Home Production and Labor Supply

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1 Time to Consider New Ways to Use Time

- Activities like cooking, cleaning, yard-work, home maintenance, and child care are a type of *home production*: goods and services we can either pay someone to do or do ourselves, if we're willing to spend the time
  - The home production framework helps us analyze time-allocation questions like:
    - Who does the housework, unclogs the sink, rakes the leaves, and looks after the kids?
    - Who works at a job?
    - How do wages, prices, unearned income, technological change, and family size and structure affect these choices?
    - How does public policy affect these choices?
- *A few years back, I'd cut home production from my Labor syllabus as a dated topic!*
  - Now, gig work and the pandemic bring home the importance of home production in the 21st Century
  - Is "work from home" what we mean by "home production"?
    - The original home producer was a farmer or an artisan, a worker who can plant, plow, weave or sew as an entrepreneur or independent contractor. What's the economic distinction between what they do and what my assistant does when he works–as an MIT employee–from home?
    - A given worker may do both: some MIT faculty and staff work as contractors or consultants once their salaried or hourly day jobs are done

1.1 Home Production Research

- A large academic lit discusses time allocation within households and families. Much of this is concerned with specification of preferences and the

implications of alternative models of HH decision-making/bargaining. See, e.g., Chiappori, Fortin, and Lacroix (2002) and Angrist (2002).

- We have time only for the basic framework introduced by Gronau (1977, 1987) and some related econometric research. This early analysis ignores HH bargaining. Later, we apply the Gronau model in the Angrist and Caldwell (2021) Uber study

2 A Theory of the Allocation of Time

- A new time-use possibility:

$$T = h_0 + h_1 + l$$

where h_0 is time spent in home production and h_1 is time spent in the market. Homemade and market goods are perfect substitutes: utility is $U(x, l)$ where $x = x_0 + x_1$.

- Whats the difference between home production and market work? Total consumption is the sum of what we make and what we buy:

$$x = x_0 + x_1$$

We make according to the increasing, concave home production function:

$$x_0 = f(h_0); f' > 0, f'' < 0$$

  - I enjoy (get utility from) what I make at home but not from the time spent producing it (that's why h_0 counts as work and not leisure)
  - Or we can just buy it:

$$px_1 = wh_1 + y = w(T - h_0 - l) + y$$

- The consumer solves:

$$\max U(x_0 + x_1, l) \; s.t. \; px_1 = y + w(T - h_0 - l); \; x_0 = f(h_0)$$

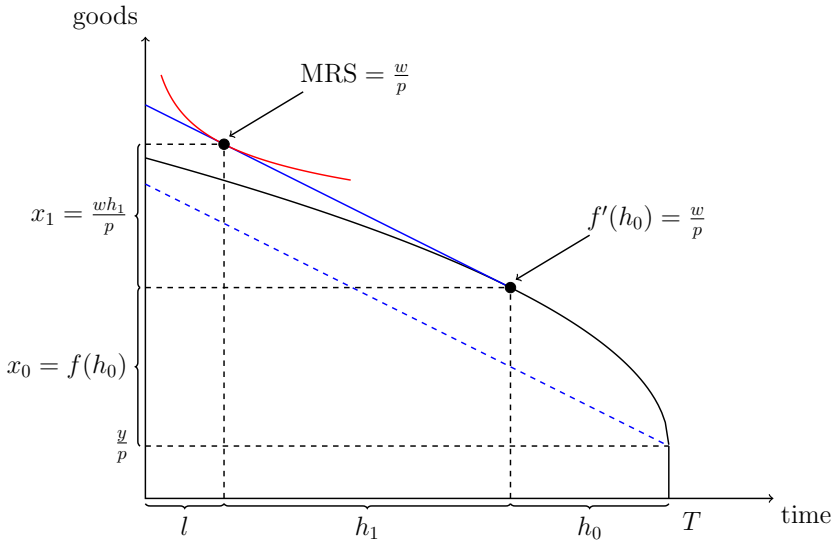
Set up the Lagrangian by subbing out x_0:

$$L = U[f(h_0) + x_1, l] - \lambda[px_1 - w(T - l - h_0) - y]$$

with FOCs:

$$\begin{aligned} h_0 &: U_x f'(h_0) - \lambda w = 0 \\ x_1 &: U_x - \lambda p = 0 \\ l &: U_l - \lambda w = 0 \end{aligned}$$

- The full interior solution (case 1):



- FOCs - four ways (as with univariate labor supply, equilibrium behavior has two margins: participation and hours for each of h_0 and h_1)

  1. $h_0 > 0, h_1 > 0$ (pictured above)

     $$f'(h_0) = \frac{w}{p}; \frac{U_l(x,l)}{U_x(x,l)} = \frac{w}{p}$$

     Equate MP=MRS=real wage: that's efficient!

  2. $h_0 > 0, h_1 = 0$

     $$f'(h_0) = \frac{U_l(x,l)}{U_x(x,l)} > \frac{w}{p}$$

     Those first hours at home are quality time, yo!

  3. $h_0 = 0, h_1 > 0$

     $$\frac{U_l(x,l)}{U_x(x,l)} = \frac{w}{p} > f'(0)$$

     Now, who do you know like that?

  4. $h_0 = h_1 = 0$ (The Boy Does Nothing)

- This model reveals...
  - who works at home and who works in the market
  - how much of each for those who do

2.1 Effects of parameters w, p, y on h_0 and h_1

Comparative Statics

- If $\uparrow w$ (or $\downarrow p$):
  1. If initially $h_0 > 0, h_1 > 0$, then $\downarrow h_0$ but the effect on h_1 and l is indeterminate.
  2. If initially $h_0 > 0, h_1 = 0$, then the person might be drawn into the labor market or he might be unaffected.

- If $\uparrow y$:
  1. If initially $h_0 > 0, h_1 > 0$, then h_0 is unaffected and $\uparrow l$ and $\downarrow h_1$ (if leisure is a normal good).
  2. If initially $h_0 > 0, h_1 = 0$, then $\uparrow l$ and $\downarrow h_0$ (if leisure is a normal good).

- Comparative statics to ponder
  - Closing gender gaps in wages
  - The role of the Roomba
  - Why children might increase $f'(h_0)$while also being a tax on the household raising them

3 Home-maker 'Metrics

3.1 Comparative advantage tested in Hofmarcher and Plug (2021)

same-sex and different-sex couples: these time-use estimates test whether the different couples specialize by taking advantage of each other's comparative advantage in earnings. In the second version, we estimate a fully interacted model on the pooled sample (including same-sex and different-sex couples) where all the independent variables in (1) and (2) are interacted with same-sex-couple dummy:

$$\begin{aligned} \textit{MARKET WORK}_i \;=\; & \alpha_{1M} + \;_{1M} \times \textit{HIGHER EARNER}_i + \;_{1M} \times X_i + \\ & \alpha_{2M} \times \textit{SAME SEX}_i + \;_{2M} \times X_i \times \textit{SAME SEX}_i + \\ & \;_{2M} \times \textit{HIGHER EARNER}_i \times \textit{SAME SEX}_i + u_i, \end{aligned} \tag{3}$$

$$\begin{aligned} \textit{HOUSEHOLD WORK}_i \;=\; & \alpha_{1H} + \;_{1H} \times \textit{HIGHER EARNER}_i + \;_{1H} \times X_i + \\ & \alpha_{2H} \times \textit{SAME SEX}_i + \;_{2H} \times X_i \times \textit{SAME SEX}_i + \\ & \;_{2H} \times \textit{HIGHER EARNER}_i \times \textit{SAME SEX}_i + \;_i, \end{aligned} \tag{4}$$

Appendix Table A1
Classification of time use

Category	Activities	Codes
market work	working, work-related activities, other income-generating activities, and travel related to these activities	0501xx, 0502xx, 0503xx, 0599xx, 1805xx
household work	household activities, caring for and helping household and non-household members, consumer purchases, professional services, household services, and telephone calls and travel related to these activities	02xxxx (except 020903, 020904), 03xxxx, 04xxxx, 07xxxx, 08xxxx (except 0805xx), 09xxxx, 160103, 160104, 160105, 160106, 160107, 1802xx, 1803xx, 1804xx, 1807xx, 1808xx (except 180805), 1809xx

Notes: The codes correspond to the ones provided in the ATUS Activity summary file.

Table 1
Summary statistics (means and standard deviations in italics)

	homosexual couples		heterosexual couples		gay men		lesbian women		heterosexual men		heterosexual women	
Time use (in minutes per day):												
market work	356	*304*	301	*290*	380	*318*	333	*287*	363	*298*	238	*268*
household work	165	*164*	226	*200*	150	*162*	180	*164*	171	*176*	282	*207*
no market work	.308		.399		.303		.312		.318		.483	
no household work	.104		.096		.130		.078		.150		.040	
Labor market characteristics (comparative advantage in earnings):												
highest earner (0/1)	.540		.522		.530		.550		.666		.375	
hourly wage	25.1	*17.9*	19.4	*16.2*	27.6	*20.5*	22.5	*14.6*	23.0	*16.8*	15.8	*14.7*
hourly wage, partner	22.8	*18.9*	18.1	*16.4*	24.5	*21.2*	21.0	*16.2*	14.7	*14.7*	21.6	*17.3*
employed (0/1)	.930		.848		.938		.922		.924		.771	
employed, spouse (0/1)	.864		.821		.845		.883		.737		.906	
employed, both (0/1)	.794		.669		.783		.805		.662		.677	
highest earner (0/1)[a]	.486		.486		.445		.524		.635		.335	
hourly wage[a]	28.0	*15.7*	23.7	*14.2*	31.6	*18.2*	24.8	*12.1*	26.2	*14.6*	21.3	*13.2*
hourly wage, partner[a]	28.2	*16.1*	23.9	*14.3*	32.6	*18.2*	24.3	*12.8*	21.4	*13.2*	26.4	*14.9*
Other characteristics:												
age	41.8	*10.1*	43.8	*10.5*	42.2	*9.7*	41.5	*10.5*	44.8	*10.5*	42.9	*10.3*
age, partner	42.2	*10.4*	44.0	*10.5*	43.0	*10.1*	41.5	*10.6*	43.0	*10.4*	45.0	*10.5*
years of education	15.4	*2.6*	14.0	*2.9*	15.1	*2.5*	15.6	*2.8*	14.0	*3.0*	14.1	*2.8*
years of education, partner	15.5	*2.7*	14.1	*2.9*	15.3	*2.7*	15.7	*2.6*	14.1	*2.9*	14.0	*3.0*
any children (0/1)	.177		.560		.102		.251		.560		.558	
number of children[b]	1.53	*.76*	1.95	*.97*	1.76	*.88*	1.45	*.70*	1.95	*.97*	1.94	*.96*
metropolitan area (0/1)	.954		.833		.968		.940		.833		.834	
tolerant state (0/1)	.449		.332		.433		.464		.331		.332	
interview on weekend (0/1)	.318		.286		.319		.317		.285		.286	
survey year	2013	*4.7*	2011	*4.9*	2013	*4.7*	2013	*4.7*	2011	*4.9*	2011	*4.9*
observation (all couples)	503		76,237		225		278		36,664		39,573	

Notes: See appendix tables A1 and A2 for the definition of the time use categories and the computation of the years of education. [a] Only two-earner couples. [b] Conditional on children living in the household. Metropolitan area is defined according to the census definition of metropolitan statistical area which has changed twice in the years included. Tolerant states are CA, CT, DE, DC, HI, ME, MD, MA, MN, NH, NJ, NM, NY, OR, RI, VT, WA in which same-sex marriage was effectively legalized before 2014 (excluding Iowa, but including Oregon). ATUS sample weights are applied.

Table 2
Comparative advantage regressions for different household types

	All couples				Two-earner couples			
	Market work		Household work		Market work		Household work	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: different-sex couples (sample sizes: 76237, 39668)								
HE	128.7***	128.9***	-77.5***	-78.2***	39.9***	39.8***	-30.7***	-30.7***
	(1.8)	(1.8)	(1.4)	(1.4)	(2.3)	(2.3)	(1.8)	(1.7)
Panel B: same-sex couples (sample sizes: 503, 321)								
HE	79.3***	73.5***	-41.5***	-34.4**	25.8	22.3	-30.4*	-32.9**
	(22.9)	(22.7)	(14.2)	(13.1)	(27.7)	(27.4)	(17.2)	(16.1)
(B-A)	-49.4**	-55.4***	36.0**	43.8***	-14.1	-17.5	0.3	-2.3
	(20.2)	(20.2)	(15.6)	(15.2)	(23.7)	(23.8)	(18.0)	(17.5)
Panel C: gay couples (sample sizes: 225, 140)								
HE	74.5**	78.7**	-62.0***	-55.8***	89.4**	90.2**	-67.7***	-68.0***
	(36.1)	(36.2)	(19.7)	(18.9)	(40.9)	(40.5)	(22.9)	(21.7)
(C-A)	-54.2*	-50.2*	15.5	22.4	49.6	50.4	-37.0	-37.4
	(29.6)	(30.2)	(22.9)	(22.7)	(35.5)	(36.2)	(26.9)	(26.6)
Panel D: lesbian couples (sample sizes: 278, 181)								
HE	80.5***	71.7***	-22.0	-12.2	4.7	-2.3	-0.5	0.3
	(28.4)	(27.5)	(19.9)	(17.5)	(36.9)	(26.3)	(24.1)	(22.5)
(D-A)	-48.2*	-57.2**	55.5**	66.1***	-35.2	-42.1	30.3	31.0
	(29.1)	(29.1)	(22.5)	(21.9)	(34.6)	(35.2)	(26.3)	(25.9)
year/day dummies	✓	✓	✓	✓	✓	✓	✓	✓
couple controls		✓		✓		✓		✓

Note–The two dependent variables are time allocated to market-work activities and time allocated to household-work activities (measured in minutes per day). The main independent variable is an indicator variable for being the highest earner in the couple (*HE*). All specifications include day-of-the-week and survey-year fixed effects. The specifications in the even columns 2, 4, 6, and 8 additionally control for the average age of the couple, the average level of education of the couple (measured in average years of education), household size, two children indicators for whether the youngest child living in the household is aged between 0 and 6 and between 7 and 17, and two location indicators for living in a metropolitan area and in a tolerant state (defined as those states which legalized same-sex marriage before 2014). The *HE* estimates indicate whether individuals in couples specialize and take advantage of each other's comparative advantage in earnings. The estimates in columns 1 and 3, columns 2 and 4, columns 5 and 7, and columns 6 and 8 represent seemingly unrelated regression estimates, which allow for correlated time-use between market work and household work. The sample used in columns 1 to 4 contains all couples with at least one earner. The sample used in columns 5 to 8 contains all two-earner couples. Observations are weighted using ATUS weights. The estimated difference in comparative-advantage estimates with different-sex couples are taken from fully interacted regression models by same-sex couples (in panel B), gay couples (in panel C), and lesbian couples (in

Table 4
Testing alternative mechanisms: same-sex couples vs. more comparable different-sex couples

	All couples				Two-earner couples			
	Market work		Household work		Market work		Household work	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: unconventional different-sex couples vs. same-sex couples (sample sizes: 55140, 39989)								
HE	49.7***	49.7***	-19.3***	-19.6***	39.9***	39.8***	-30.7***	-30.7***
	(2.1)	(2.1)	(1.5)	(1.5)	(2.3)	(2.3)	(1.8)	(1.7)
HE × *SS*	29.5	23.9	-22.2	-14.9	-14.1	-17.5	0.3	-2.3
	(19.9)	(20.0)	(14.9)	(14.6)	(23.7)	(23.8)	(18.0)	(17.5)
Panel B: unmarried different-sex couples vs. same-sex couples (sample sizes: 4360, 2540)								
HE	102.4***	100.5***	-56.8***	-54.0***	22.2**	21.5**	-24.3***	-22.6***
	(8.0)	(8.0)	(5.8)	(5.5)	(10.0)	(10.0)	(7.2)	(6.9)
HE × *SS*	-23.1	-26.9	15.4	19.6	3.5	0.7	-6.1	-10.4
	(23.8)	(23.8)	(17.4)	(16.6)	(28.6)	(28.6)	(20.7)	(19.8)
Panel C: childless different-sex couples vs. same-sex couples (sample sizes: 23738, 12638)								
HE	112.5***	112.2***	-45.9***	-45.7***	37.8***	37.4***	-25.7***	-24.8***
	(3.3)	(3.2)	(2.3)	(2.2)	(4.1)	(4.1)	(2.8)	(2.8)
HE × *SS*	-33.3	-38.6	4.5	11.2	-12.0	-15.1	-4.7	-8.1
	(24.3)	(24.3)	(16.8)	(16.7)	(28.6)	(28.7)	(19.6)	(19.6)
Panel D: younger different-sex couples vs. same-sex couples (sample sizes: 7308, 4021)								
HE	119.4***	119.1***	-75.7***	-76.8***	29.0***	27.9***	-16.7***	-17.0***
	(6.2)	(6.1)	(4.7)	(4.4)	(7.7)	(7.7)	(5.8)	(5.5)
HE × *SS*	-40.1*	-45.6**	34.3**	42.4***	-3.2	-5.6	-13.7	-15.9
	(22.9)	(22.8)	(17.4)	(16.4)	(27.7)	(27.6)	(20.9)	(19.6)
Panel E: excluding the most conventional different-sex couples (sample sizes: 60800, 39989)								
HE	82.2***	82.2***	-37.7***	-37.1***	39.1***	39.8***	-30.7***	-30.7***
	(2.0)	(2.0)	(1.5)	(1.5)	(2.3)	(2.3)	(1.8)	(1.7)
HE × *SS*	-2.9	-8.6	-3.8	2.7	-14.1	-17.5	0.3	-2.3
	(20.5)	(20.6)	(15.3)	(15.0)	(23.7)	(23.8)	(18.0)	(17.5)

Note–The two dependent variables are time allocated to market-work activities and time allocated to household-work activities (measured in minutes per day). The main independent variable is an indicator variable for being the highest earner in the couple (*HE*). All specifications include day-of-the-week and survey-year fixed effects. The specifications in the even columns 2, 4, 6, and 8 additionally control for the average age of the couple, the average level of education of the couple (measured in average years of education), household size, two children indicators for whether the youngest child living in the household is aged between 0 and 6 and between 7 and 17, and two location indicators for living in a metropolitan area and in a tolerant state (defined as those states which legalized same-sex marriage before 2014). The model we estimate is a fully interacted model by same-sex couple (*SS*). The *HE* estimates indicate whether individuals in different-sex couples specialize and take advantage of each other's comparative advantage in earnings. The *HE* × *SS* estimates indicate whether individuals in different-sex and same-sex couples specialize differently. The estimates in columns 1 and 3,

3.2 Kids and labor supply

- 'Metrics: we're interested in the effects of childbearing on parents' labor supply; in the context of the Gronau time allocation model small children increase $f'(h_0)$ while possibly reducing wages
- For starters, consider

$$y_i = \alpha + \beta_0 x_i + \epsilon_i$$

where

$$y_i = \text{LFP, weeks worked; } x_i = 1[kidcount_i > 2$$

in a sample of families with at least 2

- Since x_i is a dummy variable, the OLS regression coefficient simply compares LFP of women who do and don't have a third

$$\beta_0 = E[y_i|x_i = 1] - E[y_i|x_i = 0]$$

Omitted variable bias

- We'd like to measure the childbearing on LFP, **holding constant other factors related to LFP**. But women who have more kids are different from those who have fewer, perhaps they're lower-wage workers and so have lower LFP regardless. Define f_i to be offered wages (hidden for non-workers) and consider the augmented regression model that controls for this:

$$y_i = \alpha + \beta_1 x_i + \gamma f_i + \eta_i$$

- Suppose this multivariate "long regression" model yields an estimate of the desired causal effect, but f_i is unobserved. The short regression yields a biased measure of the long-regression coefficient on x_i. Specifically, the *omitted variables bias* (OVB) formula tells us:

$$\beta_0 = \beta_1 + \gamma \cdot \frac{Cov(f_i, x_i)}{Var(x_i)} = \beta_1 + \gamma(E[f_i|x_i = 1] - E[f_i|x_i = 0]).$$

  The short regression coefficient, β_0, likely misleads when we're after the long

Get me an instrument!

- Alas, we have no data on f_i. More generally, we may not know what the right f_i really is. Various and sundry factors cause omitted variables bias in this setup, and we can't hope to control for all of them.
- The econometric method of *Instrumental Variables* (IV) solves this OVB problem. Consider a fourth variable, z_i, with these properties:

$$E[x_i|z_i = 1] \neq E[x_i|z_i = 0]$$

$$E[\gamma f_i + \eta_i|z_i = 1] = E[\gamma f_i + \eta_i|z_i = 0]$$

- The first property tells us that z_i has an effect on fertility, x_i. This effect is called the *first stage*. The next says that z_i is unrelated to f_i and η_i. In other words, we assume there is no reason besides x_i for an association between y_i and the instrument, z_i. This assumption is called an *exclusion restriction*.

- Under these assumptions:

$$\begin{aligned}
&\frac{E[y_i|z_i = 1] - E[y_i|z_i = 0]}{E[x_i|z_i = 1] - E[x_i|z_i = 0]} \\
&\qquad = \frac{E[\alpha + \beta_1 x_i + \gamma f_i + \eta_i|z_i = 1] - E[\alpha + \beta_1 x_i + \gamma f_i + \eta_i|z_i = 1]}{E[x_i|z_i = 1] - E[x_i|z_i = 0]} \\
&\qquad = \frac{\beta_1 (E[x_i|z_i = 1] - E[x_i|z_i = 0])}{E[x_i|z_i = 1] - E[x_i|z_i = 0]} \\
&\qquad = \beta_1
\end{aligned}$$

  We've got the long regression β_1 without directly controlling for f_i. That's the miracle of IV!

- In Angrist and Evans (1998), twins and samesex instruments identify effects of children on parents' labor supply
  - Angrist and Fernandez-Val (2013) shows how the Gronau (1977) model reconciles twins and sex-mix IV estimates
  - Aaronson et al. (2021) replicates the twins and samesex IV designs using over 400 data sets from 103 countries, finding a remarkably robust income gradient in labor supply effects of childbearing

AE-98: First Stage

TABLE 3—FRACTION OF FAMILIES THAT HAD ANOTHER CHILD BY PARITY AND SEX OF CHILDREN

Sex of first child in families with one or more children	All women				Married women			
	1980 PUMS (649,887 observations)		1990 PUMS (627,362 observations)		1980 PUMS (410,333 observations)		1990 PUMS (477,798 observations)	
	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child
(1) one girl	0.488	0.694 (0.001)	0.489	0.665 (0.001)	0.485	0.720 (0.001)	0.487	0.698 (0.001)
(2) one boy	0.512	0.694 (0.001)	0.511	0.667 (0.001)	0.515	0.720 (0.001)	0.513	0.699 (0.001)
difference (2) − (1)	—	0.000 (0.001)	—	0.002 (0.001)	—	0.000 (0.001)	—	0.001 (0.001)

Sex of first two children in families with two or more children	All women				Married women			
	1980 PUMS (394,835 observations)		1990 PUMS (380,007 observations)		1980 PUMS (254,654 observations)		1990 PUMS (301,588 observations)	
	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child	Fraction of sample	Fraction that had another child
one boy, one girl	0.494	0.372 (0.001)	0.495	0.344 (0.001)	0.494	0.346 (0.001)	0.497	0.331 (0.001)
two girls	0.242	0.441 (0.002)	0.241	0.412 (0.002)	0.239	0.425 (0.002)	0.239	0.408 (0.002)
two boys	0.264	0.423 (0.002)	0.264	0.401 (0.002)	0.266	0.404 (0.002)	0.264	0.396 (0.002)
(1) one boy, one girl	0.494	0.372 (0.001)	0.495	0.344 (0.001)	0.494	0.346 (0.001)	0.497	0.331 (0.001)
(2) both same sex	0.506	0.432 (0.001)	0.505	0.407 (0.001)	0.506	0.414 (0.001)	0.503	0.401 (0.001)
difference (2) − (1)	—	0.060 (0.002)	—	0.063 (0.002)	—	0.068 (0.002)	—	0.070 (0.002)

Notes: The samples are the same as in Table 2. Standard errors are reported in parentheses.

AE-98: Wald Estimates

TABLE 5—WALD ESTIMATES OF LABOR-SUPPLY MODELS

	1980 PUMS			1990 PUMS			1980 PUMS		
		Wald estimate using as covariate:			Wald estimate using as covariate:			Wald estimate using as covariate:	
Variable	Mean difference by *Same sex*	*More than 2 children*	*Number of children*	Mean difference by *Same sex*	*More than 2 children*	*Number of children*	Mean difference by *Twins-2*	*More than 2 children*	*Number of children*
More than 2 children	0.0600 (0.0016)	—	—	0.0628 (0.0016)	—	—	0.6031 (0.0084)	—	—
Number of children	0.0765 (0.0026)	—	—	0.0836 (0.0025)	—	—	0.8094 (0.0139)	—	—
Worked for pay	−0.0080 (0.0016)	−0.133 (0.026)	−0.104 (0.021)	−0.0053 (0.0015)	−0.084 (0.024)	−0.063 (0.018)	−0.0459 (0.0086)	−0.076 (0.014)	−0.057 (0.011)
Weeks worked	−0.3826 (0.0709)	−6.38 (1.17)	−5.00 (0.92)	−0.3233 (0.0743)	−5.15 (1.17)	−3.87 (0.88)	−1.982 (0.386)	−3.28 (0.63)	−2.45 (0.47)
Hours/week	−0.3110 (0.0602)	−5.18 (1.00)	−4.07 (0.78)	−0.2363 (0.0620)	−3.76 (0.98)	−2.83 (0.73)	−1.979 (0.327)	−3.28 (0.54)	−2.44 (0.40)
Labor income	−132.5 (34.4)	−2208.8 (569.2)	−1732.4 (446.3)	−119.4 (42.4)	1901.4 (670.3)	1428.0 (502.6)	−570.8 (186.9)	−946.4 (308.6)	−705.2 (229.8)
ln(*Family income*)	−0.0018 (0.0041)	−0.029 (0.068)	−0.023 (0.054)	−0.0085 (0.0047)	−0.136 (0.074)	−0.102 (0.056)	−0.0341 (0.0223)	−0.057 (0.037)	−0.042 (0.027)

Notes: The samples are the same as in Table 2. Standard errors are reported in parentheses.

AE-98: 2SLS

TABLE 7—OLS AND 2SLS ESTIMATES OF LABOR-SUPPLY MODELS USING 1980 CENSUS DATA

	All women			Married women			Husbands of married women		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Estimation method	OLS	2SLS	2SLS	OLS	2SLS	2SLS	OLS	2SLS	2SLS
Instrument for *More than 2 children*	—	*Same sex*	*Two boys, Two girls*	—	*Same sex*	*Two boys, Two girls*	—	*Same sex*	*Two boys, Two girls*
Dependent variable:									
Worked for pay	−0.176	−0.120	−0.113	−0.167	−0.120	−0.113	−0.008	0.004	0.001
	(0.002)	(0.025)	(0.025)	(0.002)	(0.028)	(0.028)	(0.001)	(0.009)	(0.008)
			[0.013]			[0.013]			[0.013]
Weeks worked	−8.97	−5.66	−5.37	−8.05	−5.40	−5.16	−0.82	0.59	0.45
	(0.07)	(1.11)	(1.10)	(0.09)	(1.20)	(1.20)	(0.04)	(0.60)	(0.59)
			[0.017]			[0.071]			[0.030]
Hours/week	−6.66	−4.59	−4.37	−6.02	−4.83	−4.61	0.25	0.56	0.50
	(0.06)	(0.95)	(0.94)	(0.08)	(1.02)	(1.01)	(0.05)	(0.70)	(0.69)
			[0.030]			[0.049]			[0.71]
Labor income	−3768.2	−1960.5	−1870.4	−3165.7	−1344.8	−1321.2	−1505.5	−1248.1	−1382.3
	(35.4)	(541.5)	(538.5)	(42.0)	(569.2)	(565.9)	(103.5)	(1397.8)	(1388.9)
			[0.126]			[0.703]			(0.549)
ln(*Family income*)	−0.126	−0.038	−0.045	−0.132	−0.051	−0.053	—	—	—
	(0.004)	(0.064)	(0.064)	(0.004)	(0.056)	(0.056)			
			[0.319]			[0.743]			
ln(*Non-wife income*)	—	—	—	−0.053	0.023	0.016	—	—	—
				(0.005)	(0.066)	(0.066)			
						[0.297]			

Notes: The table reports estimates of the coefficient on the *More than 2 children* variable in equations (4) and (6) in the text. Other covariates in the models are *Age, Age at first birth,* plus indicators for *Boy 1st, Boy 2nd, Black, Hispanic,* and *Other race.* The variable *Boy 2nd* is excluded from equation (6). The *p*-value for the test of overidentifying restrictions associated with equation (6) is shown in brackets. Standard errors are reported in parentheses.

AE-98: Heterogenous Effects Predicted by Gronau (1977)!

TABLE 10—2SLS ESTIMATES OF LABOR-SUPPLY MODELS WITH INTERACTION TERMS USING 1990 CENSUS DATA

Sample/variables	*More than 2 children* First stage	*Worked for pay* Mean of dependent variable	OLS	2SLS	*Weeks/year* Mean of dependent variable	OLS	2SLS
A. Results for wives by *husband's earnings:*							
Bottom third of husband's earnings distribution	0.064 (0.003)	0.668	−0.160 (0.003)	−0.129 (0.045)	26.3	−8.8 (0.15)	−5.99 (2.18)
Middle third of husband's earnings distribution	0.076 (0.003)	0.728	−0.133 (0.003)	−0.151 (0.039)	29.8	−8.09 (0.15)	−8.37 (1.88)
Top third of husband's earnings distribution	0.071 (0.003)	0.61	−0.137 (0.003)	−0.029 (0.040)	23.6	−7.27 (0.14)	−2.74 (1.93)
B. Results for wives by *wife's education:*							
Wife < high-school graduate	0.069 (0.004)	0.531	−0.145 (0.004)	−0.257 (0.061)	19.2	−7.34 (0.20)	−12.9 (2.91)
Wife high-school graduate	0.078 (0.003)	0.661	−0.140 (0.003)	−0.100 (0.035)	26.3	−8.07 (0.14)	−5.57 (1.67)
Wife > high-school graduate	0.064 (0.002)	0.718	−0.147 (0.003)	−0.058 (0.038)	29.1	−8.43 (0.13)	−3.60 (1.84)
C. Results for wives by *wife's education* for women whose *husband's earnings* are in middle third:							
Wife < high-school graduate	0.073 (0.008)	0.579 —	−0.128 (0.008)	−0.279 (0.097)	21.7	−6.92 (0.37)	−15.4 (4.85)
Wife high-school graduate	0.082 (0.004)	0.707 —	−0.122 (0.005)	−0.204 (0.052)	28.8	−7.62 (0.23)	−9.20 (2.58)

Table 1. *Wald Estimates of the Effects of Family Size on Labor Supply*

			Twins Instrument		Same-Sex Instrument		Both
Dependent Variable	Mean	OLS (1)	First Stage (2)	Wald Estimates (3)	First Stage (4)	Wald Estimates (5)	2SLS Estimates (6)
Weeks worked	20.83	−8.98	0.603	−3.28	0.060	−6.36	−3.97
		(0.072)	(0.008)	(0.634)	(0.002)	(1.18)	(0.558)
	Overid: $\chi^2(1)$ (p-value)	—	—	—	—	—	5.3 (0.02)
Employment	0.565	−0.176		−0.076		−0.132	−0.088
		(0.002)		(0.014)		(0.026)	(0.012)
	Overid: $\chi^2(1)$ (p-value)	—	—	—	—	—	3.5 (0.06)

Note: The table reports OLS, Wald, and 2SLS estimates of the effects of a third birth on labor supply using twins and sex composition instruments. Data are from the Angrist and Evans (1998) extract from the 1980 U.S. census 5 percent sample, including women aged 21–35 with at least two children. OLS models include controls for mother's age, age at first birth, ages of the first two children, and dummies for race. The sample size is 394,840.

Table 2. *Complier Characteristics for Twins and Sex Composition Instruments*

Variable	Population Mean $E[x_{1i}]$ (1)	Mean for Twins Compliers $E[x_{1i}\|D_{1i} > D_{0i}]$ (2)	Mean for Twins Compliers $E[x_{1i}\|D_{1i} > D_{0i}]/E[x_{1i}]$ (3)	Mean for Same-Sex Compliers $E[x_{1i}\|D_{1i} > D_{0i}]$ (4)	Mean for Same-Sex Compliers $E[x_{1i}\|D_{1i} > D_{0i}]/E[x_{1i}]$ (5)
A. Dummy characteristics					
Age of second child is less than or equal to 4 years	0.343	0.449	1.31	0.194	0.565
High school graduate	0.488	0.498	1.02	0.515	1.06
Some college	0.202	0.212	1.05	0.212	1.05
College graduate	0.132	0.151	1.14	0.092	0.702
B. Discrete, ordered characteristics					
Age of second child	6.59	5.51	0.835	7.14	1.08
Mother's schooling	12.13	12.43	1.03	12.09	1.00

Note: The table reports an analysis of complier characteristics for twins and sex composition instruments. The ratios in columns 3 and 5 in Panel A give the relative likelihood that compliers have the characteristic indicated at left. The values in columns 2 and 4 in Panel B represent Abadie's (2003) kappa-weighted means. Data are from the 1980 census 5 percent sample including mothers aged 21–35 with at least two children, as in Angrist and Evans (1998). The sample size is 394,840.

3.3 Free child care and labor supply

- As we saw in 2020, public preschool and kindergarten equals free child care for many (How might this be parameterized in the context of our home production model?)
- In Gelbach (2002), children's quarter of birth is an instrument that identifies effects of public school enrollment on mothers' labor supply
  - Fitzpatrick (2012) updates Gelbach (2002), finding much smaller public-enrollment effects in more recent data

3.4 Pandemic school closures, childcare, and labor supply

- Garcia and Cowan (2021) identify causal effects of pandemic-related school closures on parents labor supply in a differences-in-differences event-study framework
  - Using monthly CPS data for 2020 and 2021, closures are defined as the share the share of schools in each county and month that are closed, where closed is determined by tracking cell phone usage near school buildings
  - The identification strategy is a two-way fixed effects model in which the treatment variable is closures interacted with the presence of school-age children in a CPS respondents' household and (sometimes) dummies for the presence of younger children not yet old enough to be enrolled in school

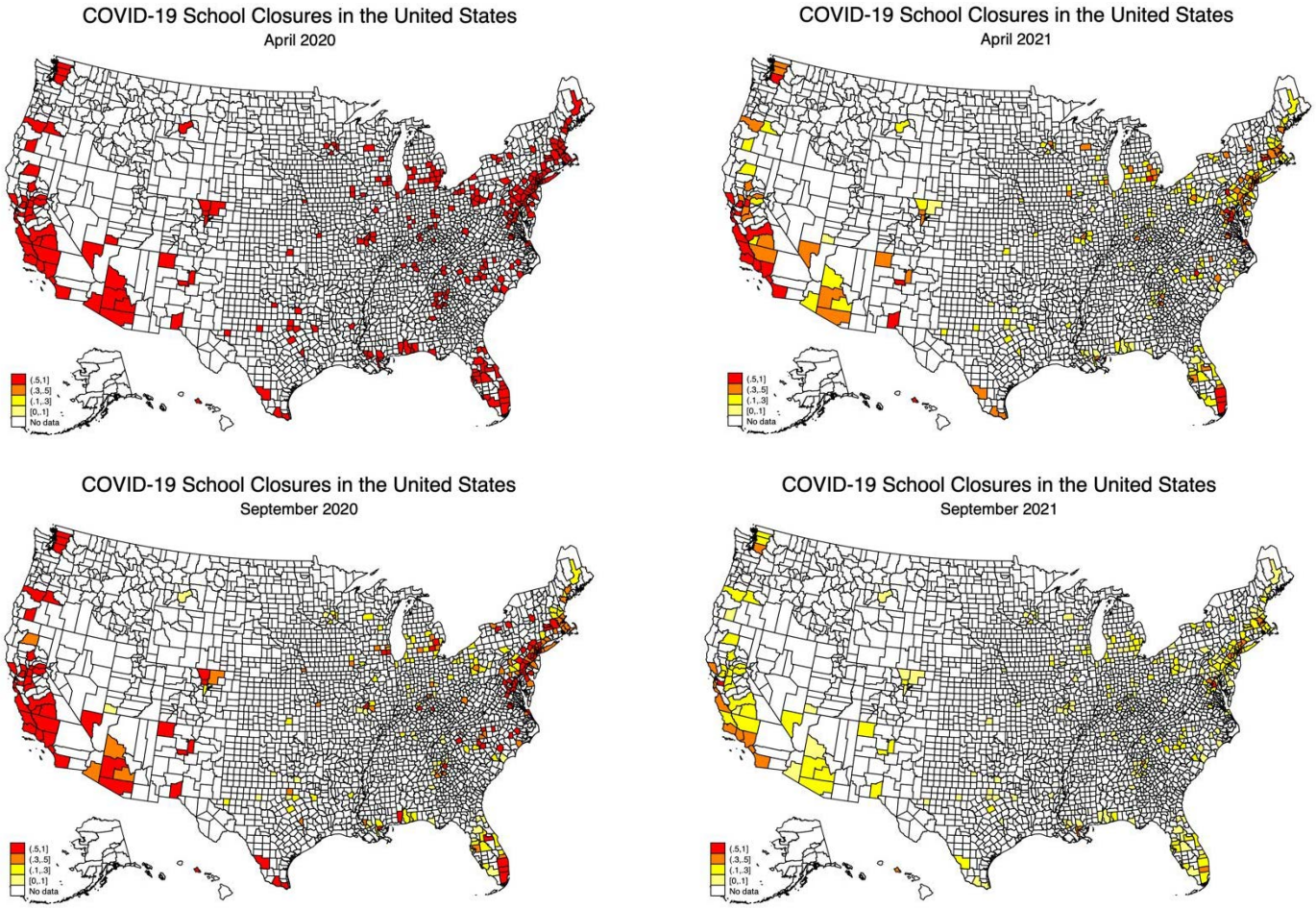


Figure 2. Percentage of school closures in CPS sample with county identifiers according to Parolin and Lee (2021) database, April 2020 & 2021, and September 2020 & 2021

Table 2. OLS Regressions on "At Work", "Full-time", "Hours Worked" and "Log of Weekly Earnings", Female

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	At work	At work	At work	Full-time	Full-time	Full-time	Hours worked	Hours worked	Hours worked	Log of Real Weekly Earnings	Log of Real Weekly Earnings	Log of Real Weekly Earnings
School closure	-0.016***	-0.015***	-0.015***	-0.010	-0.010	-0.009	-0.819***	-0.817***	-0.745***	-0.143**	-0.133*	-0.140**
	(0.005)	(0.005)	(0.005)	(0.008)	(0.008)	(0.008)	(0.265)	(0.261)	(0.264)	(0.068)	(0.068)	(0.070)
Presence of school-age children (5-17)	0.015***	0.003	0.011**	0.003	-0.013***	0.005	0.421***	-0.314**	0.425*	0.047	0.017	0.022
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.007)	(0.146)	(0.146)	(0.237)	(0.035)	(0.036)	(0.051)
School closure x presence of school-age children	-0.015***	-0.015***	-0.018***	-0.021***	-0.020***	-0.019***	-0.834***	-0.803***	-0.829***	-0.122*	-0.131*	-0.147*
	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.250)	(0.258)	(0.269)	(0.071)	(0.073)	(0.080)
Presence of young children only (0-4)		-0.041***			-0.061***			-2.746***			-0.062	
		(0.005)			(0.008)			(0.245)			(0.066)	
School closure x presence of young children only		-0.011			-0.003			0.031			-0.158	
		(0.012)			(0.014)			(0.533)			(0.137)	
Lag closure (past 3-6 months average)			0.001			-0.006			-0.305			0.023
			(0.007)			(0.011)			(0.412)			(0.095)
Lead closure (next 3-6 months average)			-0.011			-0.022			-0.715			-0.170
			(0.011)			(0.014)			(0.528)			(0.120)
Lag closure x presence of school-age children			0.009			0.004			0.140			0.005
			(0.006)			(0.009)			(0.318)			(0.073)
Lead closure x presence of school-age children			0.005			-0.011			-0.145			0.086
			(0.007)			(0.012)			(0.364)			(0.086)
N	348,278	348,278	348,278	348,278	348,278	292,865	348,278	348,278	348,278	90,461	90,461	90,461
R-squared	0.768	0.769	0.768	0.502	0.503	0.502	0.667	0.667	0.667	0.695	0.695	0.695

*** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses. School closures refer to the share of all schools in each county that had at least 50 percent year-on-year decline in in-person visits.

Table 3. OLS Regressions on "At Work", "Full-time", "Hours Worked" and "Log of Real Weekly Earnings", Male

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	At work	At work	At work	Full-time	Full-time	Full-time	Hours worked	Hours worked	Hours worked	Log of Real Weekly Earnings	Log of Real Weekly Earnings	Log of Real Weekly Earnings
School closure	0.002	0.003	0.001	0.006	0.009	0.005	0.015	0.098	-0.091	0.091	0.090	0.089
	(0.006)	(0.006)	(0.006)	(0.009)	(0.009)	(0.009)	(0.303)	(0.307)	(0.312)	(0.086)	(0.088)	(0.094)
Presence of school-age children (5-17)	0.007**	0.007*	0.008	0.024***	0.027***	0.024***	0.978***	1.087***	1.245***	0.117**	0.164***	0.077
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.007)	(0.191)	(0.218)	(0.284)	(0.051)	(0.058)	(0.068)
School closure x presence of school-age children	-0.007	-0.008	-0.007	-0.034***	-0.037***	-0.034***	-1.290***	-1.374***	-1.042***	-0.118	-0.117	-0.156
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.268)	(0.269)	(0.326)	(0.080)	(0.081)	(0.101)
Presence of young children only (0-4)		0.004			0.028***			0.875***			0.160**	
		(0.005)			(0.008)			(0.303)			(0.081)	
School closure x presence of young children only		-0.008			-0.051***			-1.495***			0.023	
		(0.010)			(0.013)			(0.575)			(0.154)	
Lag closure (past 3-6 months average)			0.008			0.007			0.412			0.044
			(0.009)			(0.012)			(0.479)			(0.115)
Lead closure (next 3-6 months average)			-0.019*			-0.024			-0.602			-0.137
			(0.012)			(0.017)			(0.707)			(0.146)
Lag closure x presence of school-age children			-0.002			0.011			-0.438			0.049
			(0.006)			(0.009)			(0.374)			(0.099)
Lead closure x presence of school-age children			0.000			-0.011			-0.551			0.101
			(0.007)			(0.010)			(0.438)			(0.110)
N	312,703	312,703	312,703	312,703	312,703	312,703	312,703	312,703	312,703	80,932	80,932	80,932
R-squared	0.727	0.727	0.728	0.517	0.517	0.517	0.622	0.622	0.622	0.580	0.580	0.580

*** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses. School closures refer to the share of all schools in each county that had at least 50 percent year-on-year decline in in-person visits.

Table 5. OLS Regressions on "At Work", "Full-time", "Hours Worked", "Log of Real Weekly Earnings", "Remote Work due to COVID", Female

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	At Work	Full-time	Work Hours	Log of Real Weekly Earnings	Remote Work due to COVID	At Work	Full-time	Work Hours	Log of Real Weekly Earnings	Remote Work due to COVID
Panel A			College					Less than College		
School closure x presence of school-age children	-0.006	0.002	-0.034	-0.049	0.081***	-0.024***	-0.040***	-1.459***	-0.162**	0.017***
	(0.008)	(0.013)	(0.435)	(0.110)	(0.009)	(0.007)	(0.008)	(0.285)	(0.079)	(0.005)
N	143,990	143,990	143,990	37,431	143,990	204,288	204,288	204,288	53,030	204,288
Panel B			Married					Not Married		
School closure x presence of school-age children	-0.015***	-0.023***	-0.789***	-0.150**	0.058***	-0.029***	-0.038***	-1.647***	-0.201*	0.009
	(0.005)	(0.009)	(0.285)	(0.072)	(0.008)	(0.011)	(0.011)	(0.414)	(0.113)	(0.009)
N	175,245	175,245	175,245	45,229	175,245	173,033	173,033	173,033	45,232	173,033
Panel C			White					Non-white		
School closure x presence of school-age children	-0.014**	-0.027***	-0.962***	-0.127*	0.045***	-0.010	-0.007	-0.303	-0.064	0.057***
	(0.006)	(0.008)	(0.294)	(0.072)	(0.008)	(0.011)	(0.014)	(0.510)	(0.139)	(0.010)
N	263,009	263,009	263,009	68,187	263,009	85,269	85,269	85,269	22,274	85,269
Panel D			Teleworkability = 1					Teleworkability < 1		
School closure x presence of school-age children	0.002	-0.004	0.093	-0.125	0.045***	-0.021***	-0.026***	-1.108***	-0.096	0.016***
	(0.009)	(0.014)	(0.451)	(0.121)	(0.014)	(0.007)	(0.008)	(0.299)	(0.087)	(0.004)
N	91,363	91,363	91,363	24,515	91,363	256,915	256,915	256,915	65,946	256,915
Panel E			Frontline Industry					Non-frontline Industry		
School closure x presence of school-age children	-0.009	-0.014	-0.337	-0.133	0.016	-0.015**	-0.019**	-0.820***	-0.123	0.056***
	(0.015)	(0.018)	(0.609)	(0.149)	(0.012)	(0.007)	(0.008)	(0.309)	(0.076)	(0.008)
N	54,139	54,139	54,139	14,500	54,139	294,139	294,139	294,139	75,961	294,139

(1) *** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses. School closures refer to the share of all schools in each county that had at least 50 percent year-on-year decline in in-person visits.

(2) Teleworkability values are based on Dingel and Neiman (2020): https://github.com/jdingel/DingelNeiman-workathome/blob/master/onet_to_BLS_crosswalk/output/onet_teleworkable_blscodes.csv.

(3) Frontline industry classification is based on the classification from Rho et al. (2020): https://cepr.net/a-basic-demographic-profile-of-workers-in-frontline-industries/.

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