. In addition, for men and women, we find neighbour peer effects and family peer effects of about 6 to 12 minutes. Hence, peer effects on working hours from colleagues are stronger than peer effects from neighbours or family.

A key robustness check in this paper is whether setting the instrument to zero for individuals without (in)direct peers matters for the analysis of peer effects. We argued this is justified in light of our full-population data and as we exclude self-employed individuals for whom we do not observe working hours. In addition, this removed sample selection issues in terms of now also retaining individuals who are less likely to have peers or peers-of-peers. The results of this analysis showed statistically significant peer effects from neighbours and colleagues, but not from family, for both fathers and mothers. For fathers, the significant peer effects are smaller than the estimates of our main analysis and equal to about 3 minutes for a focal individual if the individual's peers change their working hours by one hour. For mothers, impacts are larger for colleagues and equal to about 6 to 12 minutes, and for neighbour peers and family peers comparable to estimates found for fathers.

The results of our analysis suggest that the colleague network matters most for fathers' and mothers' labour supply. Importantly, we also provide robust evidence of significant neighbour peer effects, and weaker evidence of family peer effects. In terms of governmental policies, and firm diversity and inclusion strategies, our research emphasizes the role of social multiplier effects in eliciting change in terms of attitudes on the number of paid working hours. From our results on colleague peer effects, it is clear that there is an important role of firms in narrowing gender gaps in paid working hours. Promising avenues for future research involve the analysis of peer effects on other labour market outcomes that approximate job flexibility, that study other countries reflecting on cross-country differences in institutions (e.g., laws on the amount and duration of unemployment benefits and maternity/parental leave) and norms (e.g., norms driving a tendency to work full time or part time), and that study other time periods considering changes in gender role attitudes over the last decades.

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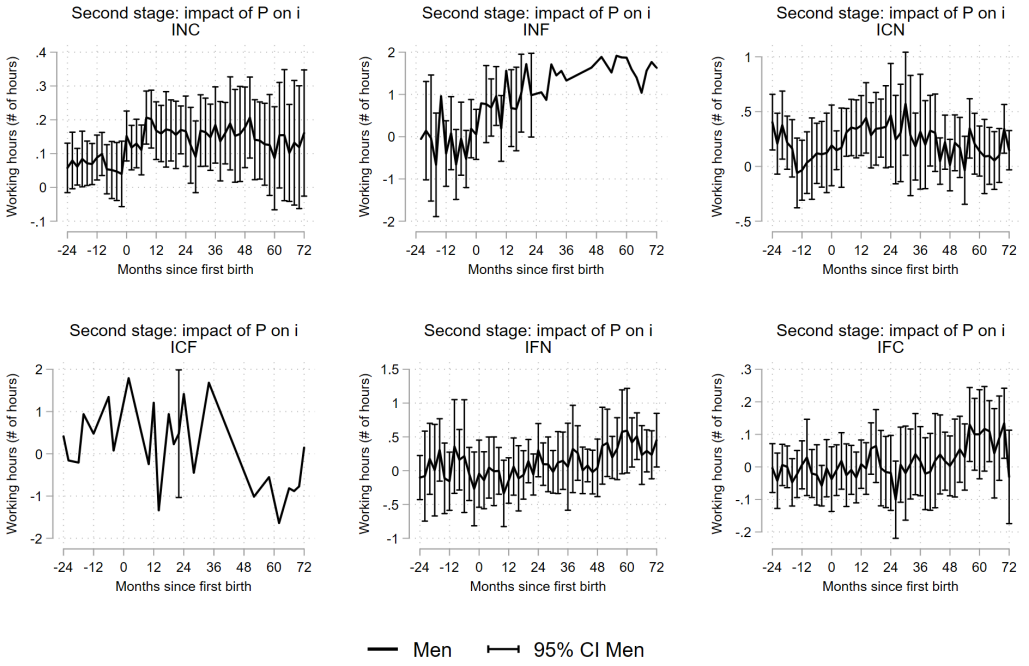
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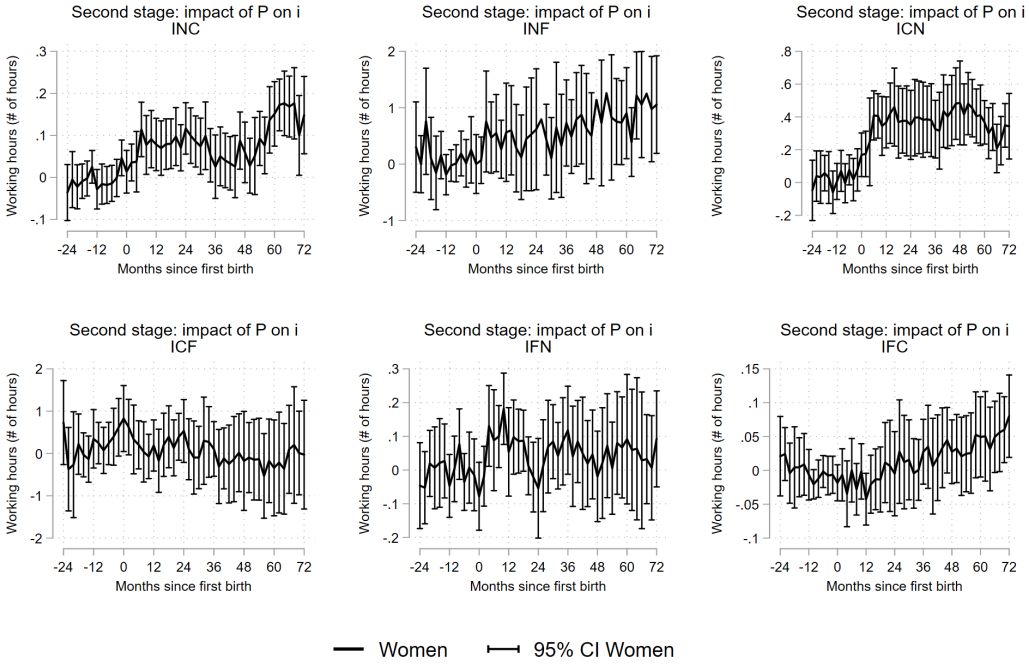
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A Other Tables and Figures

Figure A1: IV results - High-educated individuals only



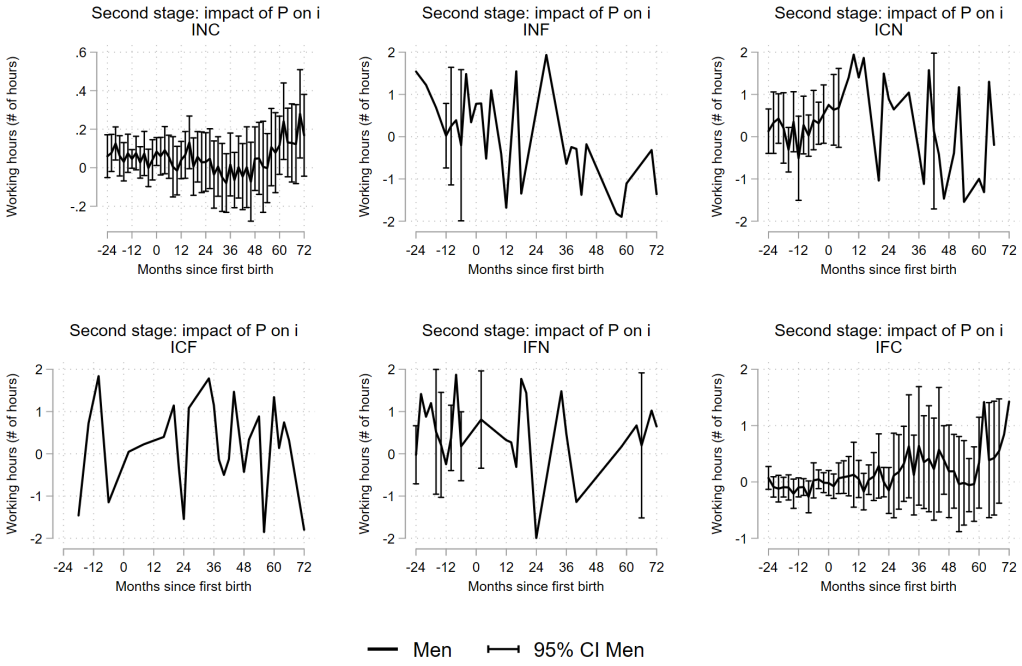
(a) Men



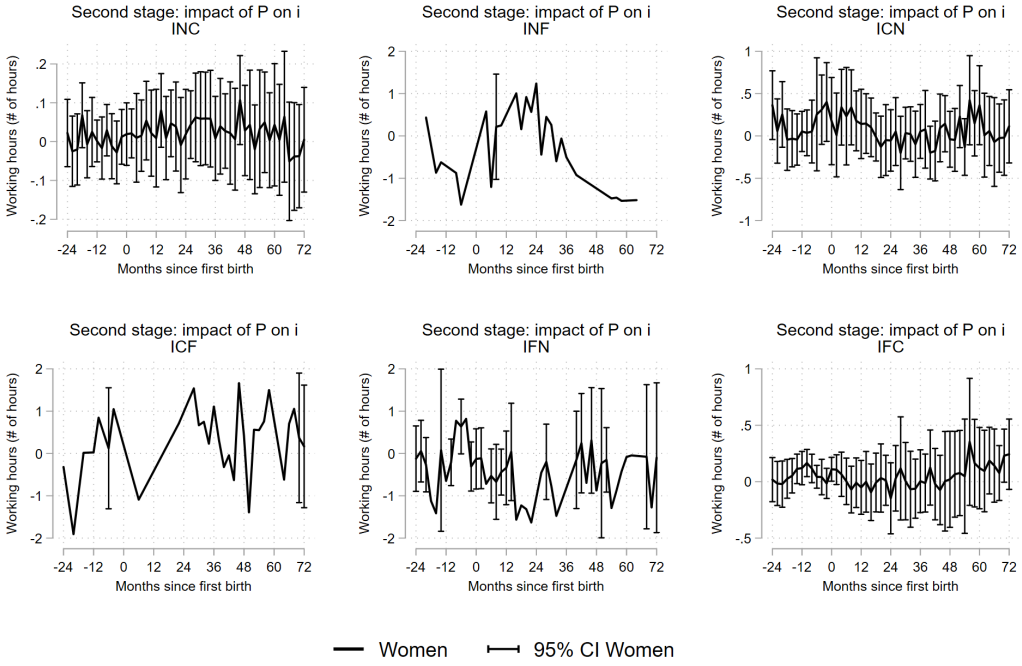
(b) Women

Notes: See Figure 3.

Figure A2: IV results - Low-educated individuals only



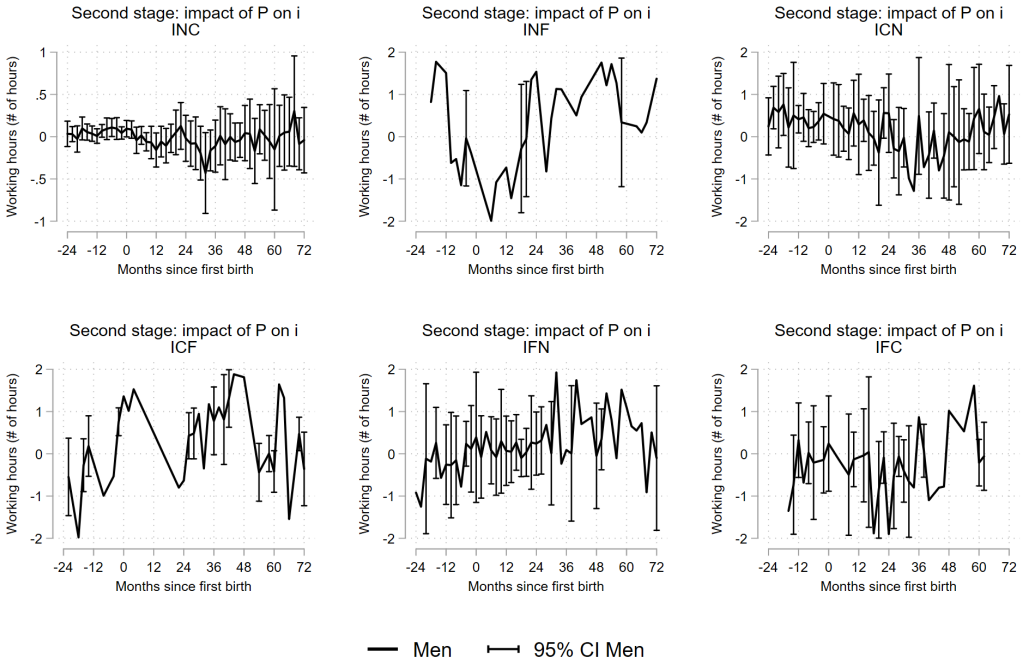
(a) Men



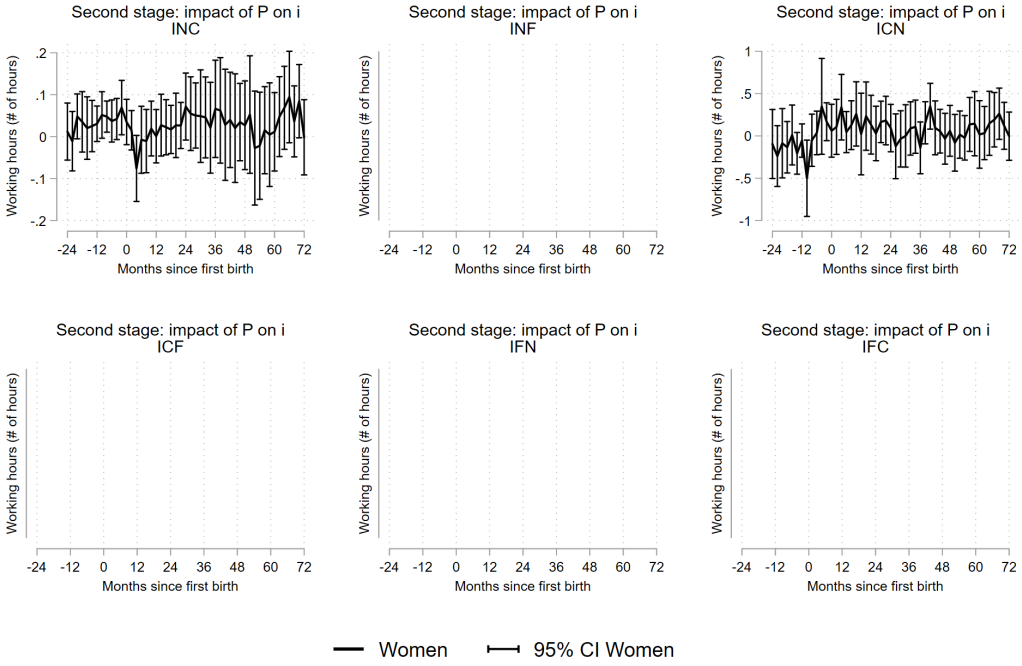
(b) Women

Notes: See Figure 3.

Figure A3: IV results - Individuals with missing educational information only



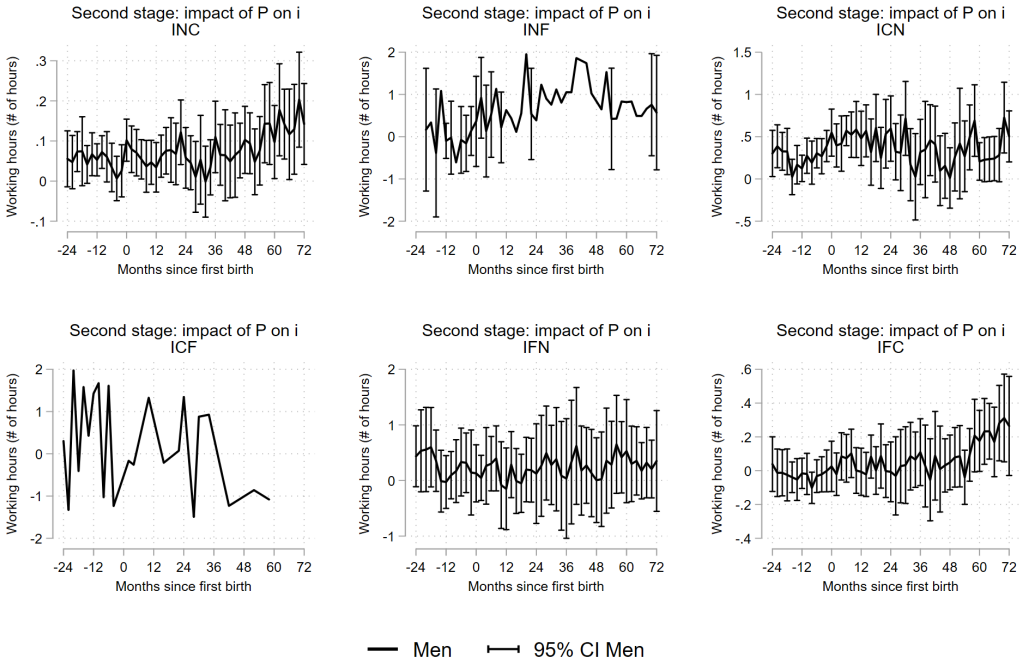
(a) Men



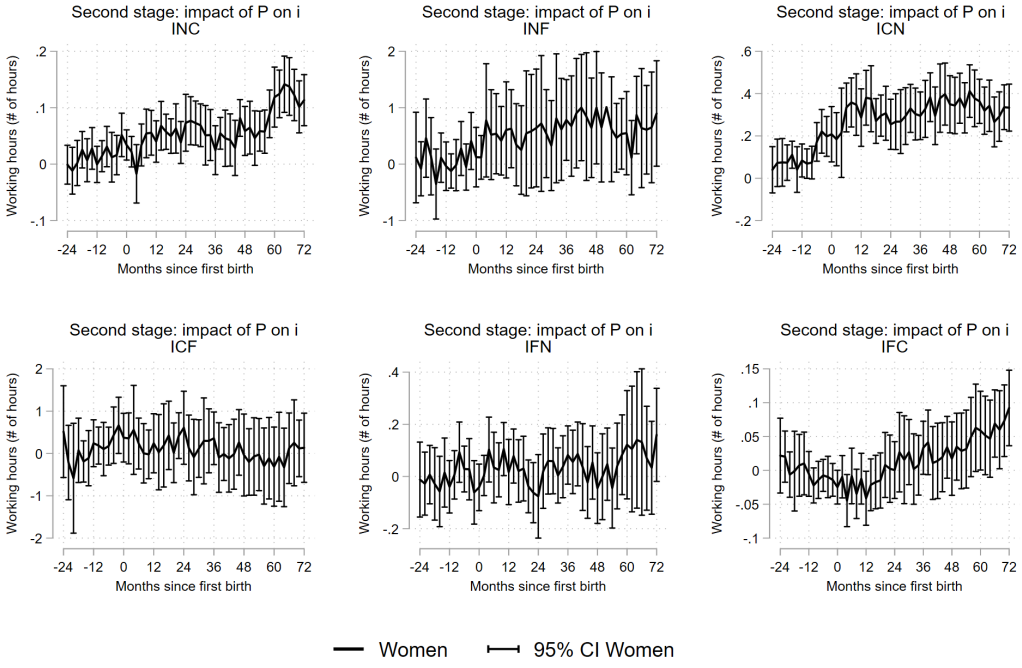
(b) Women

Notes: See Figure 3.

Figure A4: IV results - Including singles and younger/older individuals



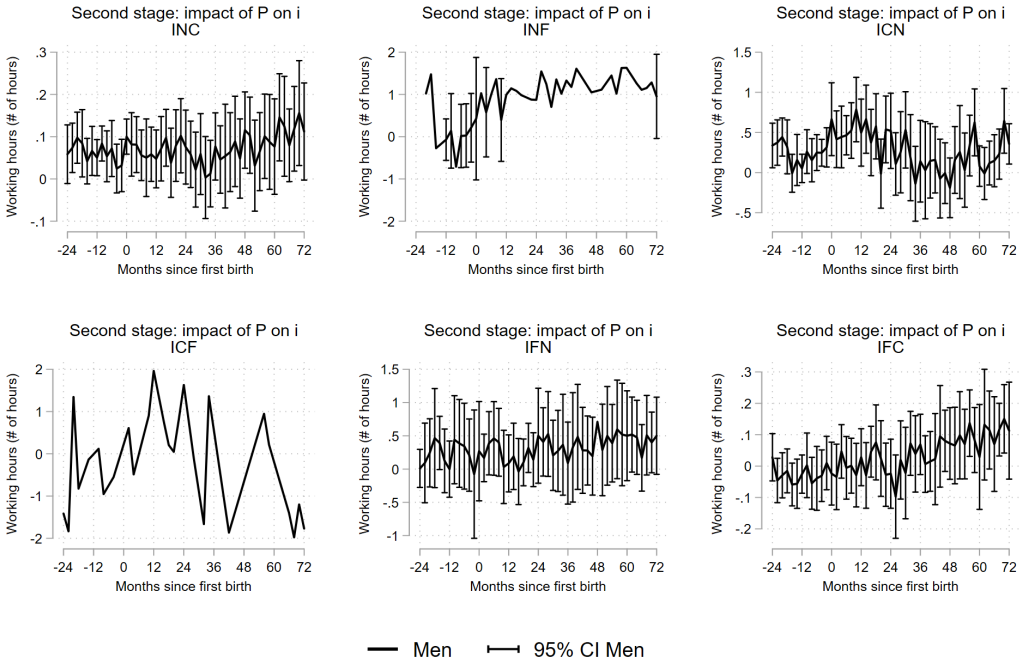
(a) Men



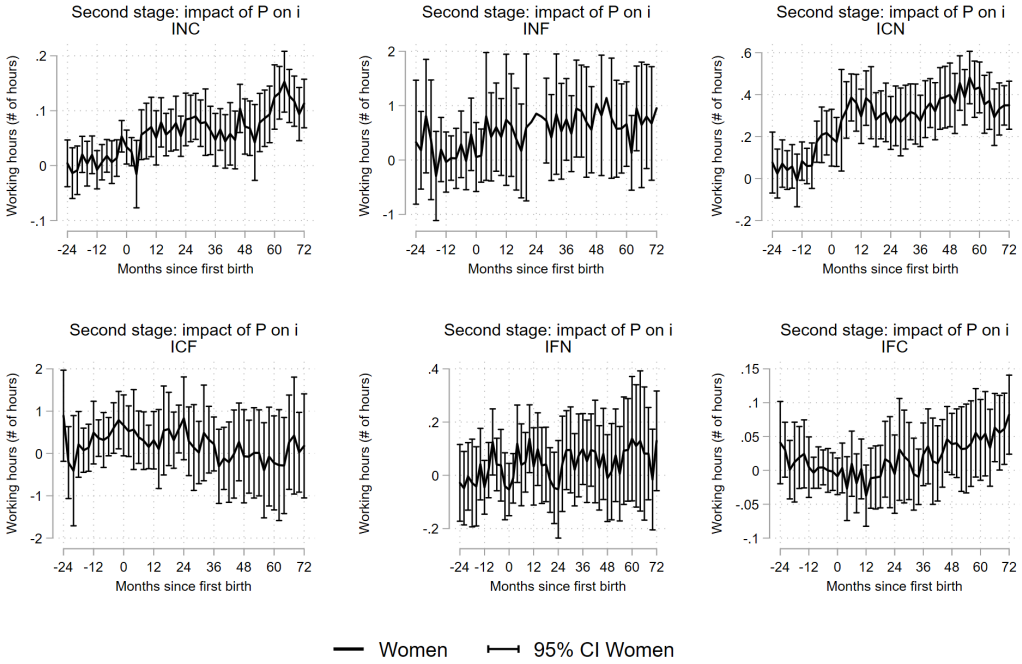
(b) Women

Notes: See Figure 3.

Figure A5: IV results - Excluding individuals employed in the public sector



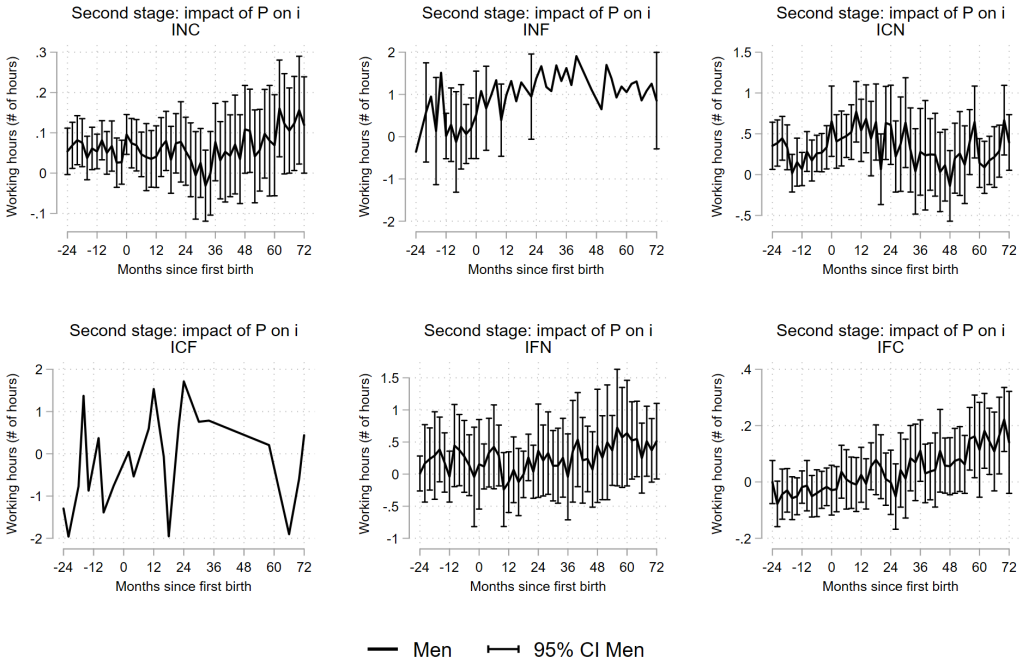
(a) Men



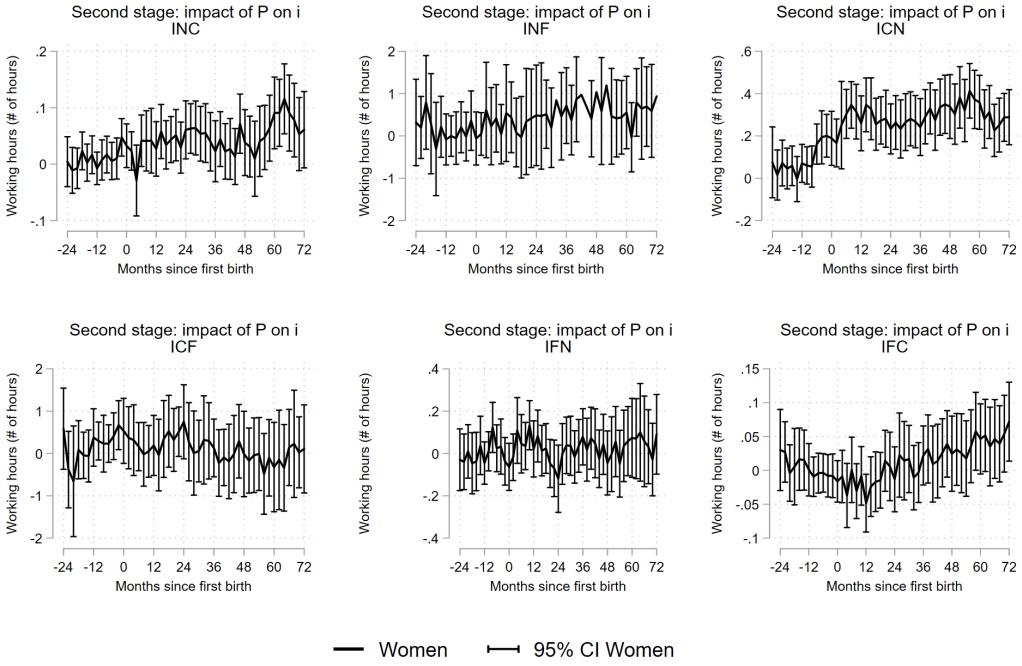
(b) Women

Notes: See Figure 3.

Figure A6: IV results - Using municipality FE and clustering se's instead of at PES level



(a) Men



(b) Women

Notes: See Figure 3.