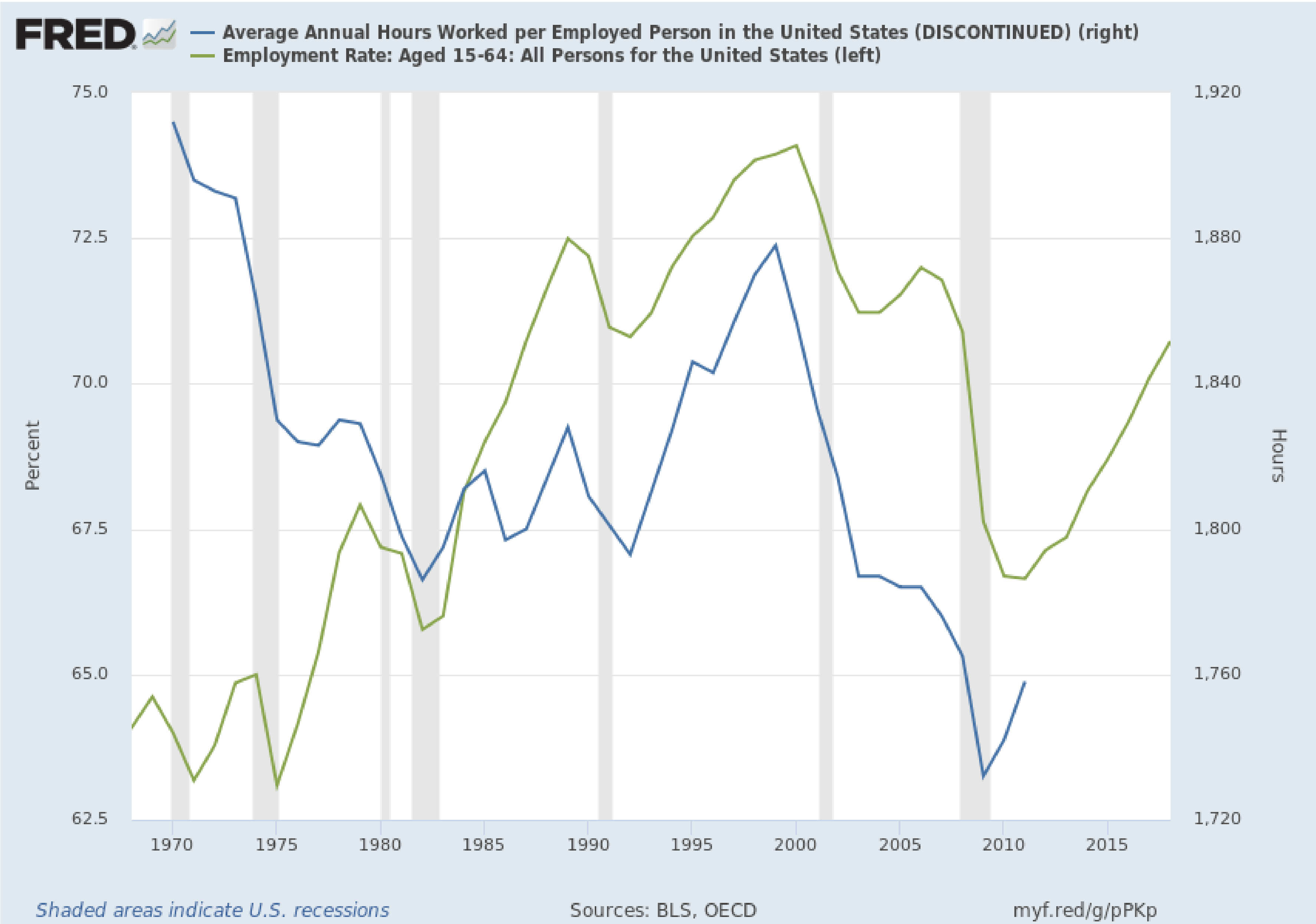
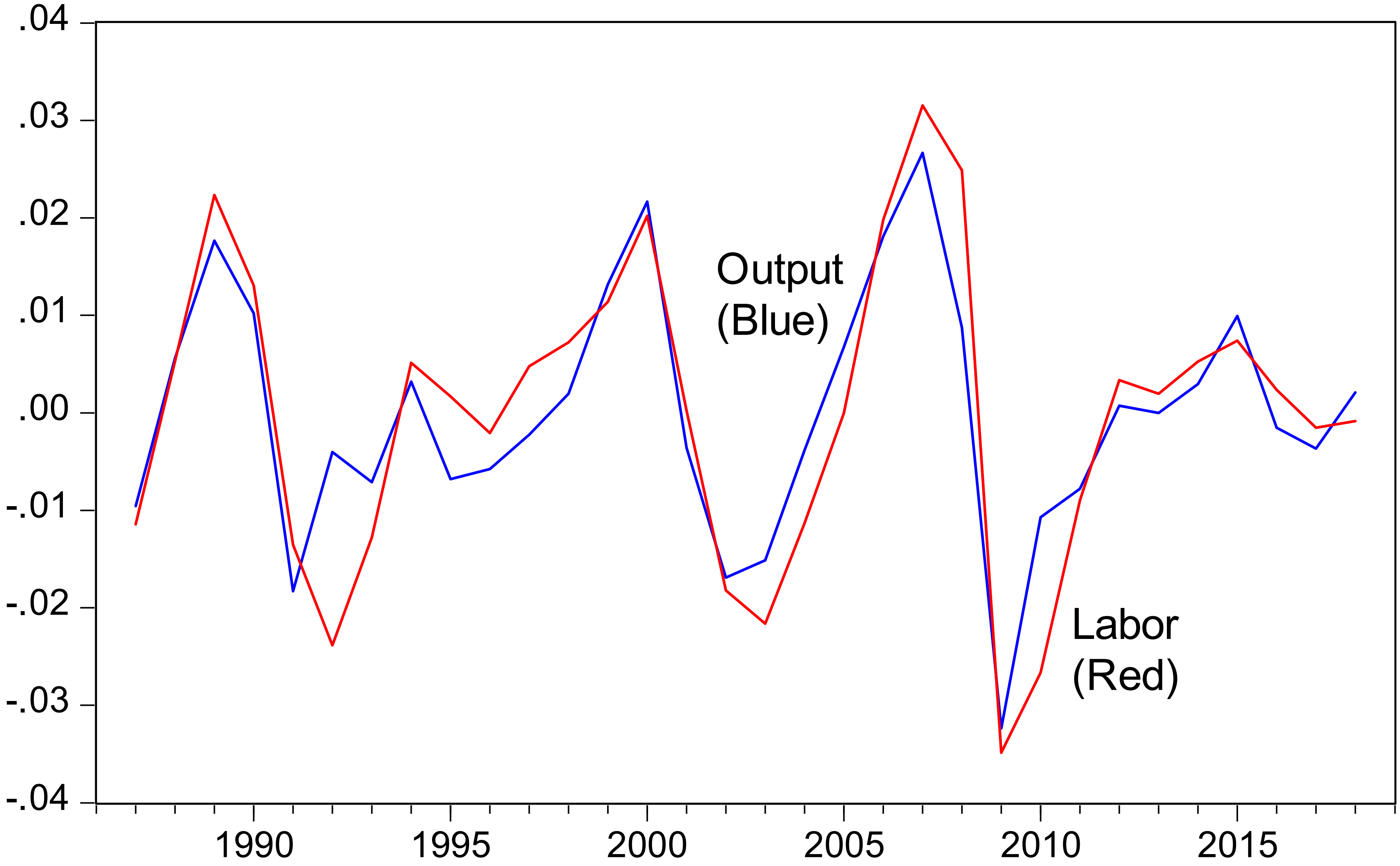
Overview and Labor Wedge

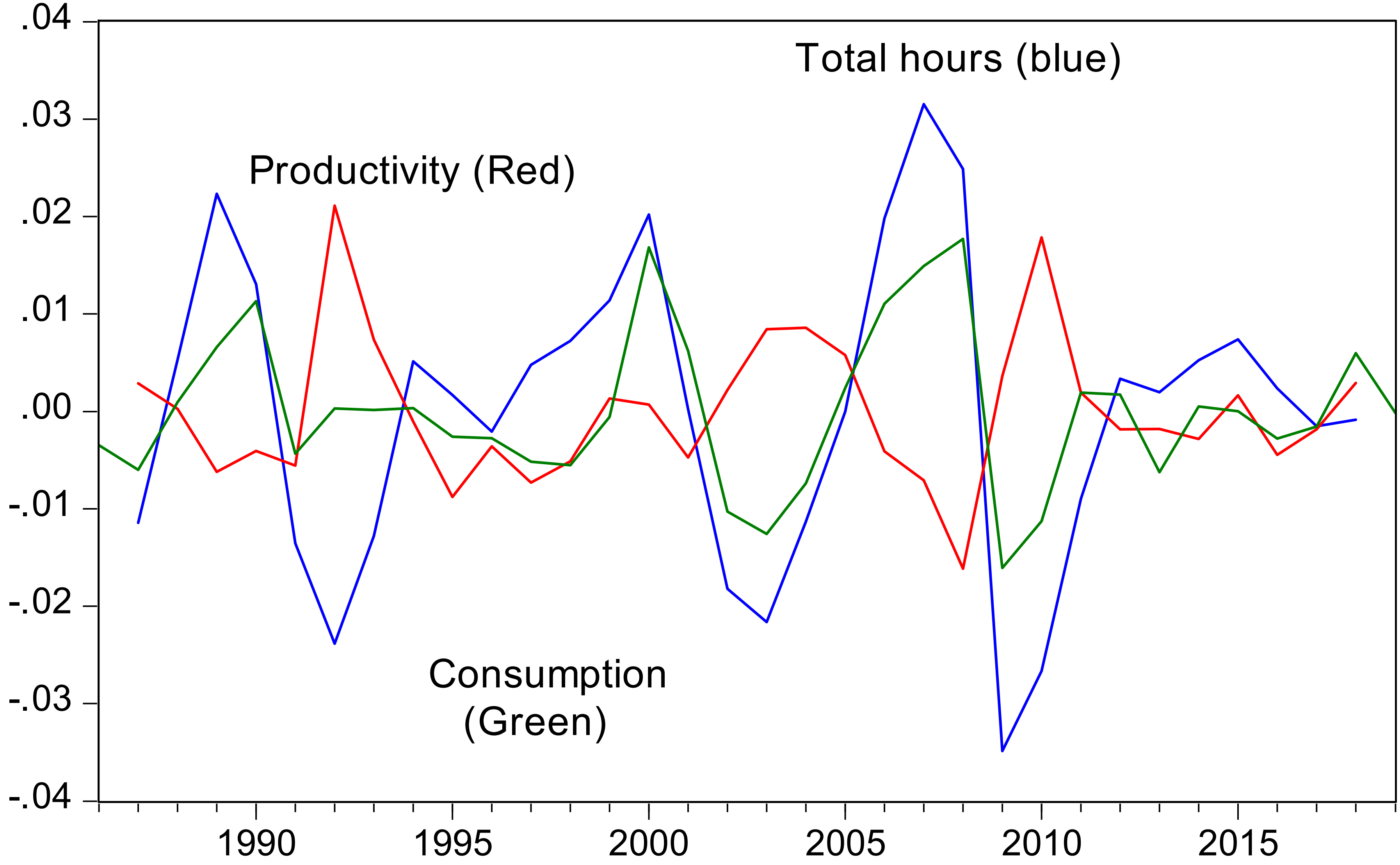
U.S. Emp/Pop and Hours per Worker



Cyclicality: Real Output and Total Hours (Private sector, HP filtered)



Cyclicality: Labor Productivity and Consumption (HP filtered, Cons = Nondurs and Services)

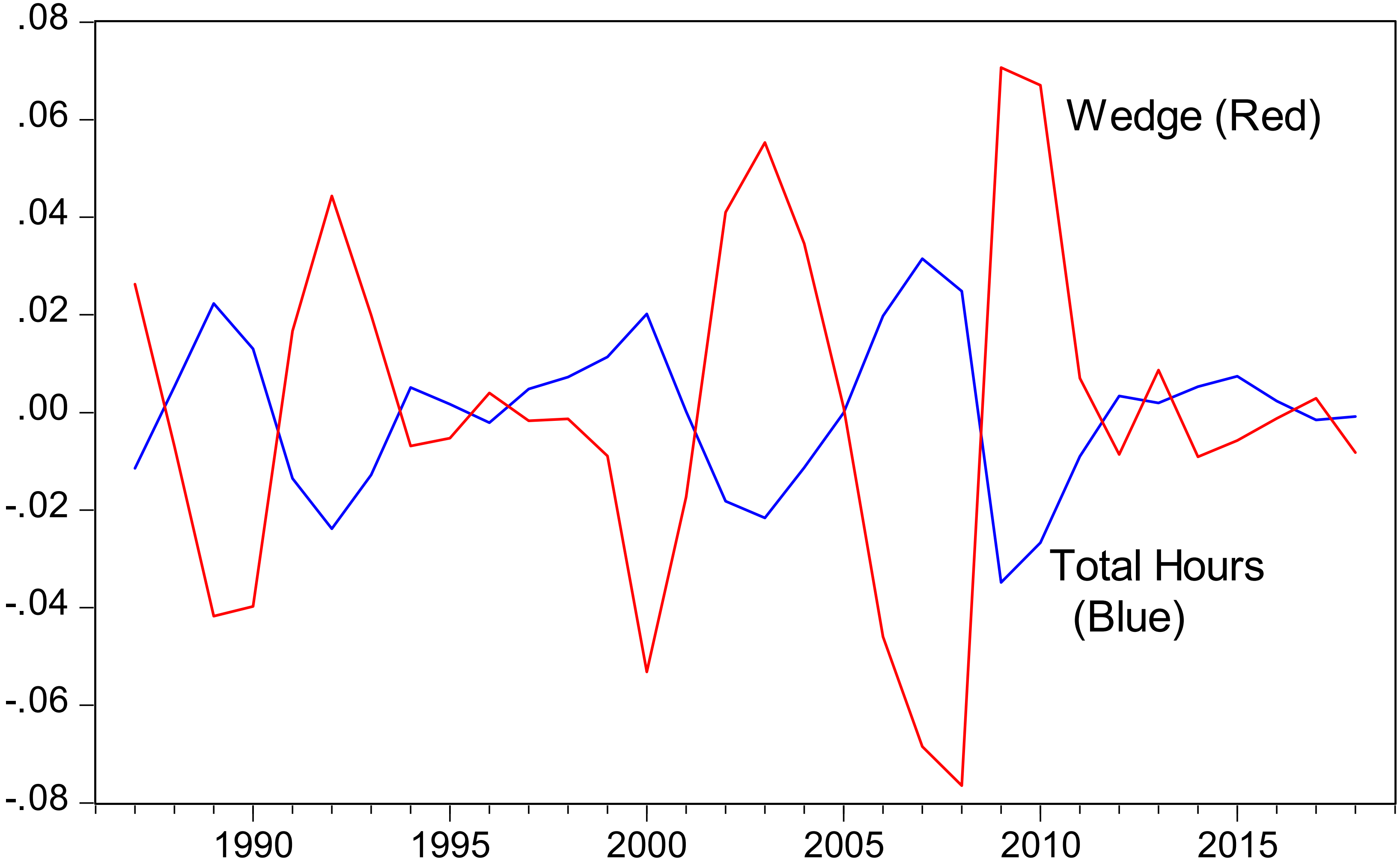


U.S. Labor Wedge, 1987 to 2018

	Elasticity with respect to:	
	Real GDP	Total Hours
Labor Productivity	− 0.26 (.10)	− 0.33 (.08)
Total hours	1.48 (.10)	1
Consumption	0.71 (08)	0.43 (.06)
Wedge	− 3.16 (.31)	− 2.19 (.11)

Notes: Total hours and labor productivity is for private economy; GDP includes government sector. Consumption is nondurables and services. Sample covers 1987 to 2018. All series are logged and HP-filtered. The wedge assumes an IES of 0.5 and a Frisch of 1.0.

Cyclicality in Wedge versus Total Hours



Uses Frisch of one, IES of one-half

Labor Supply

Boppart and Krusell Overview

- Standard Macro model assumes balanced growth path, with constant hours worked
  - But data show declining hours (will see figures)
  - Looks roughly like linear trend (constant negative growth rate) in Ln(hours)

- Is also consistent with higher hours worked in poorer countries (Bick et. al., will show below)

- Consider preferences that produce balanced growth with declining hours: requires stronger wealth effect on leisure than in KPR

Intuition for Preferences

In compact terms, one can describe the period utility function under KPR as a power function of $cv(h)$, where c is consumption and h hours worked and v is an arbitrary (decreasing) function. What we show in our main Theorem 1 is that the broader class has the same form: period utility is a power function of $cv(hc^{\frac{\nu}{1-\nu}})$, where $\nu < 1$ is the preference parameter that guides how fast hours shrink relative to productivity. In terms of gross rates, if productivity grows at rate γ, then hours grow at rate $\gamma^{-\nu}$, whereas consumption grows at $\gamma^{1-\nu}$. For $\nu > 0$, the factor $c^{\frac{\nu}{1-\nu}}$ captures the stronger income effect: as consumption grows, there is an added "penalty" to working (since v is decreasing). Our preference class obviously nests KPR: KPR corresponds to $\nu = 0$.

Little trend in U.S. hours post WWII

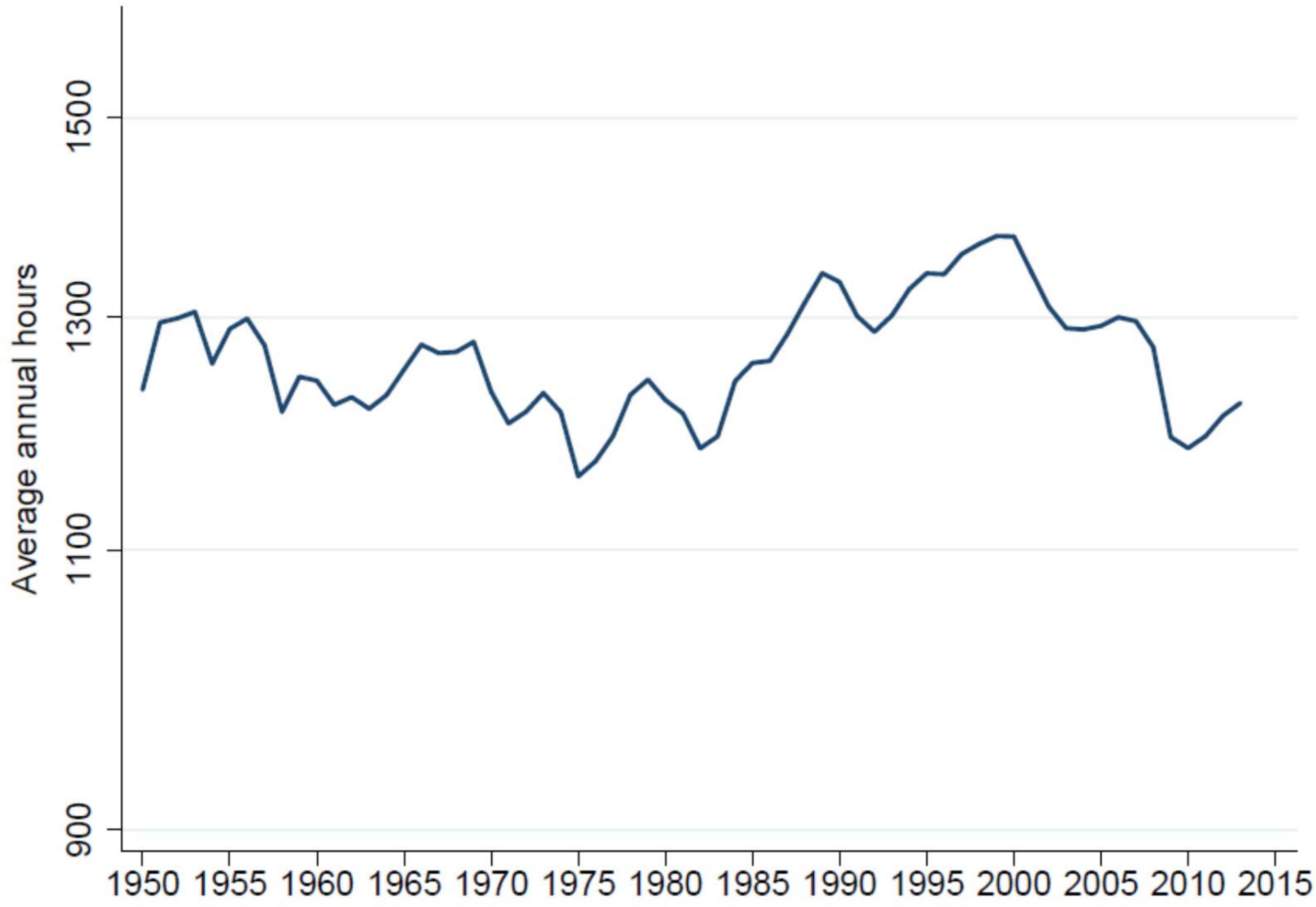
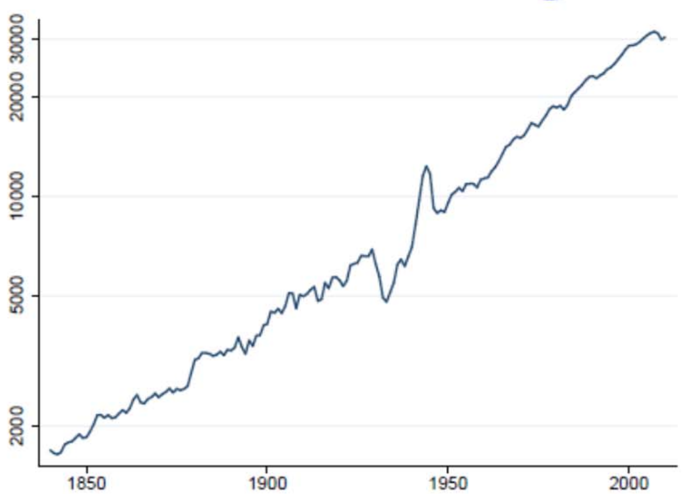


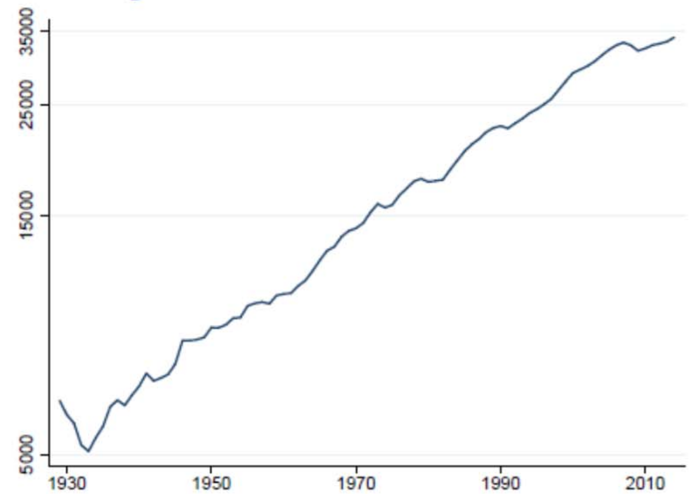
Figure: **U.S. average annual hours per capita aged 15–64, 1950–2013**

Notes: Source: GGDC Total Economy Database for total hours worked and OECD for the data on population aged 15–64. The figure is comparable to the ones in Rogerson (2006). Regressing the logarithm of hours worked on time gives an insignificant slope coefficient.

U.S. balanced growth stylized facts



(a) GDP per capita



(b) Consumption per capita

(c) Consumption-output ratio

(d) Capital-output ratio

But decline in many countries

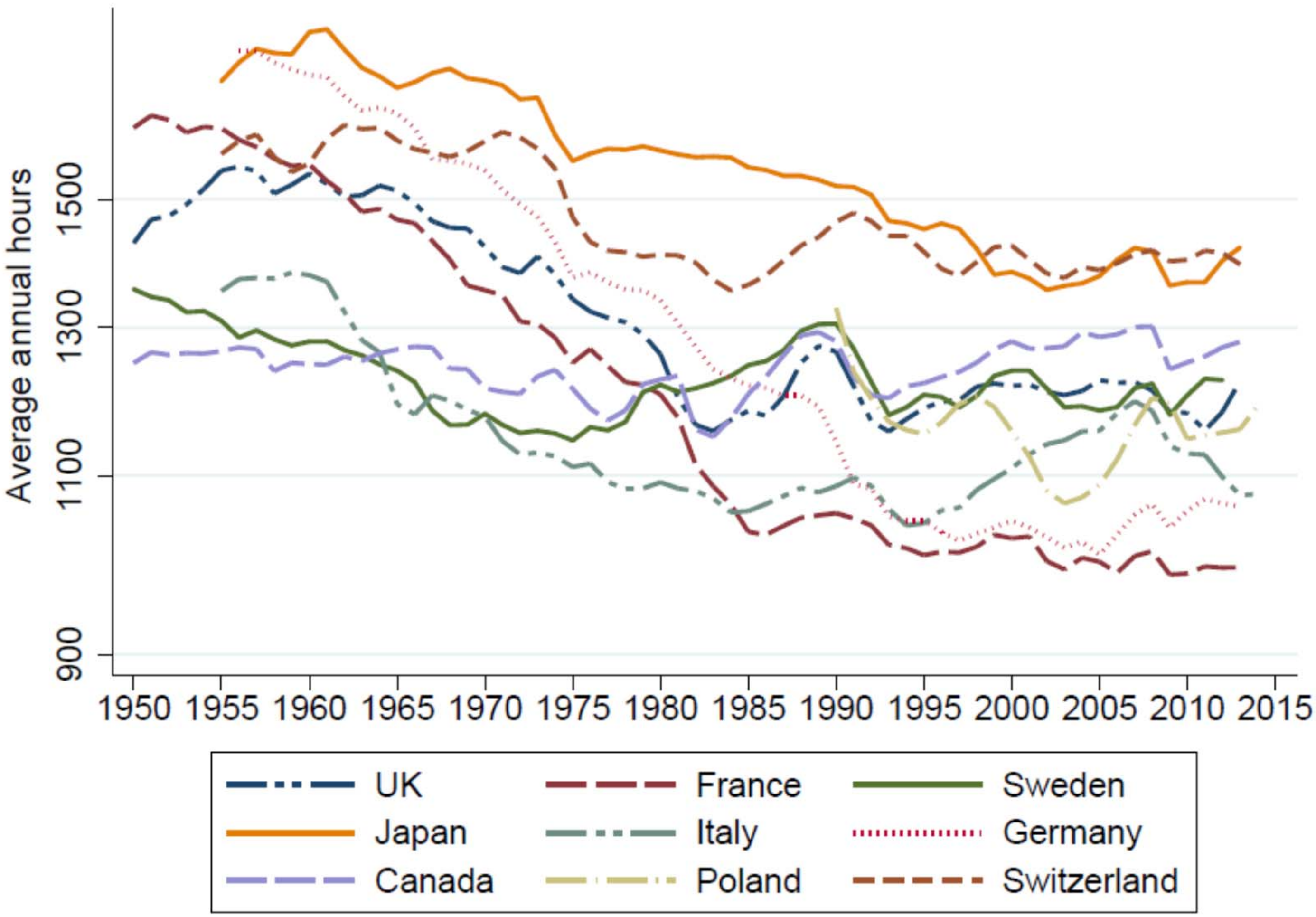


Figure: **Selected countries average annual hours per capita aged 15–64, 1950–2015**

Notes: Source: GGDC Total Economy Database for total hours worked and OECD for the data on population aged 15–64. The figure is comparable to the ones in Rogerson (2006). Regressing the logarithm of hours worked on time gives a slope coefficient of -0.00455.

Declined historically in U.S.

U.S. data including the pre-war period

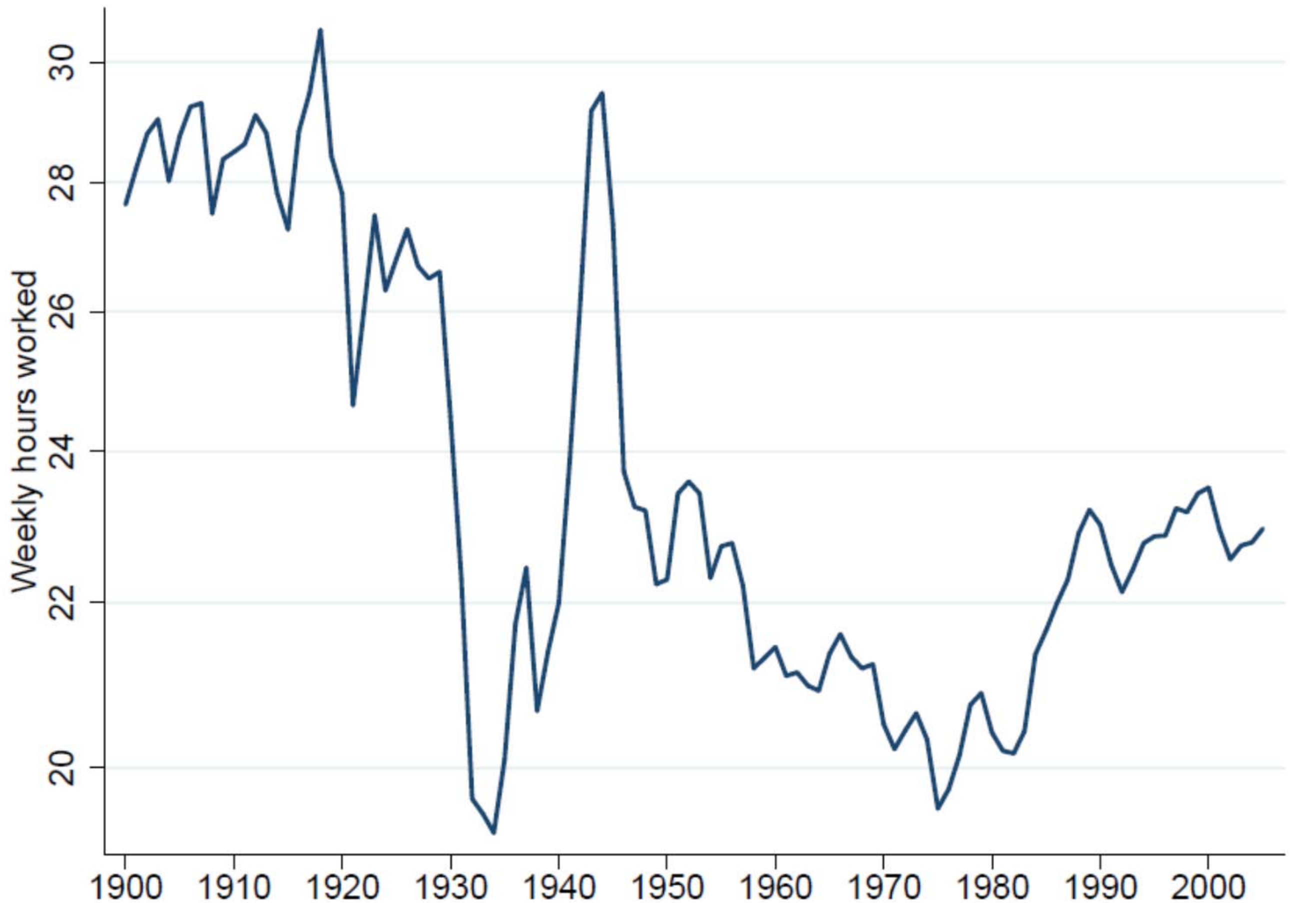
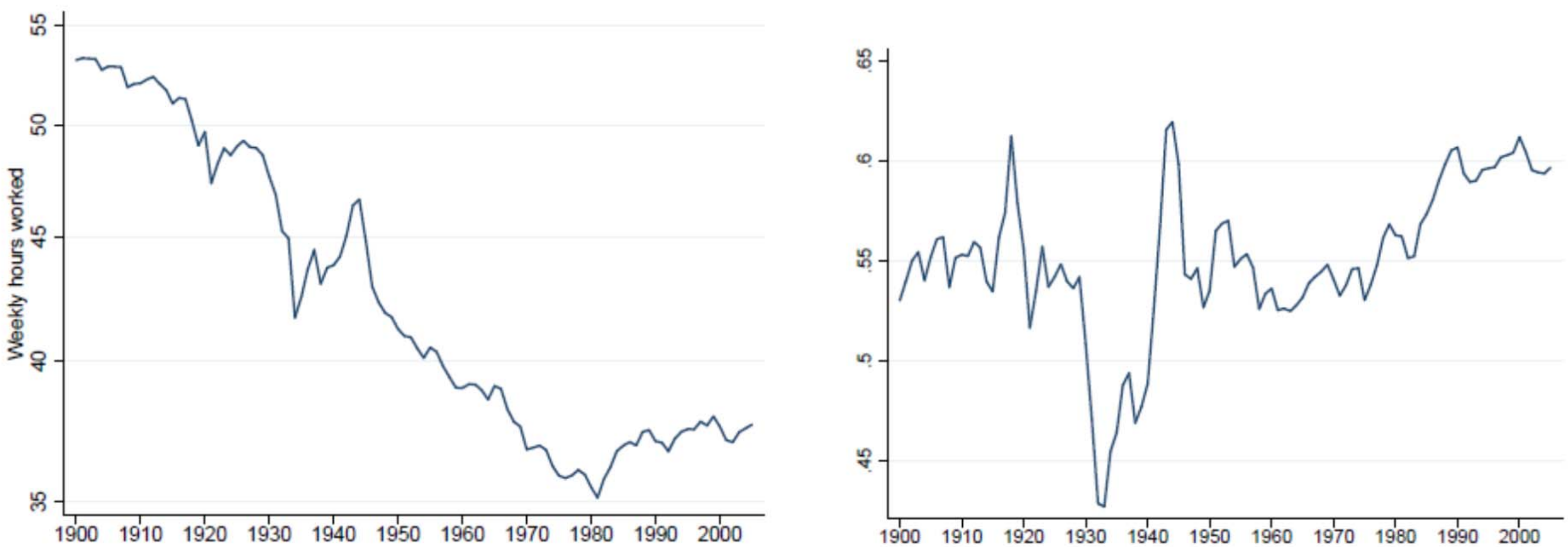


Figure: **Weekly hours worked per population aged 14+, 1900–2005**

Notes: Source: Ramey and Francis (2009). Regressing the logarithm of hours worked on time gives slope coefficient of -0.00285.

At intensive margin

Intensive and extensive margin over 100+ years



(a) Hours per worker (b) Participation rate

Figure: Hours per worker and participation rate in the U.S.

Notes: The scale is logarithmic in the figure on hours worked per worker. Regressing the logarithm of hours worked per worker on time gives slope coefficient of -0.00418. Source: Ramey and Francis (2009).

U.S. workweek back to 1830

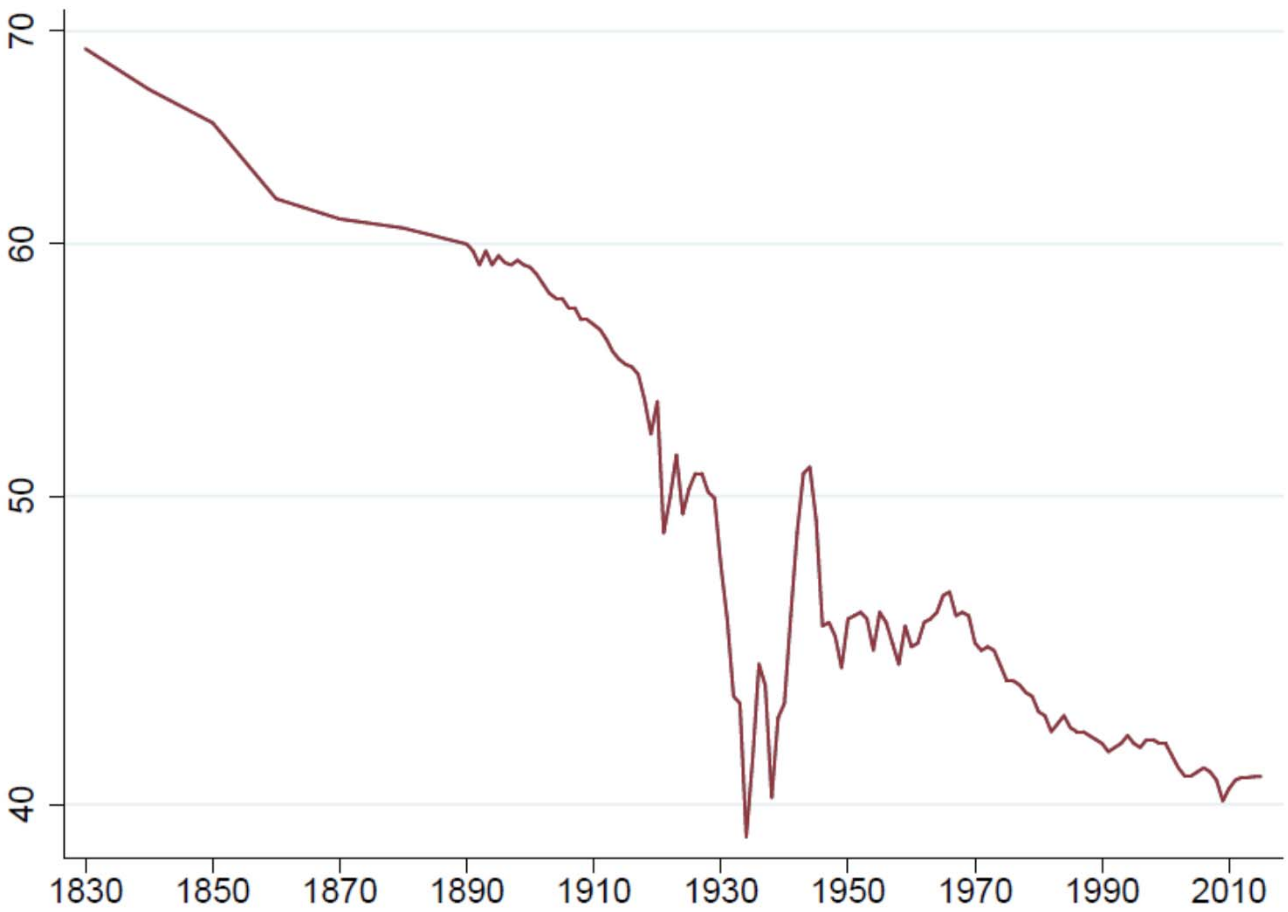


Figure: **U.S. weekly hours worked in nonfarm establishments 1830–2015**

Source: Average weekly hours data for 1830–80: Whaples (1990, Table 2.1). 1890-1970: Historical Statistics of the United States: Colonial Times to 1970 (Series D765 and D803). 1970–2015: Statistical Abstract of the United States the number for nonfarm establishments. This graph shows an updates series of the data in Greenwood and Vandenbroucke (2008). Regressing the log of hours on a constant and year gives a slope coefficient of -0.00315 in the full sample (and -0.00208 for the years 1970–2015).

Declined historically elsewhere

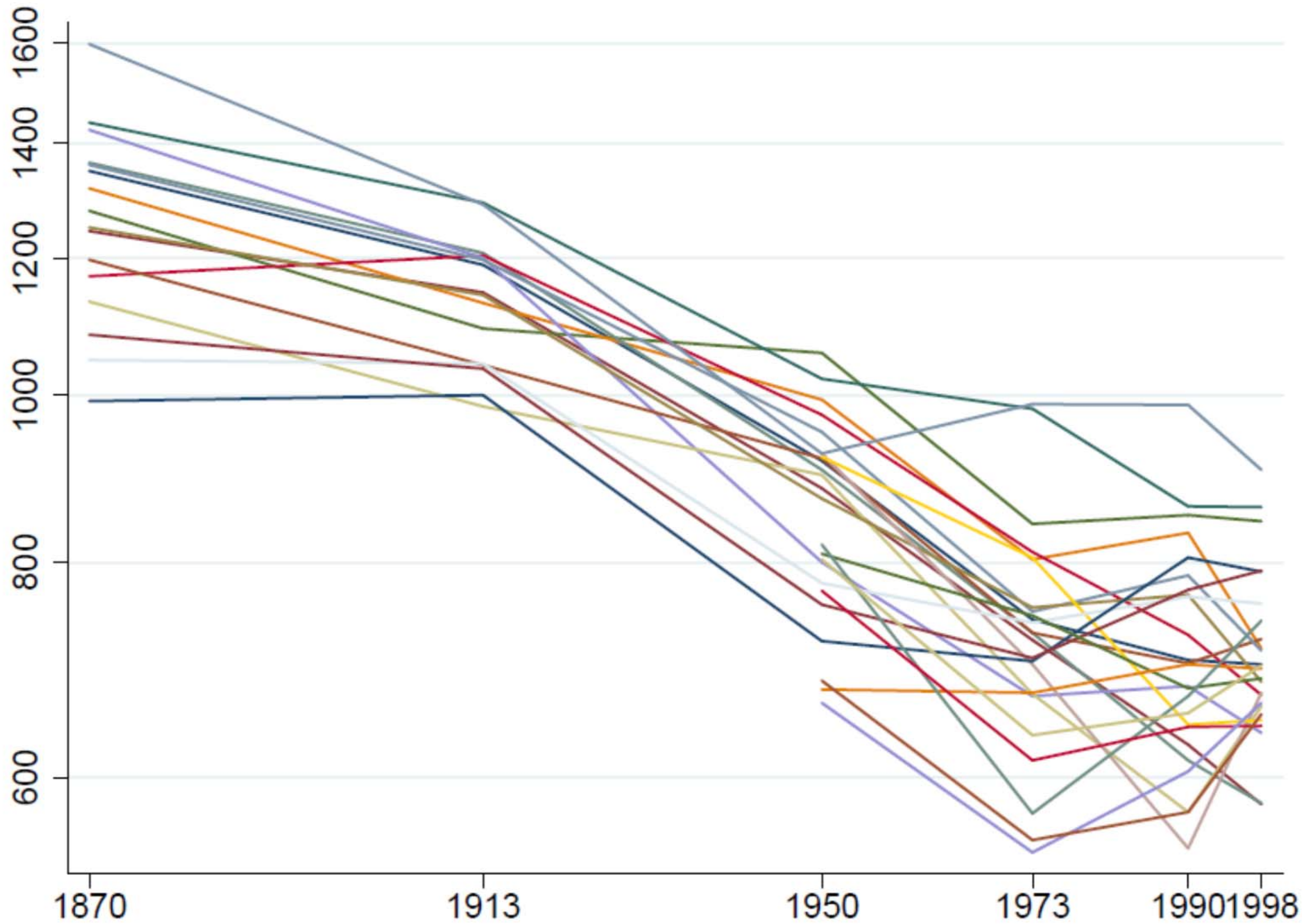


Figure: **Yearly hours worked per capita 1870–1998**

Source: Maddison (2001). The sample includes the following 25 countries: Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Sweden, Switzerland, United Kingdom, Ireland, Spain, Australia, Canada, United States, Argentina, Brazil, Chile, Colombia, Mexico, Peru, Venezuela, Japan. Regressing the log of hours on a country fixed effect and year gives a slope coefficient of -0.00462 in the full sample (and -0.00398 for the period 1950–1998).

So post WWII not representative

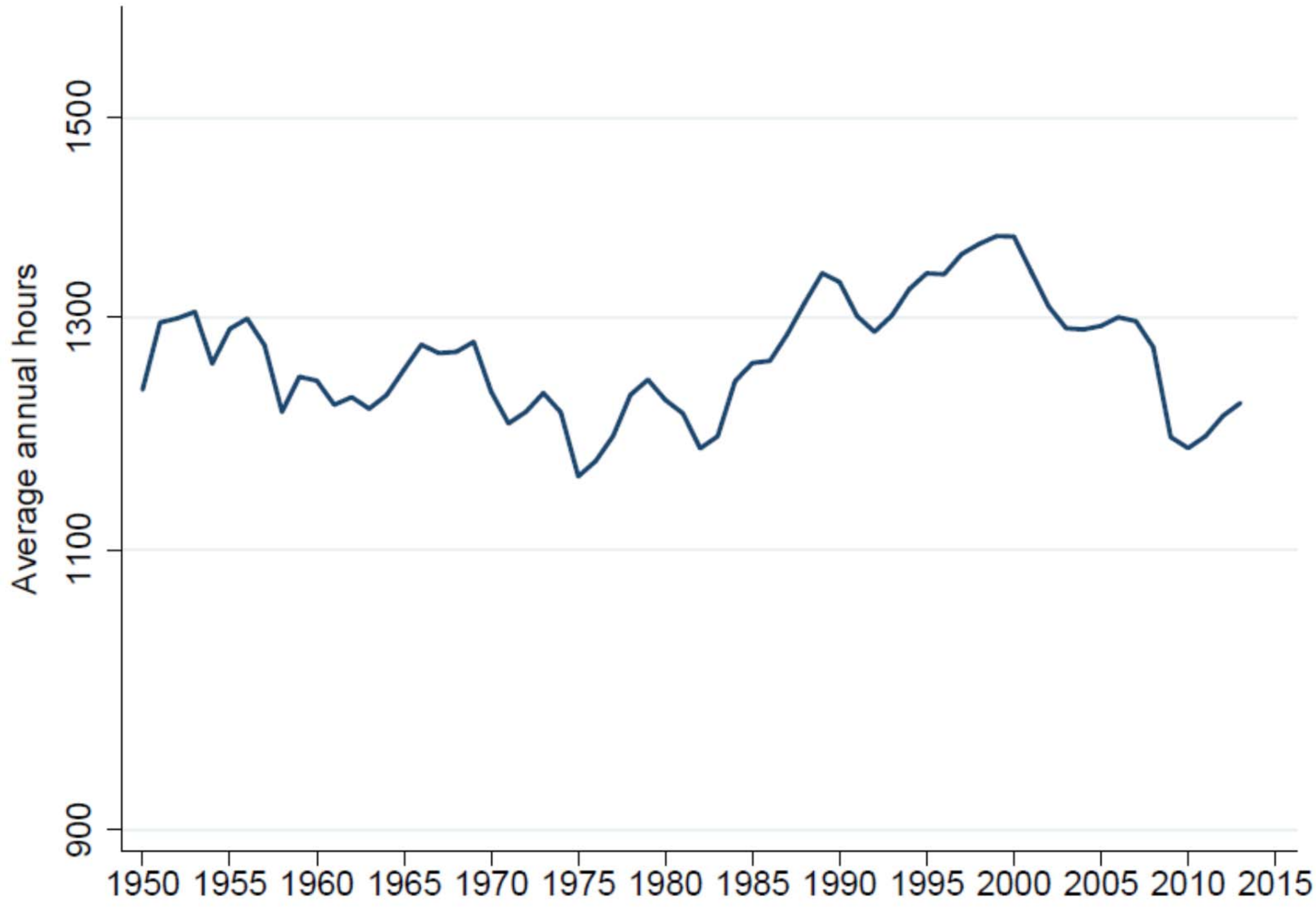


Figure: **U.S. average annual hours per capita aged 15–64, 1950–2013**

Notes: Source: GGDC Total Economy Database for total hours worked and OECD for the data on population aged 15–64. The figure is comparable to the ones in Rogerson (2006). Regressing the logarithm of hours worked on time gives an insignificant slope coefficient.

Important caveats

- **Leisure has notably increased (Aguiar & Hurst)**

Leisure since 1965, Aguiar & Hurst

HOURS PER WEEK SPENT IN LEISURE FOR FULL SAMPLE, MEN, AND WOMEN

Time-use category (hours per week)	Average hours per week spent in leisure					
	1965	1975	1985	1993	2003	Difference: 2003–1965
Panel 1: Full sample						
Leisure Measure 1	30.77	33.24	34.78	37.47	35.33	4.56
Leisure Measure 2	102.23	106.62	107.82	110.04	107.73	5.50
Leisure Measure 3	105.90	109.74	111.46	113.16	113.23	7.33
Leisure Measure 4	109.93	114.06	114.33	116.39	117.98	8.05
Panel 2: Men						
Leisure Measure 1	31.80	33.36	35.15	37.65	37.40	5.60
Leisure Measure 2	101.68	105.33	106.81	108.50	107.88	6.20
Leisure Measure 3	103.12	106.73	108.47	109.97	111.13	8.01
Leisure Measure 4	106.75	110.62	110.68	112.82	115.04	8.29
Panel 3: Women						
Leisure Measure 1	29.89	33.14	34.46	37.32	33.54	3.65
Leisure Measure 2	102.70	107.75	108.69	111.38	107.59	4.89
Leisure Measure 3	108.31	112.35	114.05	115.92	115.06	6.75
Leisure Measure 4	112.69	117.05	117.49	119.48	120.52	7.83

All means are calculated using fixed demographic weights, as described in the text. Leisure Measure 1 refers to the time individuals spent socializing, in passive leisure, in active leisure, volunteering, in pet care, and gardening. Leisure Measure 2 refers to the time individuals spent in Leisure Measure 1 plus time spent sleeping, eating, and in personal activities (excluding own medical care). Leisure Measure 3 includes Leisure Measure 2 plus time spent in child care. Leisure Measure 4 is defined as any time not allocated to market or nonmarket work. See Table IX and text for additional detail. The relevant sample sizes are as reported in Table II. The sample restrictions are described in the footnote to Table I.

Leisure since 1965, Aguiar & Hurst

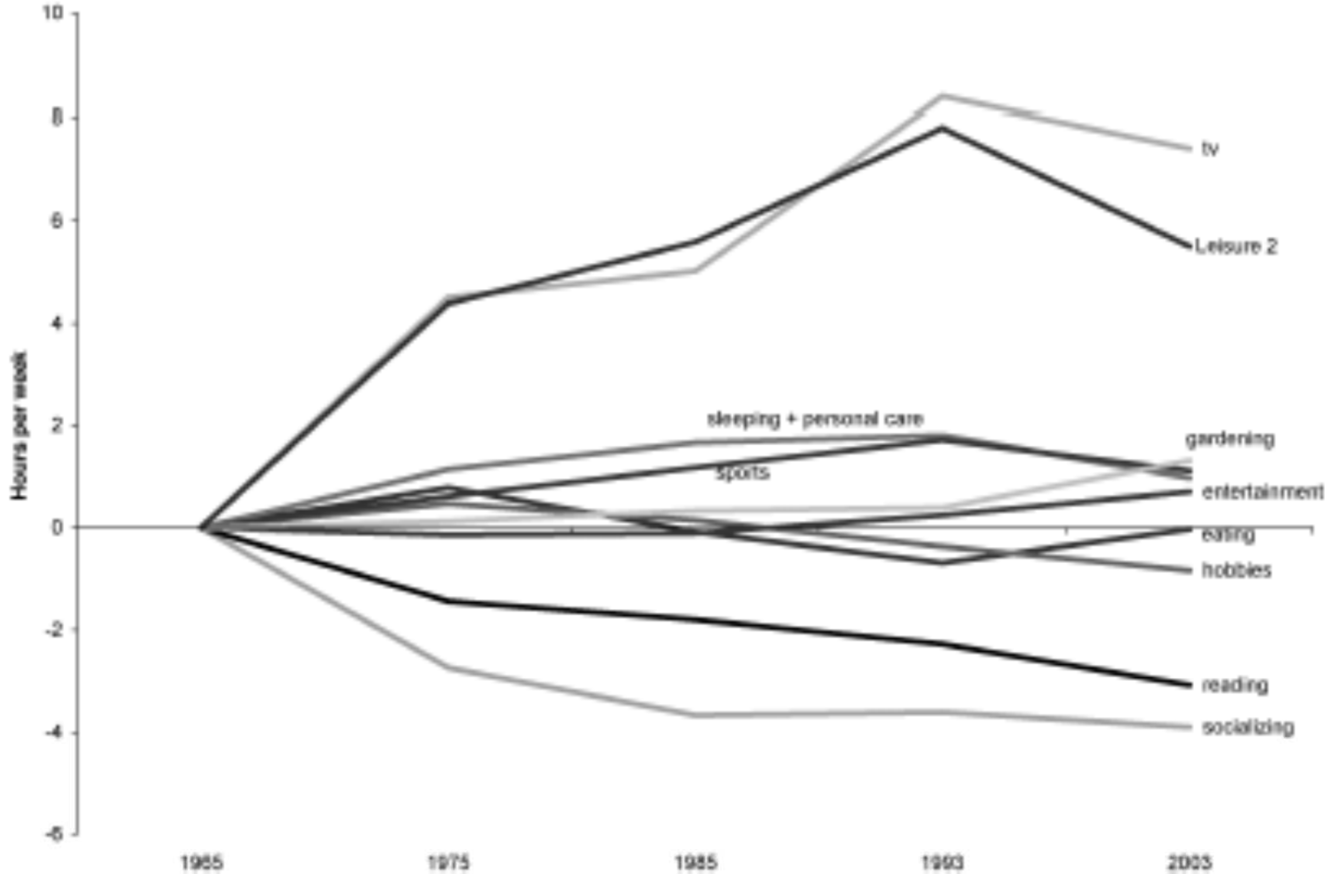


FIGURE I

Breakdown of Leisure by Activity, Deviations from 1965

This figure plots the evolution of the subcomponents of Leisure 2 for the full sample, represented as differences from each subcomponent's mean in 1965. All means are calculated using fixed demographic weights, as described in the text.

Rise in leisure inequality

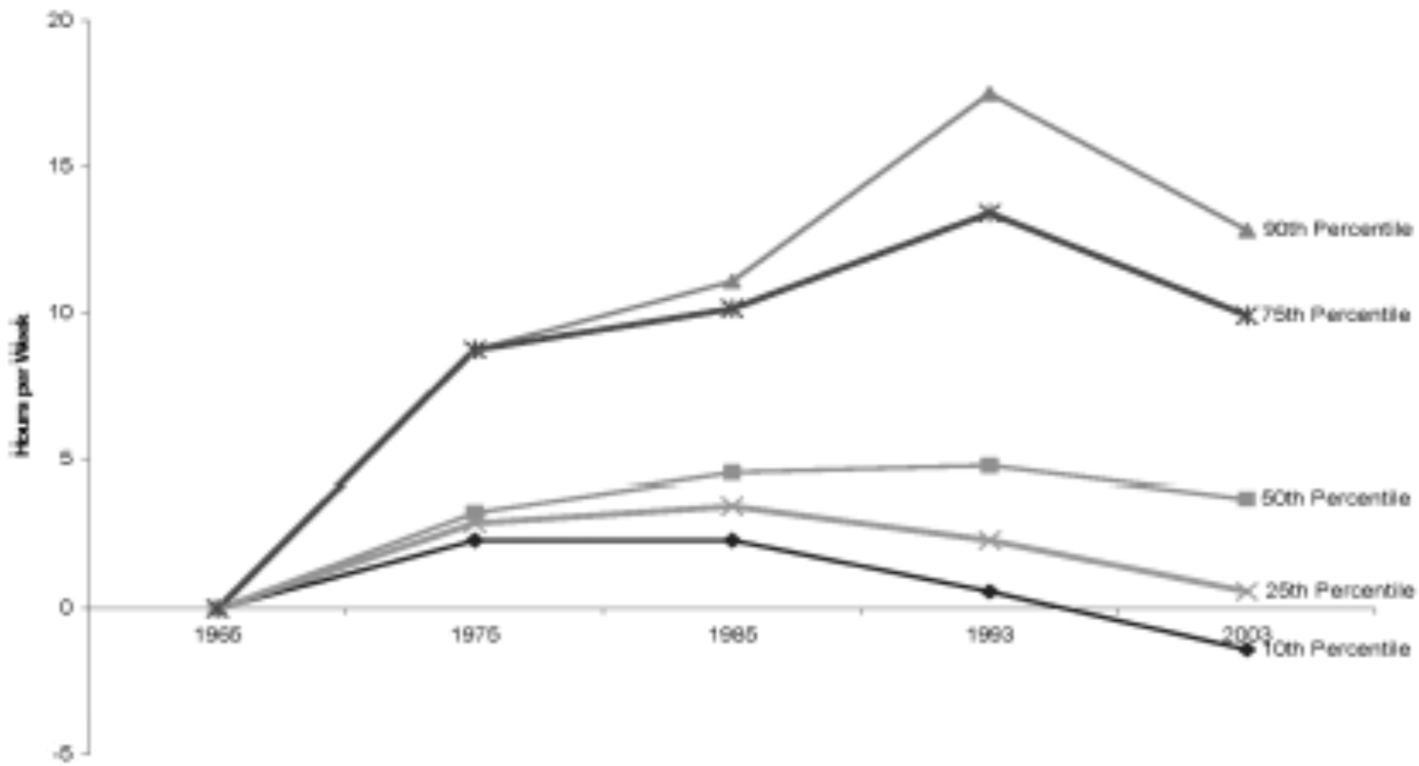


FIGURE II

Key Percentiles of Leisure 2 Distribution, Deviations from 1965

This figure plots the evolution of key percentiles of the cross-sectional distribution of Leisure 2 for the full sample, represented as differences from each percentile point's value in 1965. The percentile points represent the unconditional sample distribution in each year, unadjusted for demographic changes.

Leisure shifted to lower-waged workers

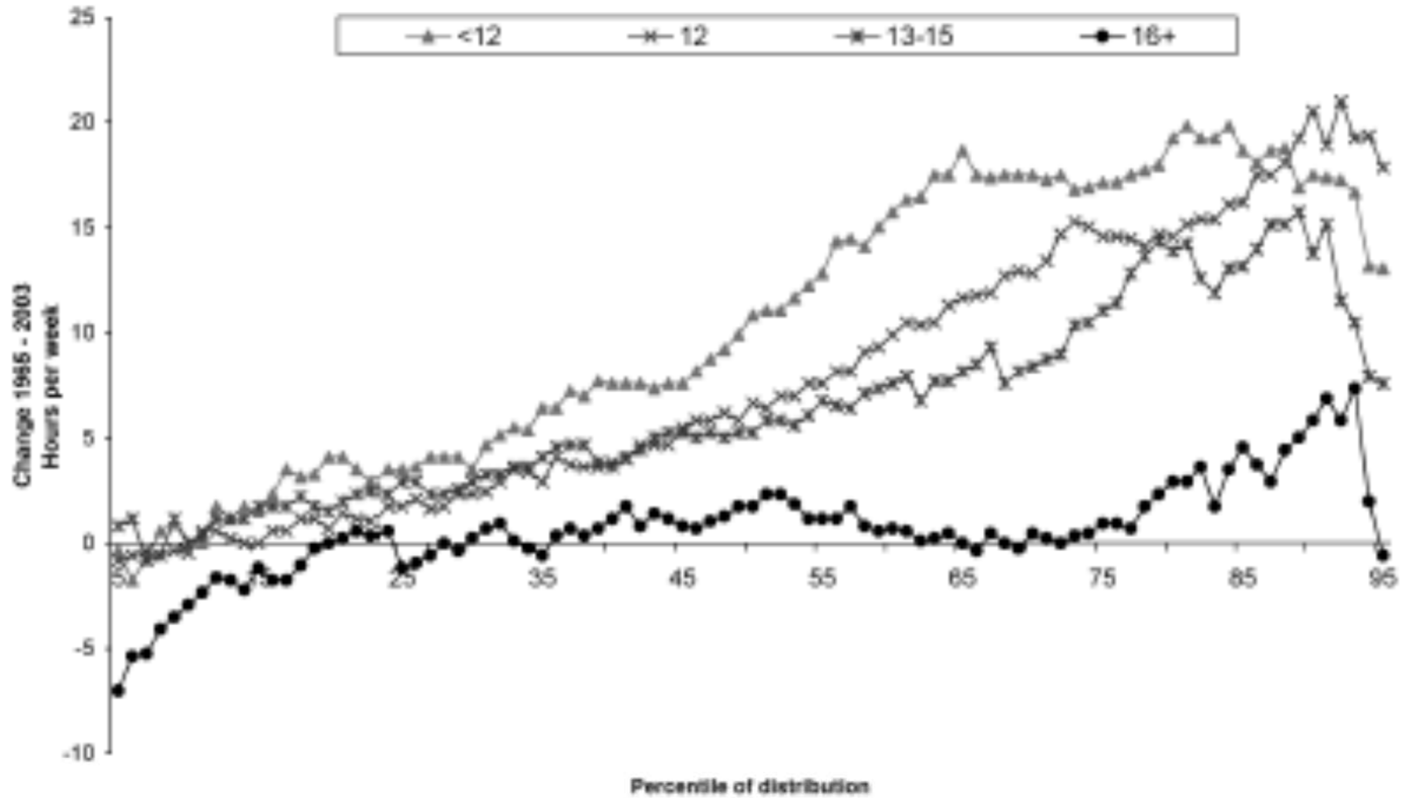


FIGURE IV

Change by Percentile Point for Leisure 2 by Educational Attainment 1965–2003

This figure plots the change at each percentile point of the Leisure 2 distribution between 1965 and 2003, broken down by educational attainment. The percentile points represent the unconditional distribution of the respective subsample in each year, unadjusted for demographic changes.

Important caveats

- Leisure has notably increased (Aguiar & Hurst)

- Models abstract from a number of factors
  - Nature of work/leisure dramatically evolves
  - Innovations in home production—increased market labor
  - The variety of market goods evolves: encouraged market labor
  - Nature of leisure activities evolved—ambiguous effect

Bick, et al., “How Do Hours worked vary with income?”

- Compare employment rates and average hours across large set of countries—compared as of year 2000, for ages 25-54

- Focus on 48 core countries with similar samples/definitions
  - Workers working in sectors measured in GDP: includes agric. & self-employed, but not home sector
  - Respondents report actual hours worked over recent time period (last week, month); data collected over entire calendar year

Bick, et al., Main findings

- Rich countries (top 3rd GDP) work 18.9 hours per week, compared to 28.5 in poor countries (bottom 3rd GDP), 40 percent difference in logs
  - Elasticity of hours wrt GDP/hour is −0.12
  - Employ. rates account for 3/4ths (same as for business cycles)
  - Expands welfare differences, about 40% in income units—high income/low factor 19 rather than 12 (nature of work also different)
- Within countries
  - Relative hours fall with relative wage in most countries, but in richest countries do not (in poorer countries fit relation across countries)
  - Is stronger for men--reflect lack of non-market info?

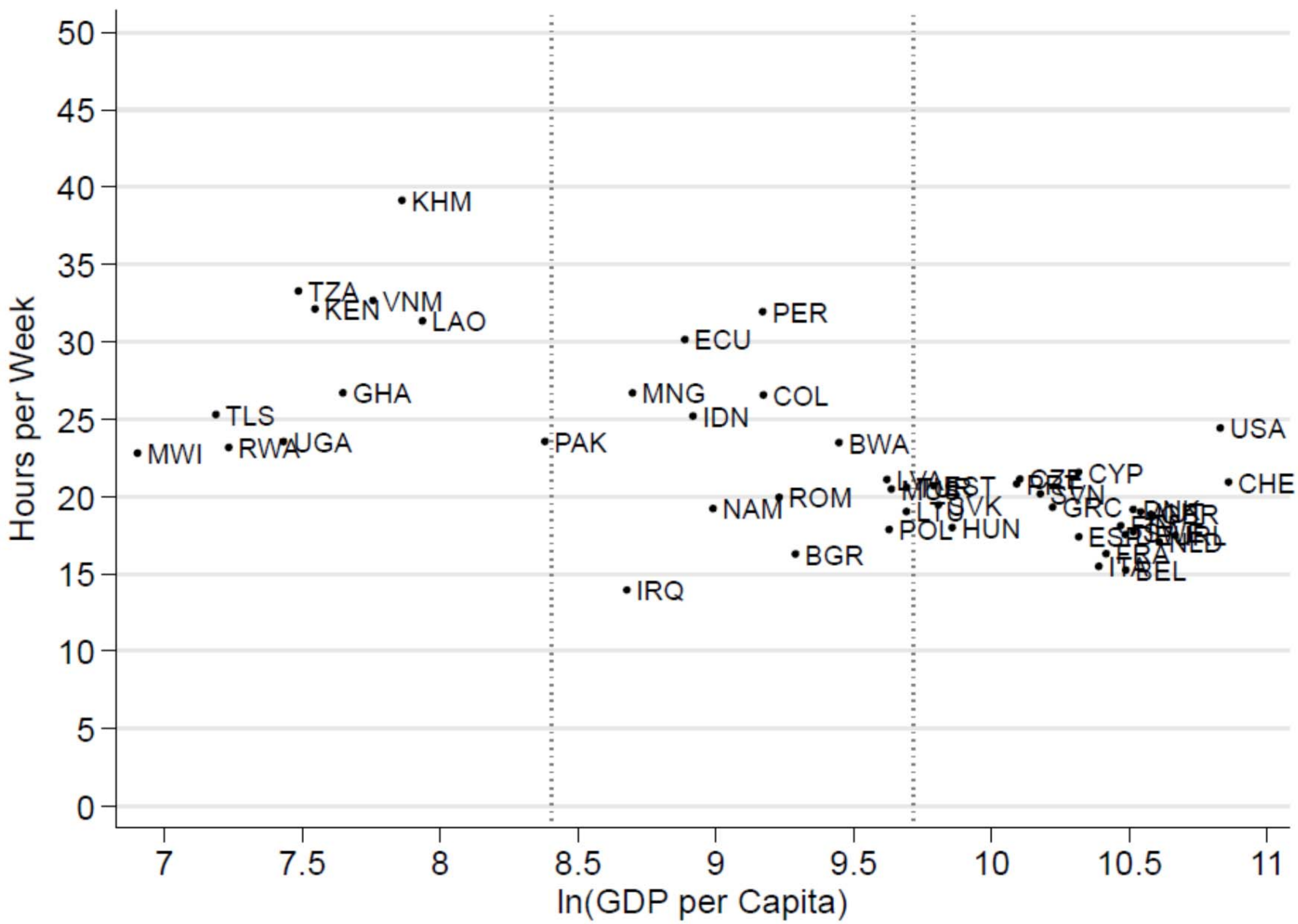
Main cross-section

Table 2: Employment Rates and Hours Per Employed

	Country Income Group		
	Low	Middle	High
Hours Per Adult	28.5	22.2	18.9
Employment Rate	75.3	53.7	54.9
Hours Per Worker	38.4	41.2	34.5

Main cross-section cont.

Figure 1: Average Hours Worked per Adult in Core Countries



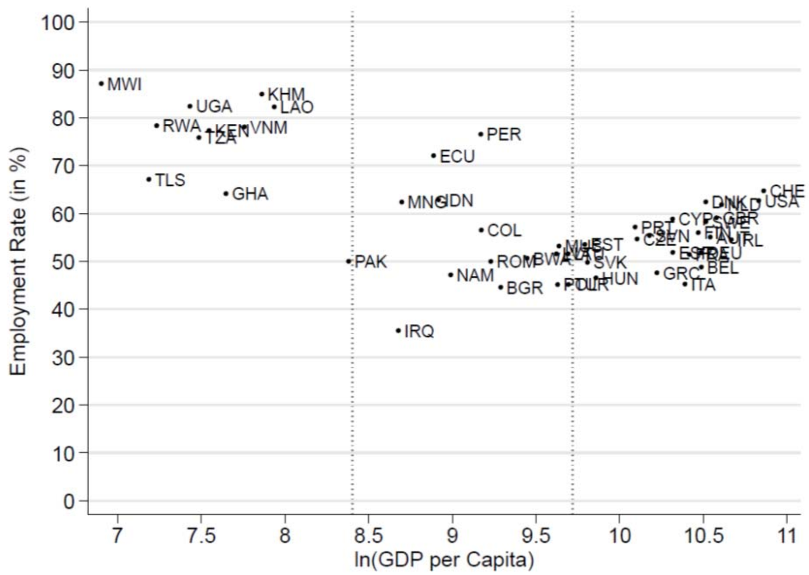
Holds controlling for gender, education

Sex	Country Income Group		
	Low	Middle	High
All	28.5	22.2	18.9
Women	24.4	16.3	14.6
Men	32.7	28.4	23.5

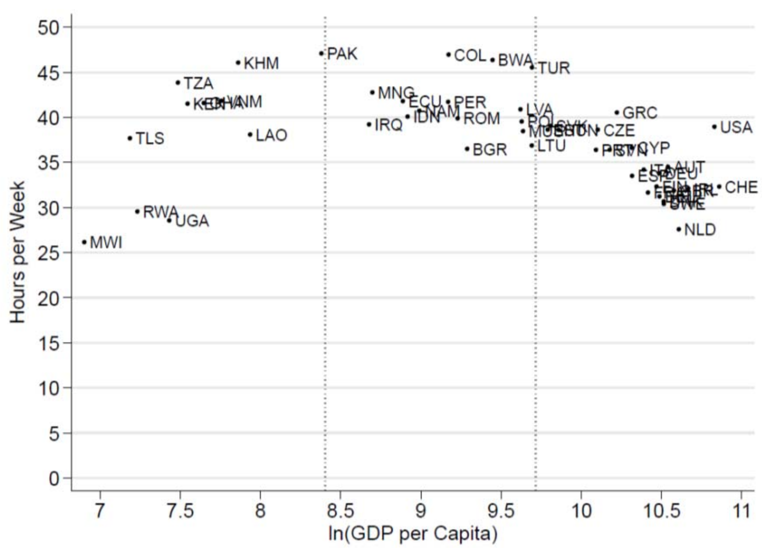
Education	Country Income Group		
	Low	Middle	High
All Ages	28.5	22.2	18.9
Ages 25+ (*Non-missing Educ.*)	33.0	25.7	20.7
Ages 25+			
Less than Secondary	31.8	19.8	12.2
Secondary Completed	37.3	29.3	23.4
More than Secondary	39.5	31.7	26.9

Employent versus workweek

(a) Employment Rate

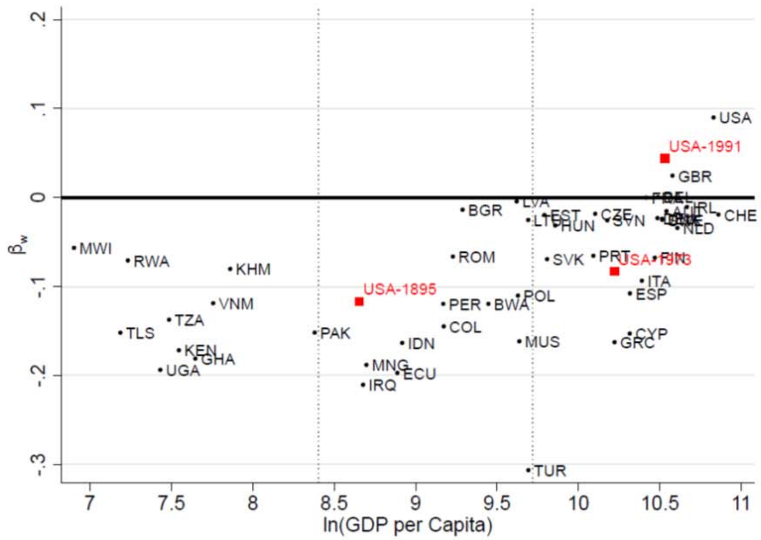


(b) Hours per Worker

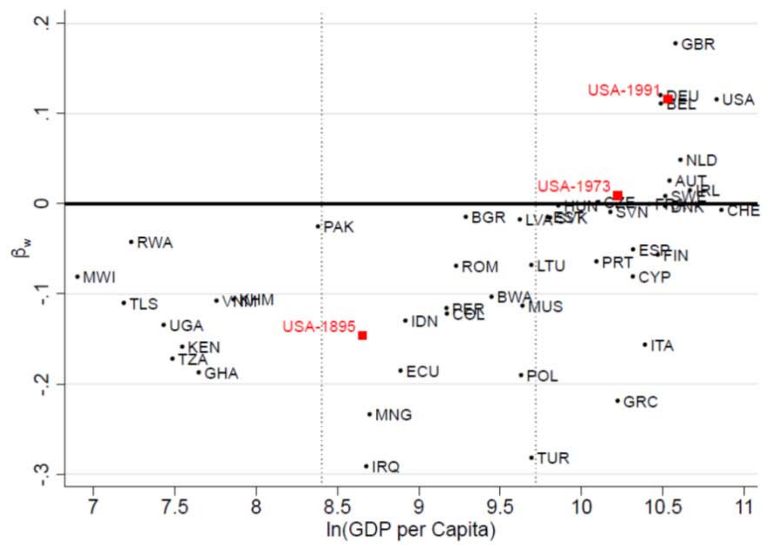


Within country patterns

(a) Men



(b) Women



Bick et al. (2019)

WHY ARE AVERAGE HOURS WORKED LOWER IN RICHER COUNTRIES?

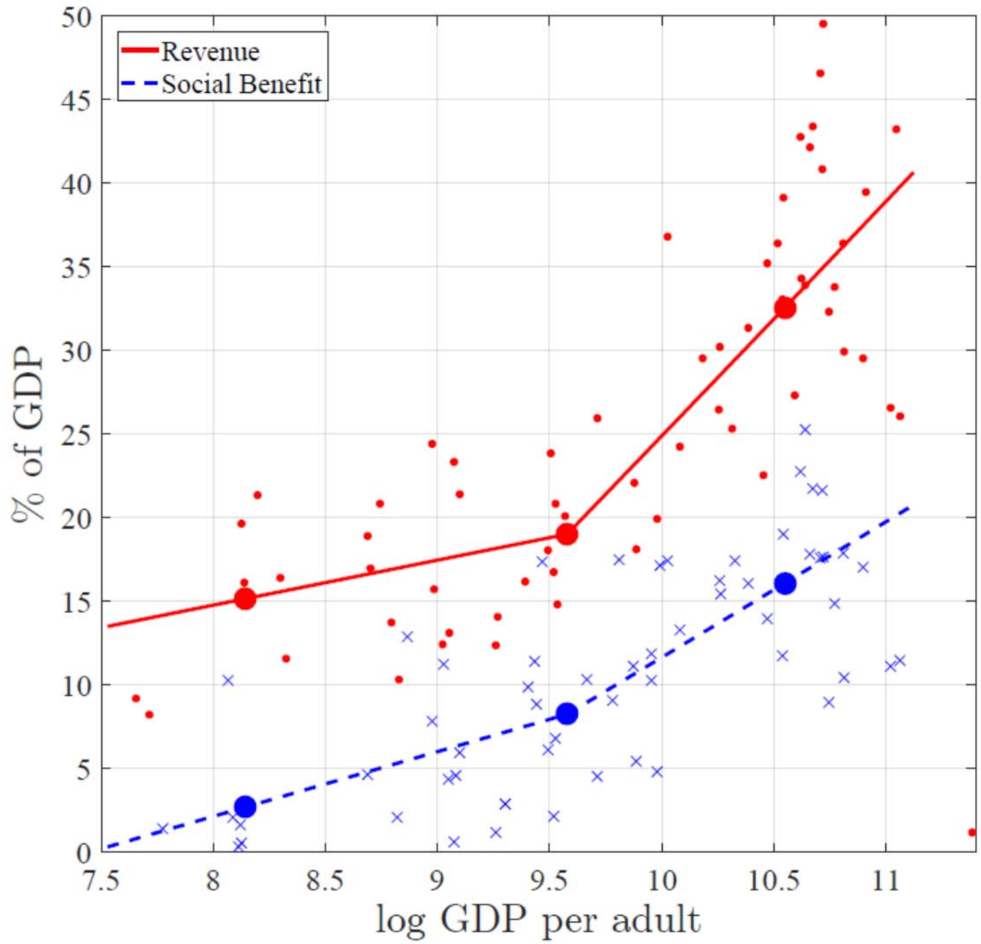
Alexander Bick
Nicola Fuchs-Schündeln
David Lagakos
Hitoshi Tsujiyama

Working Paper 26554
http://www.nber.org/papers/w26554

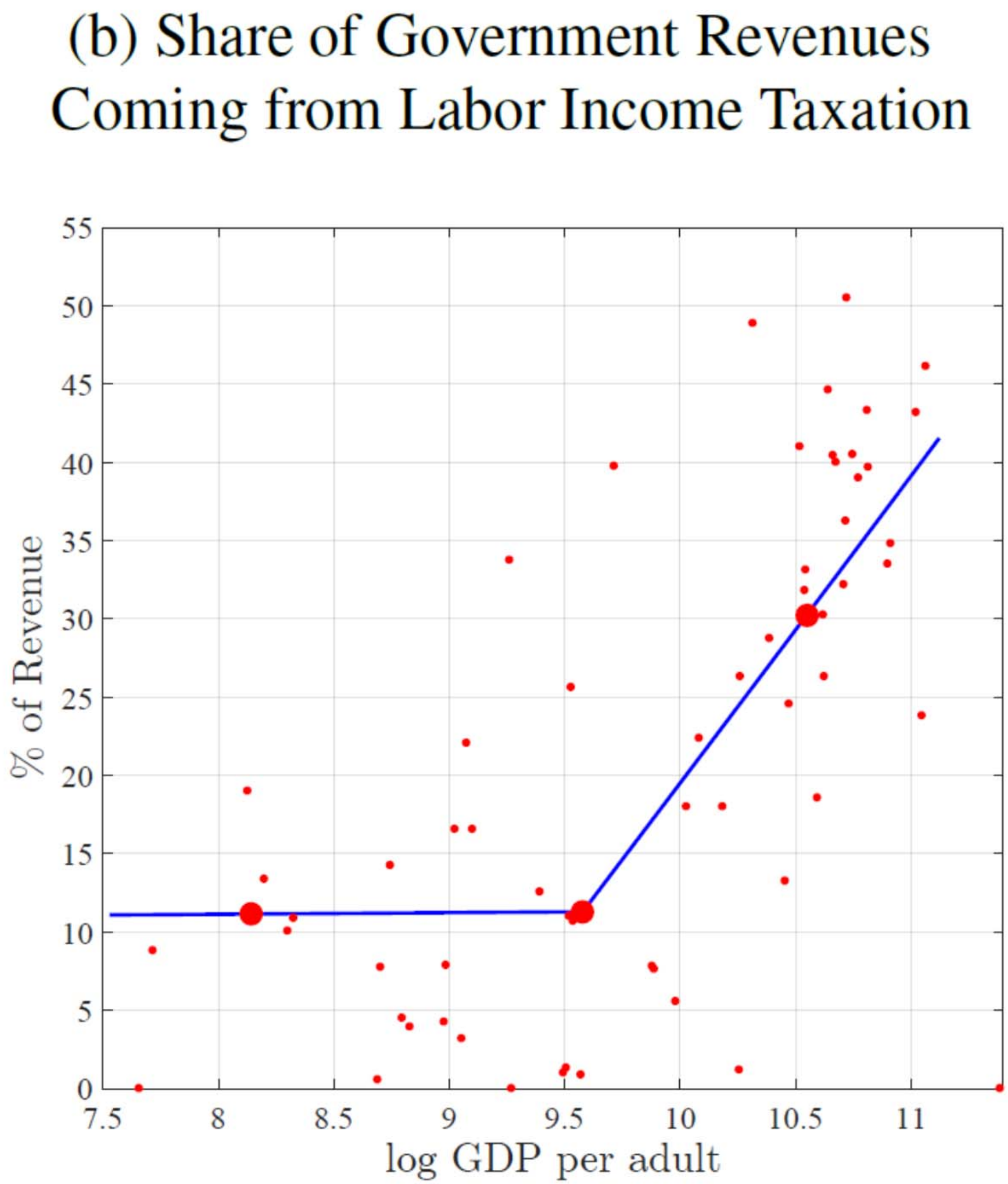
NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 2019

Bick et al. (2019), cont. (Wagner's Law)

(c) Government Revenue
and Social Benefits Relative to GDP



Bick et al. (2019), continued again



Chang-Kim, with two-earner family

- **Allow for family**
- **Income processes assumed orthogonal**

$$U = \max_{\{c_t, h_{mt}, h_{ft}\}_{t=0}^{\infty}} E_0 \left\{ \sum_{t=0}^{\infty} \beta^t u(c_t, h_{mt}, h_{ft}) \right\}$$

with

(1) $$u(c_t, h_{mt}, h_{ft}) = 2\ln(0.5c_t) - B_m \frac{h_{mt}^{1+1/\gamma}}{1+1/\gamma} - B_f \frac{h_{ft}^{1+1/\gamma}}{1+1/\gamma}$$

(2)
$$V_{ee}(a, x_m, x_f; \lambda, \mu) = \max_{a' \in \mathcal{A}} \left\{ u(c, \bar{h}, \bar{h}) + \beta E\left[\max\left\{ V'_{ee}, V'_{en}, V'_{ne}, V'_{nn} \right\} \middle| x_m, x_f, \lambda \right] \right\}$$

subject to

$$c = w(x_m\bar{h} + x_f\bar{h}) + (1+r)a - a'$$

$$a' \geq \bar{a}$$

Chang & Kim parameters

TABLE 2

PARAMETERS OF THE BENCHMARK ECONOMY

Parameter	Description
$\alpha = 0.64$	Labor share in production function
$\beta = 0.9807392$	Discount factor
$\gamma = 0.4$	Intertemporal substitution elasticity
$B_m = 93.5$	Utility parameter for male
$B_f = 150.1$	Utility parameter for female
$\bar{h} = 1/3$	Amount of labor supply when working
$\rho_x = 0.948\ (0.925)$	Persistence of productivity x for male (female)
$\sigma_x = 0.269\ (0.319)$	Standard deviation of ϵ_x for male (female)
$\bar{a} = -4.0$	Borrowing constraint

Some steady-state features

LABOR-MARKET STEADY STATES

	CPS	Model I	Model II
Employment rates			
Male	77.33	77.34	77.36
Female	49.75	49.78	49.75
Aggregate	63.54	63.56	63.56
Fraction of households			
Both members working	43.87	45.35	45.83
Only male working	33.46	31.98	31.52
Only female working	5.88	4.42	3.92
Neither working	16.79	18.23	18.72

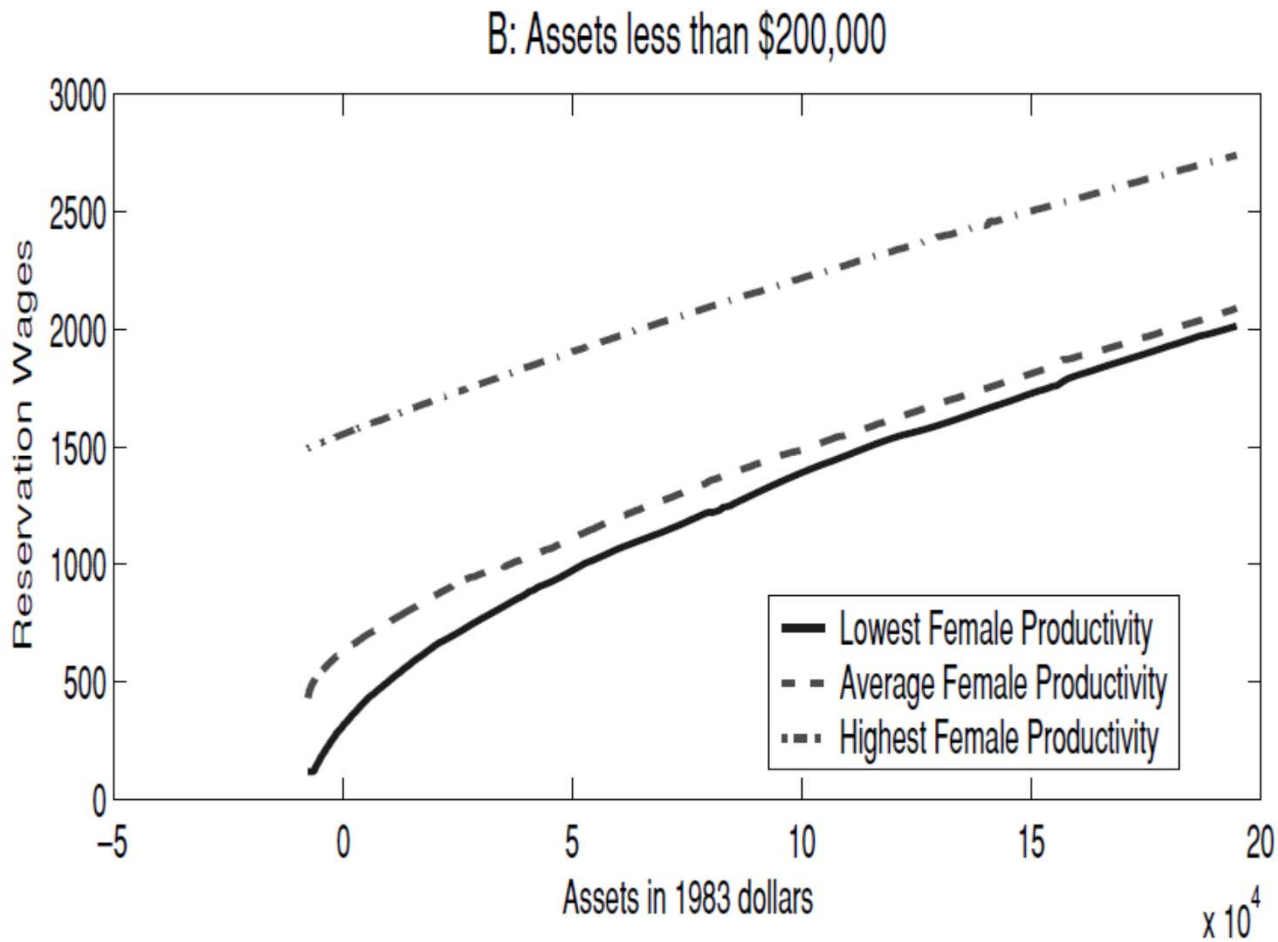
NOTE: All variables are percentages. The statistics for the CPS are annual averages of married households in the March Supplements for the period of 1968–2001.

GINI INDICES FOR WEALTH AND EARNINGS

	PSID	Model I	Model II
Wealth	0.76	0.64	0.61
Earnings	0.53	0.57	0.54

NOTE: The PSID statistics reflect the family wealth and earnings in the 1984 survey.

Reservation wages for men

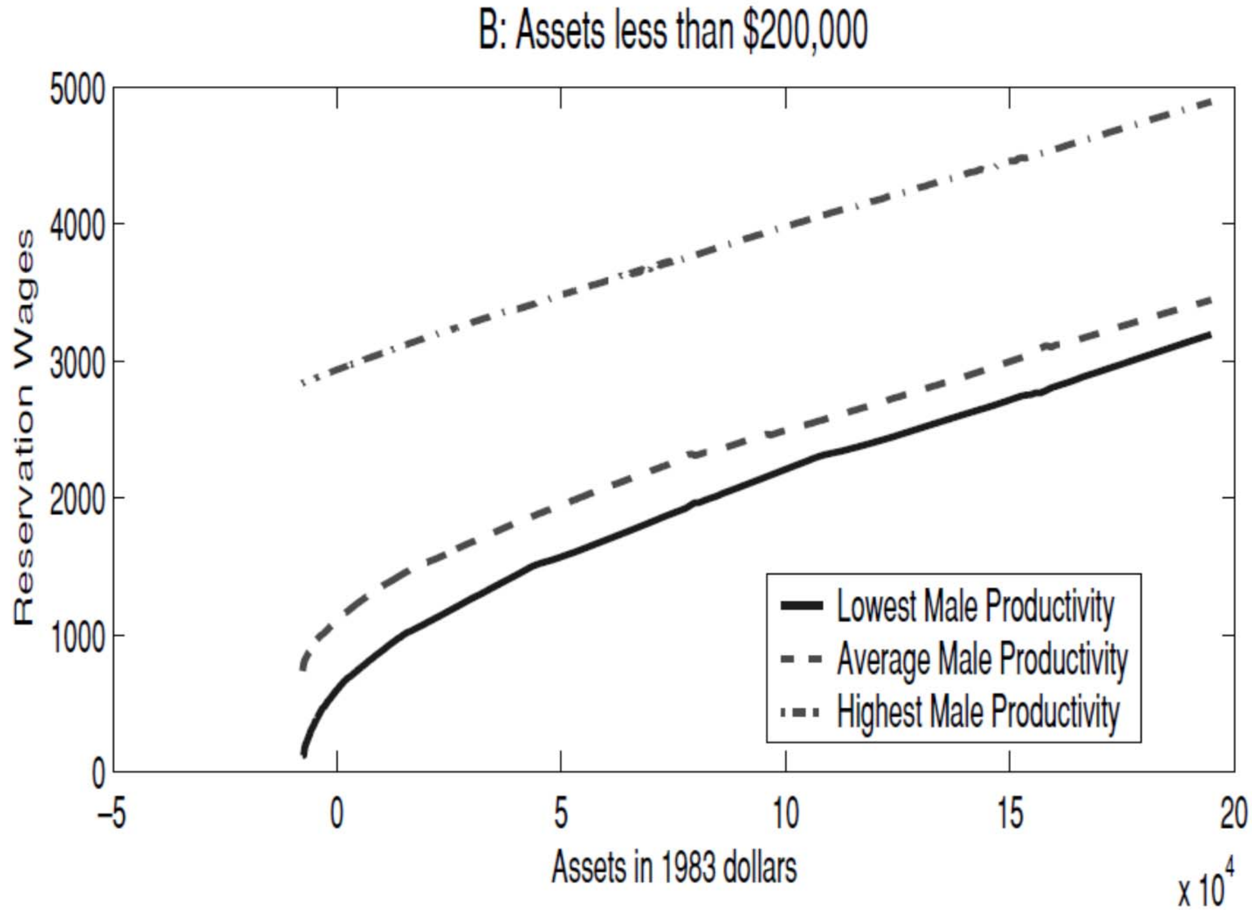


NOTES: The graphs denote the reservation-wage schedule of the three types of male worker (whose wife has the highest, average, and lowest productivity). Wages (quarterly earnings) and assets are in 1983 dollars.

FIGURE 3

RESERVATION-WAGE SCHEDULE OF MALE WORKERS: MODEL I

Reservation wages for women

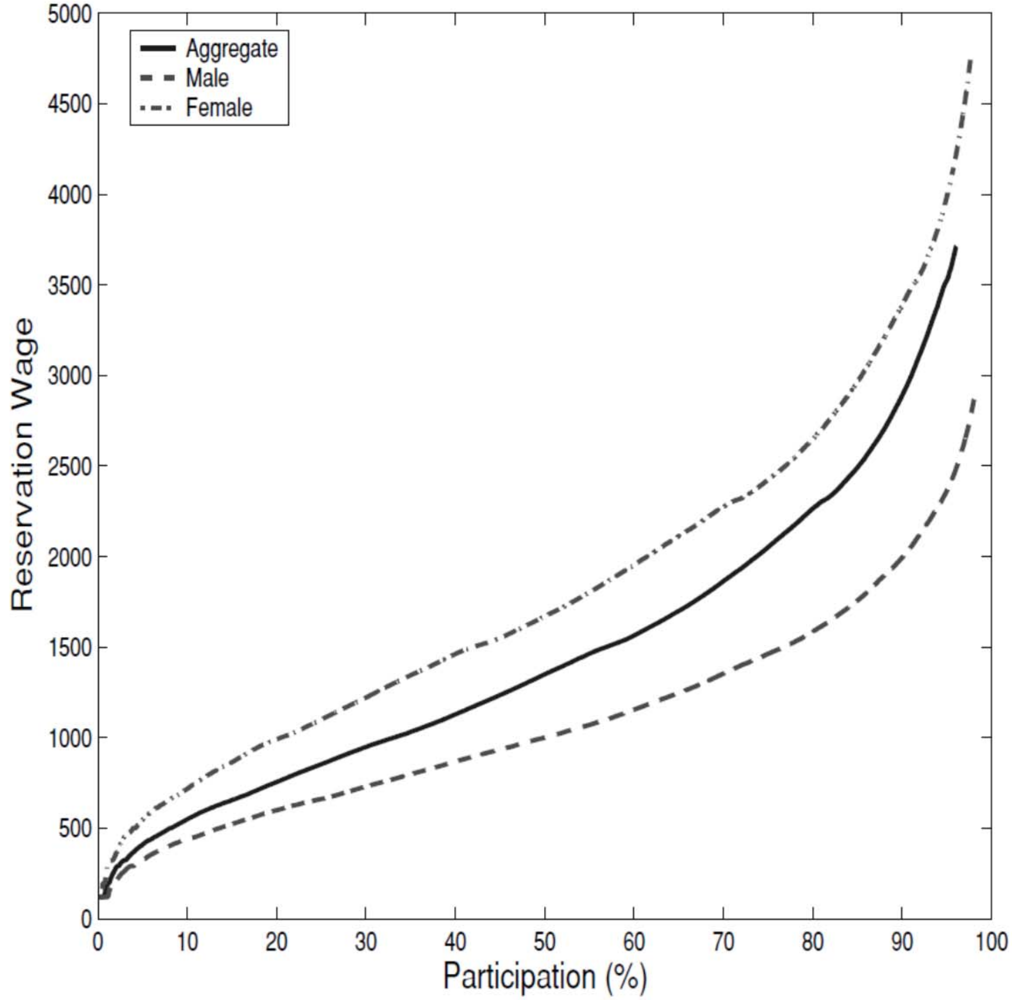


NOTES: The graphs denote the reservation-wage schedule of the three types of female worker (whose husband has the highest, average, and lowest productivity). Wages (quarterly earnings) and assets are in 1983 dollars.

FIGURE 4

RESERVATION-WAGE SCHEDULE OF FEMALE WORKERS: MODEL I

Reservation wage schedules



NOTES: The graph denotes the inverse cumulative distribution functions of reservation wages. Wages are quarterly earnings in 1983 dollars.

FIGURE 5

RESERVATION WAGES AND PARTICIPATION RATES: MODEL I

Implied Frisch Elasticities at Extensive Margin

IMPLIED ELASTICITY FROM THE STEADY-STATE RESERVATION-WAGE DISTRIBUTION

Model	Male	Female	Aggregate
Model I	0.84	1.36	0.94
Model II	0.96	1.71	1.12

NOTE: The numbers reflect the elasticity of the labor-market participation rate with respect to reservation wage (evaluated around the steady state) based on the steady-state reservation-wage distribution.

Adjusting wedge for heterogeneous workers

Assume:

- **75% of movements in total hours are via employment (data)**
- **“Marginal” workers less productive by one third (Barsky, Parker, Solon)**
  - **biases labor productivity countercyc: add back (3/4)*(1/3) = 1/4**
- **Leave workforce causes drop of one-sixth (16.7%) in consumption**
  - **biases consumption procyc: subtract back − (3/4)*(1/6) = 1/8**

Labor wedge "corrected" for heterog.

	Elasticity with respect to Total Hours:	
	Uncorrected	Corrected
Labor Productivity	− 0.33	− 0.08
	(.08)	
Total hours	1	1
Consumption	0.43	0.30
	(.06)	
Wedge	− 2.19	− 1.68
	(.11)	

Notes: Total hours and labor productivity is for private economy; Consumption is nondurables and services. Sample covers 1987 to 2018. All series are logged and HP-filtered. The wedge assumes an IES of 0.5 and a Frisch of 1.0. Correction assumes: (i) three-quarters of movements in total hours via employment; (ii) workers coming in and out of workforce cyclically are one-third less productive; (iii) consumption rises (fall) by one-sixth when enter (exit) workforce.

Park: “Consumption, Reservations Wages, and Aggregate Labor Supply

Uses empirical joint distribution of wages and consumption to estimate supply elasiticity

Key insight—consumption is sufficient statistic for wealth and future earnings

Reservation wage curve

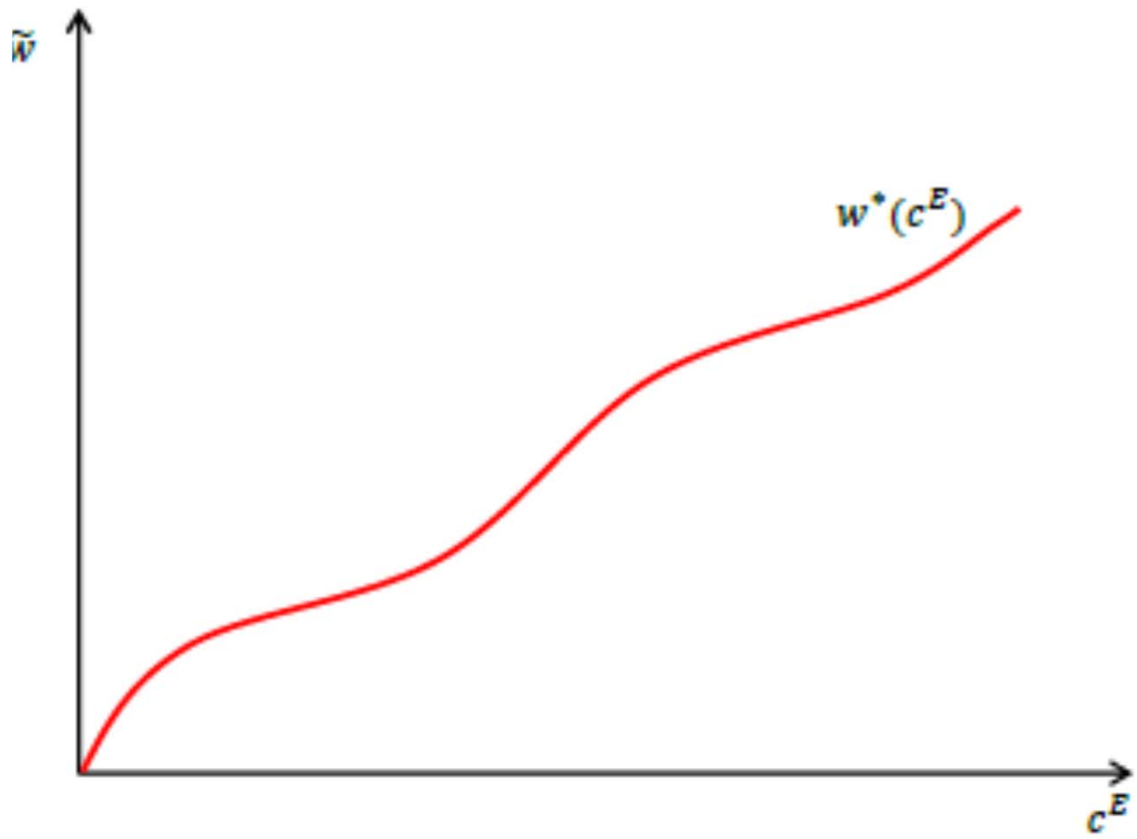


Figure 2: Reservation Wage Curve

Robustness of Conditioning on Consumption

The key result is that the reservation wage conditional on consumption is unique and independent of the state variables. Intuitively, individual saving decisions reflect their future expectations based on constraints they face, and these are all summarized in their consumption choices. Thus, given consumption and wage, the period utility cost of working determines whether they work or not.[9]

Within the class of models defined in equation (1), the reservation property conditional on consumption is robust to the following specification choices:

1. arbitrary heterogeneity in discount factors, borrowing constraints, and wage processes,
2. time horizon: infinite time versus life cycles,
3. flexibility of hours choices: both margins of labor supply versus indivisible labor,
4. separability between consumption and leisure in the period utility function,
5. two earner's problem when labor is indivisible.

Distributions

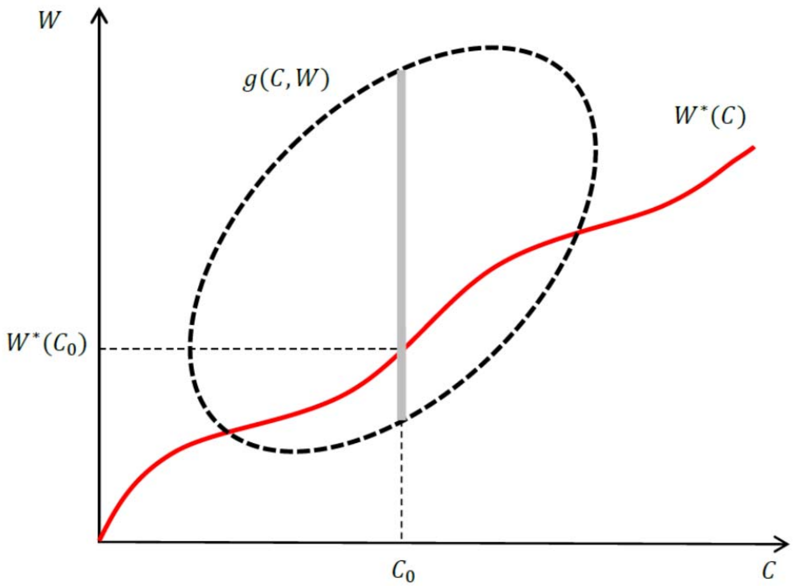


Figure 3: Population Joint Distribution and Employment Rate

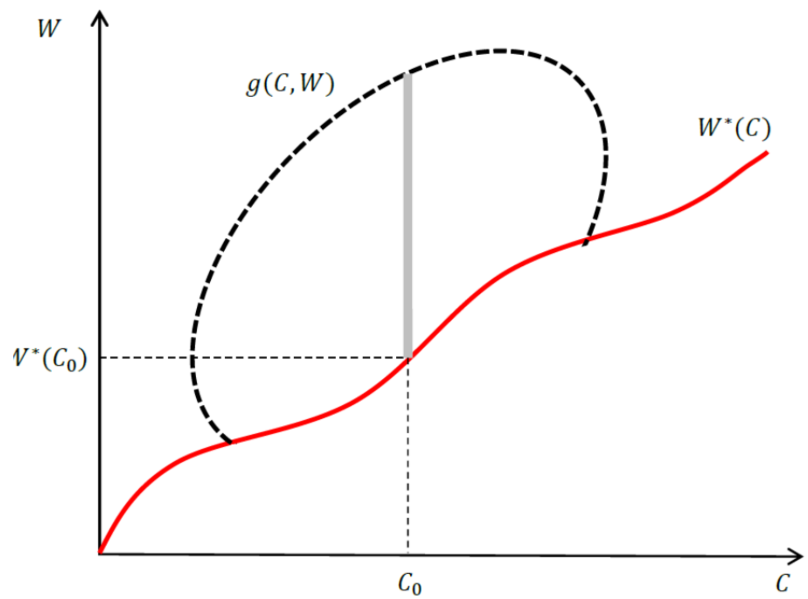


Figure 4: Observed Distribution of Workers

Observed wages at a particular consumption and the extensive Frisch

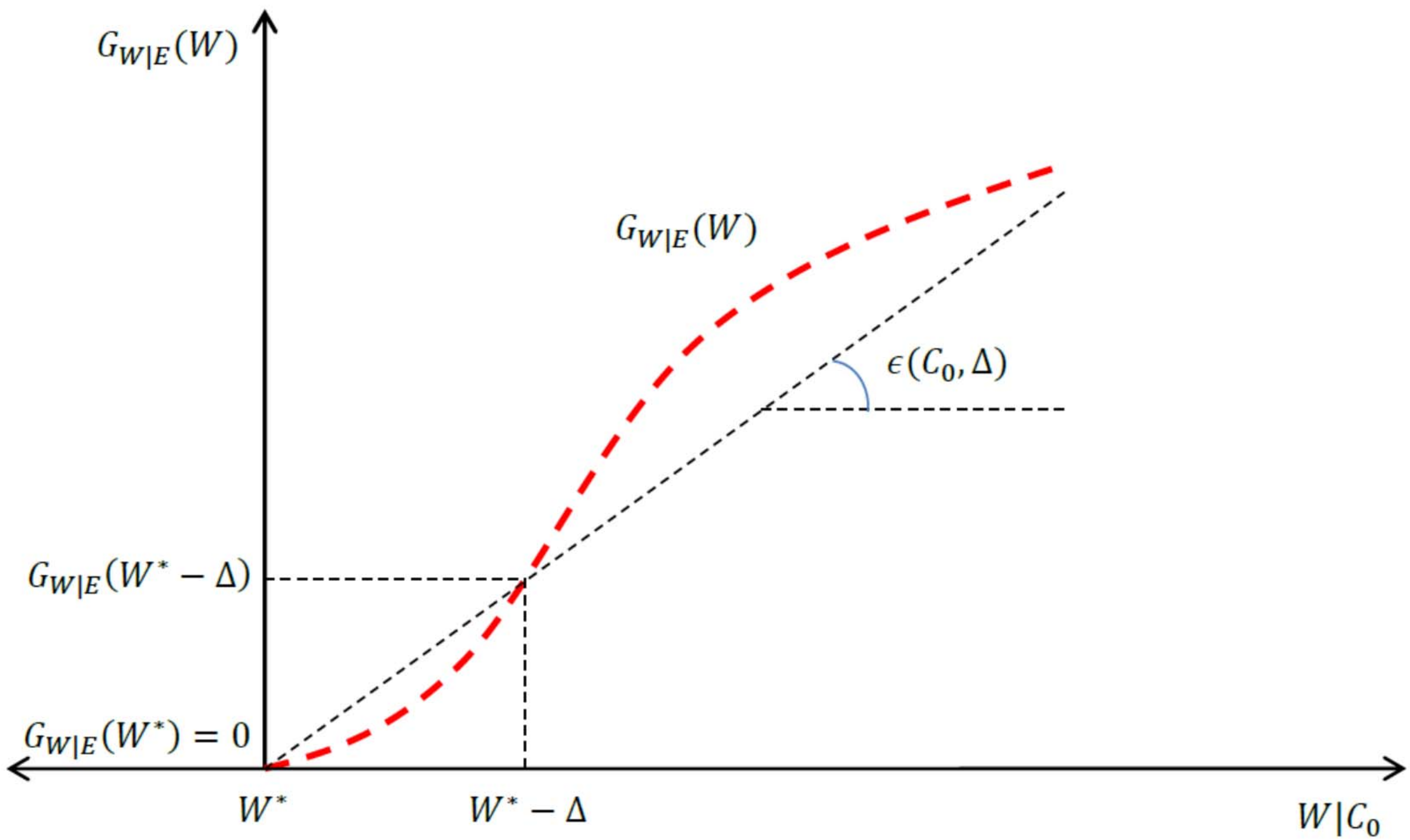


Figure 5: Conditional Distribution and Extensive Margin Frisch Elasticity

Allowing for measurement error

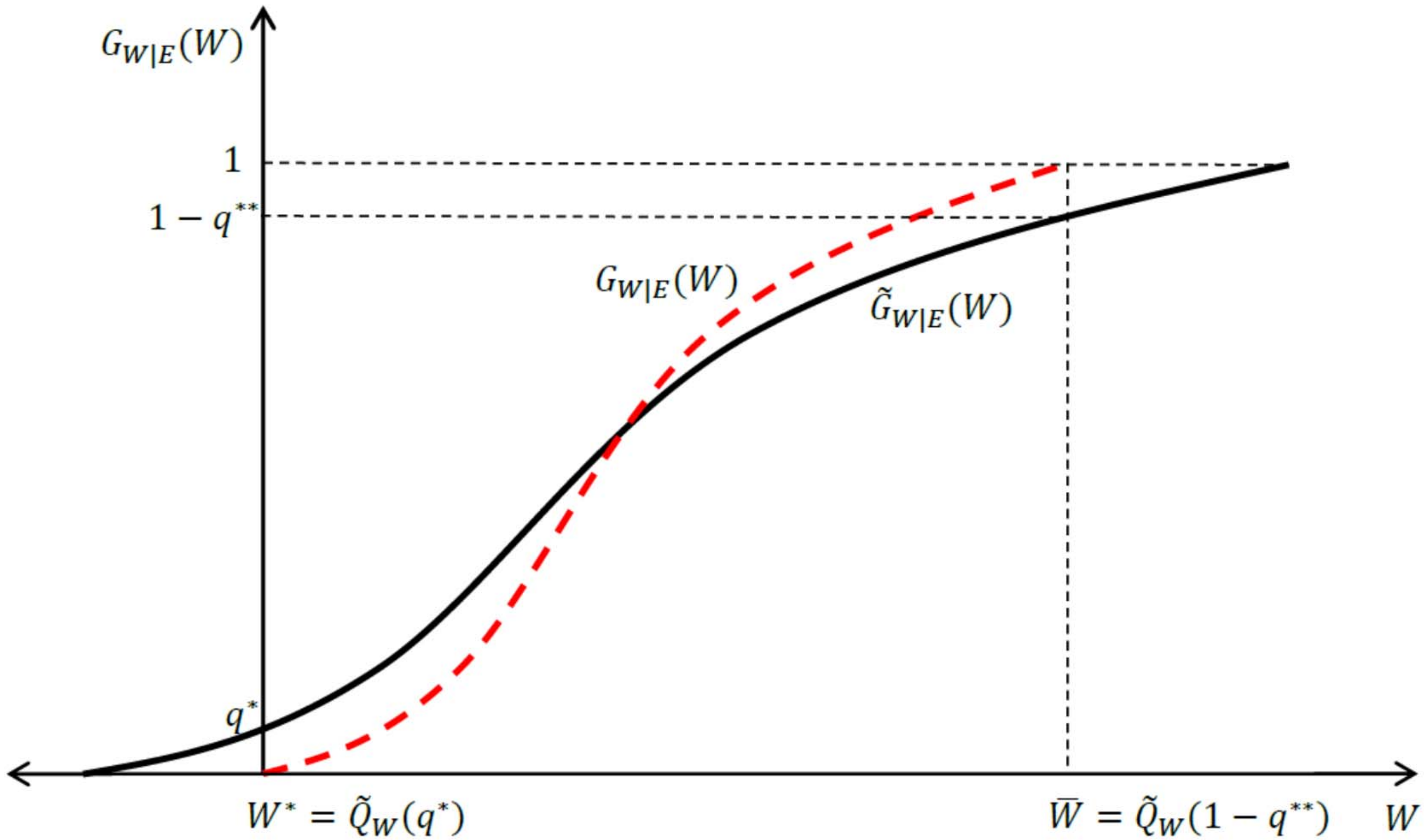


Figure 7: The Effects of Measurement Error on the Distribution

Results for extensive Frisch

		$q^* = q^{**}$				
		0.03	0.04	0.05	0.06	0.07
Aggregate		0.22	0.31	**0.40**	0.48	0.54
		(0.02)	(0.03)	(0.04)	(0.05)	(0.05)
Gender	Male	0.21	0.28	**0.34**	0.40	0.45
		(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
	Female	0.23	0.34	**0.52**	0.57	0.64
		(0.03)	(0.05)	(0.07)	(0.08)	(0.08)
Age	[25,34]	0.26	0.35	**0.43**	0.55	0.65
		(0.03)	(0.04)	(0.05)	(0.06)	(0.08)
	[35,54]	0.19	0.29	**0.39**	0.45	0.50
		(0.02)	(0.02)	(0.04)	(0.05)	(0.05)
	[55,65]	0.23	0.31	**0.41**	0.47	0.48
		(0.03)	(0.04)	(0.06)	(0.06)	(0.06)
Education	Non-college	0.25	0.35	**0.51**	0.57	0.64
		(0.03)	(0.04)	(0.06)	(0.07)	(0.06)
	College	0.16	0.23	**0.28**	0.34	0.40
		(0.01)	(0.02)	(0.02)	(0.03)	(0.03)
Race	White	0.20	0.28	**0.36**	0.44	0.52
		(0.01)	(0.02)	(0.03)	(0.04)	(0.04)
	Non-white	0.36	0.52	**0.61**	0.65	0.67
		(0.06)	(0.08)	(0.08)	(0.10)	(0.13)
Marital Status	Married	0.21	0.29	**0.36**	0.44	0.50
		(0.01)	(0.02)	(0.03)	(0.03)	(0.03)
	Single	0.25	0.38	**0.59**	0.65	0.68
		(0.06)	(0.08)	(0.11)	(0.10)	(0.12)

Krusell, Mukoyama, Rogerson and Sahin

- Look at Labor Supply Response to Cyclical Fluctuations

- Reflects both comparative advantage and search frictions
  - Unlike most DMP models, allow wealth effect

- Give rich depiction of labor flows
  - Job-to-job, exogenous and endogenous separations from employment
  - Endogenous search: transitions between employed, unemployed, OLF

- Movements between unemployed/OLF give insight into labor supply (i.e. substitution and wealth effects), not imposing competitive labor demand

Unemployed vs. OLF

Employed: In the Current Population Survey (CPS), classified as employed if, during the survey reference week, they meet any of the following criteria:

- worked at least 1 hour as a paid employee
- worked at least 1 hour in their own business, profession, trade, or farm
- were temporarily absent from their job, business, or farm
- worked without pay for min. 15 hours in business/farm owned by member of family

Unemployed: In CPS, classified as unemployed if meet all of the following criteria:

- They were not employed during the survey reference week.
- They were available for work during the survey reference week, except for temporary illness.
- They made at least one specific, active effort to find a job during the 4-week period ending with the survey reference week OR they were temporarily laid off and expect to be recalled.
- *Classification as unemployed in no way depends upon a person's eligibility for, or receipt of, unemployment insurance benefits.*

Search recognized

Active job search methods are defined as those that have the potential to result in job offer without further action on the part of the job seeker. Examples include:

- contacting an employer directly about a job
- having a job interview
- submitting a resume or application to an employer or to a job website
- using a public or private employment agency, job service, placement firm
- contacting a job recruiter or head hunter
- seeking assistance from friends, relatives, or via social networks
- placing or answering a job advertisement
- checking union or professional registers
- Methods that do not constitute an active job search are referred to as passive job search methods. Passive methods are those that could not result in a job offer unless additional steps were taken. Examples include simply looking at job postings or taking a training course.

Data: Stocks

Dataset: Current Population Survey 1978Q1-2012Q3.

	u	$lfpr$	E
$std(x)$	0.1170	0.0026	0.0099
$corrcoef(x, Y)$	-0.84	0.21	0.83
$corrcoef(x, x_{-1})$	0.93	0.69	0.92

- Unemployment rate is countercyclical.
- Labor force participation rate is weakly procyclical.
- Employment rate is procyclical.

Data: Averages of gross worker flows

Unadjusted Data				Abowd-Zellner Correction			
FROM	TO			FROM	TO		
	E	U	N		E	U	N
E	0.957	0.015	0.028	E	0.972	0.014	0.014
U	0.254	0.535	0.211	U	0.228	0.637	0.135
N	0.047	0.028	0.925	N	0.022	0.021	0.957

- Correcting for misreporting reduces flows between U and N, but there still are large flows.

Abowd-Zellner (1985) correction

$$\begin{bmatrix} \widehat{E} \\ \widehat{U} \\ \widehat{N} \end{bmatrix}_t = \underbrace{\begin{bmatrix} 1-\varepsilon_{EU}-\varepsilon_{EN} & \varepsilon_{UE} & \varepsilon_{NE} \\ \varepsilon_{EU} & 1-\varepsilon_{UE}-\varepsilon_{UN} & \varepsilon_{NU} \\ \varepsilon_{EN} & \varepsilon_{UN} & 1-\varepsilon_{NE}-\varepsilon_{NE} \end{bmatrix}}_{\mathbf{E}} \begin{bmatrix} E \\ U \\ N \end{bmatrix}_t$$

$$\begin{aligned} \widehat{UN}_t &\approx (1-\varepsilon_{UN}-\varepsilon_{NU})\, UN_t + \varepsilon_{UN} UU_t + \varepsilon_{NU} NN_t, \text{ and} \\ \widehat{NU}_t &\approx (1-\varepsilon_{UN}-\varepsilon_{NU})\, NU_t + \varepsilon_{UN} UU_t + \varepsilon_{NU} NN_t. \end{aligned}$$

Abowd-Zellner cont.

$$\mathbf{N}_t = \begin{bmatrix} EE & UE & NE \\ EU & UU & NU \\ EN & UN & NN \end{bmatrix}_t$$

$$\mathbf{N}_t = \mathbf{E}^{-1}\widehat{\mathbf{N}}_t \left(\mathbf{E}^{-1}\right)'$$

Abowd-Zellner estimates

Table 1: Abowd and Zellner (1985) estimates of classification errors

Original	Status determined on reinterview		
interview status	Employed	Unemployed	Non-participant
Employed	98.78	1.91	0.50
Unemployed	0.18	88.57	0.29
Non-participant	1.03	9.52	99.21

Source: Abowd and Zellner (1985, Table 6).

Cyclicality of Flows

Unadjusted Data

	f_{EU}	f_{EN}	f_{UE}	f_{UN}	f_{NE}	f_{NU}
$std(x)$	0.075	0.033	0.077	0.053	0.041	0.064
$corrcoef(x, Y)$	−0.70	0.35	0.79	0.66	0.61	−0.70
$corrcoef(x, x_{-1})$	0.69	0.22	0.82	0.71	0.52	0.78

Abowd-Zellner Correction

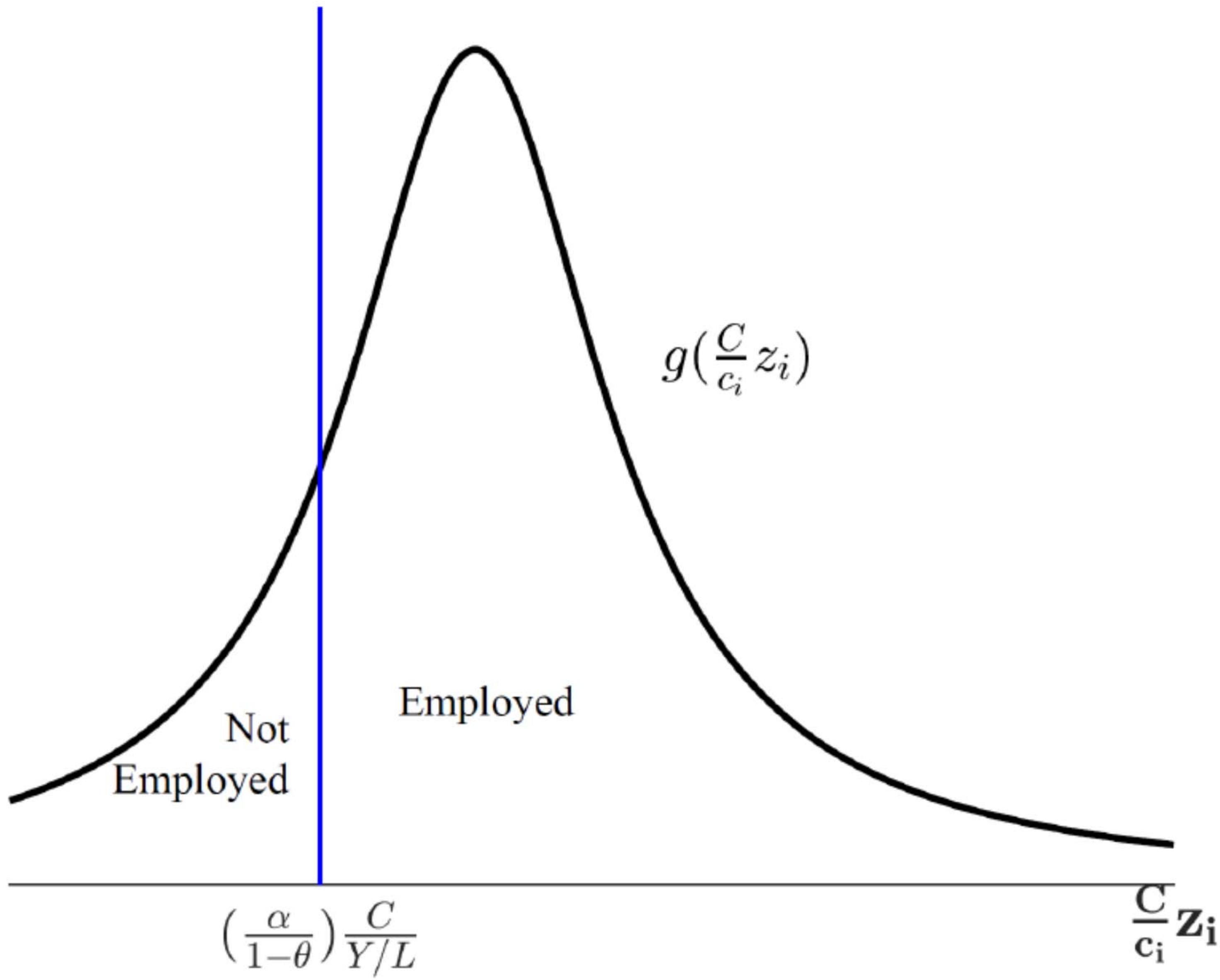
	f_{EU}	f_{EN}	f_{UE}	f_{UN}	f_{NE}	f_{NU}
$std(x)$	0.089	0.083	0.088	0.106	0.103	0.072
$corrcoef(x, Y)$	−0.63	0.43	0.76	0.61	0.52	−0.23
$corrcoef(x, x_{-1})$	0.59	0.29	0.75	0.62	0.38	0.30

- EU and UE are intuitive, given that the labor demand (frictions from the worker's perspective) is cyclical.
- NE and NU can also be interpreted through the lens of labor market frictions.
- EN and UN are the least intuitive.

Model Overview

- Discrete-time, partial equilibrium model of consumer behavior
- Consumers make consumption/saving decision and labor supply decision.
- Frictional labor market: job offers come with some probability. There are exogenous separations.
- No insurance markets but can save (self-insure).
- Incorporates on-the-job search and realistic unemployment insurance system.

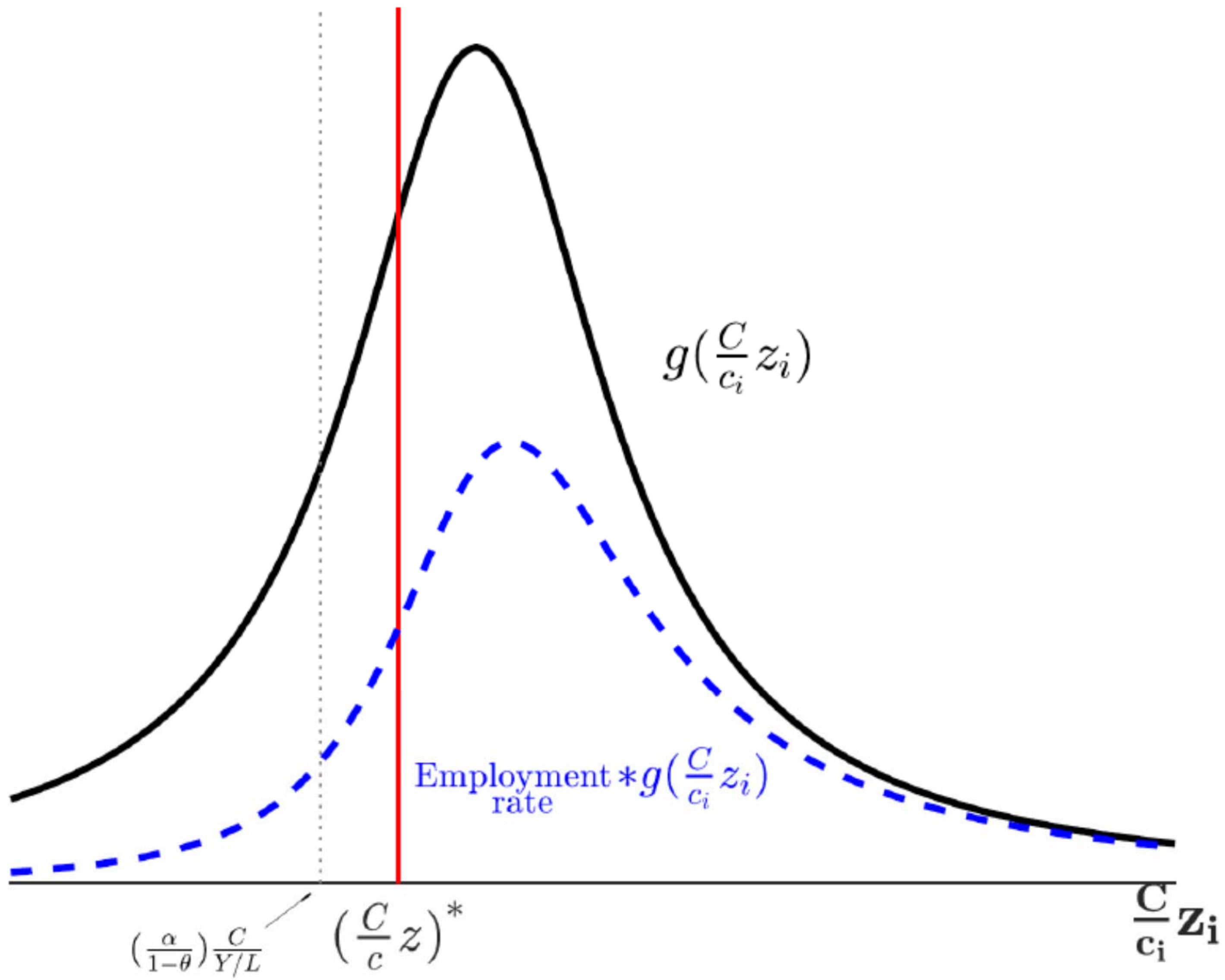
Ignore search frictions



Add rich set of frictions, choices governing flows

- Two exogenous flows: Exogenous job-to-job and exogenous separations
- Endogenous separations, endogenous take up of offers, endogenous search
- A number of qualitative predictions:
  - Separation rate decreasing in $\frac{w_i}{c_i}$
  - Probability unemployed versus OLF increasing in $\frac{w_i}{c_i}$
  - Probability transit unemployed to employed increasing in $\frac{w_i}{c_i}$
- $\frac{C}{Y/L}$ remains key statistic for judging cyclicality of endogenous choices

Comparative advantage Gets “smoothed” out



Comp. adv. still key to search/separation decisions

- Focus on search decision
  - Take perfect-insurance case: critical z^*, search if, only if, $z \geq z^*$
  - perturb z^* today and next period to hold matches constant going forward

    Net benefit (ignoring heterogeneity in match quality)

$$= -\gamma + (\lambda_u - \lambda_n)\left(\frac{z_i(1-\theta)Y}{L}\frac{1}{C} - \alpha + (1-\sigma)\beta\frac{\gamma}{(\lambda_u - \lambda_n)}\right)$$

$$\Rightarrow z^* = \left(\frac{\alpha}{1-\theta}\right)\frac{C}{Y/L}\left(1 + \frac{\gamma/\alpha}{(\lambda_u - \lambda_n)}\Big(1 - \beta(1-\sigma)\Big)\right)$$

  - Threshold (as without frictions) dictated by statistic: $\frac{Y/L}{C} = \frac{(Y/E)(E/L)}{C}$

Steady state calibration

- 1 period = 1 month
- Set β and τ: $\beta = 0.9947$ and $\tau = 0.3$.
- $\rho = 0.996$ and $\sigma_\varepsilon = 0.096$, from the micro estimates of earnings processes.
- r, w, and T come from the background general equilibrium model.
- UI parameters: $\mu = 1/6$ (eligible for 6 months) and replacement rate$= 0.23$, to match the UI/(total earnings).
- $\bar{\gamma} = (3.5/40) \times \alpha$, from time use data.

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- $\bar{\gamma} = (3.5/40) \times \alpha$, from time use data.

For the following, we use the steady state version of the model to find the (average value of) parameter values.

- α to match E.
- λ_u to match the unemployment rate.
- λ_n to match the NE flow rate.
- σ to match the EU flow rate.
- λ_e and σ_q to match job-to-job transition rate and the wage gain upon transition.

Steady state flows (monthly)

Gross Worker Flows in the Data and the Model

AZ-Adjusted Data				Model			
FROM	TO			FROM	TO		
	E	U	N		E	U	N
E	0.972	0.014	0.014	E	0.972	0.014	0.014
U	0.228	0.637	0.135	U	0.219	0.652	0.130
N	0.022	0.021	0.957	N	0.022	0.020	0.958

- Each flow is matched well to the data.
- The model captures the relationship between wealth and flows well.

◂ wealth and flows

Business cycle analysis

- We let the labor market condition $(\lambda_u, \lambda_n, \lambda_e, \sigma)$ vary over the business cycle. We assume a two-point Markov process (all move together) that resembles business cycles.
- λ_u fluctuates so that the standard deviation of f_{UE} to the data.
- σ fluctuates so that the standard deviation of f_{EU} to the data.
- λ_n and λ_e maintain the same proportion to λ_u.
- w and r are constant.

Cyclical properties of stocks

	Data			Model		
	u	$lfpr$	E	u	$lfpr$	E
$std(x)$	0.1170	0.0026	0.0099	0.1207	0.0015	0.0096
$corrcoef(x, Y)$	-0.84	0.21	0.83	-0.99	0.37	0.995
$corrcoef(x, x_{-1})$	0.93	0.69	0.92	0.87	0.71	0.89

- The labor force participation rate is weakly procyclical. Two forces:
  - In recession, when the job-finding rate decreases and the separation rate increases, workers increases participation rate to offset the frictions (the wealth effect of labor supply). This is a countercyclical force.
  - The return to search is larger in booms, because (i) λ_u is larger, (ii) σ is smaller, and (iii) λ_e is larger (implicit 'wage movement'). This is a procyclical force.
  - These two forces almost offset with each other.

Cyclical properties of gross flows

Data						
	f_{EU}	f_{EN}	f_{UE}	f_{UN}	f_{NE}	f_{NU}
$std(x)$	0.089	0.083	0.088	0.106	0.103	0.072
$corrcoef(x,Y)$	-0.63	0.43	0.76	0.61	0.52	-0.23
$corrcoef(x,x_{-1})$	0.59	0.29	0.75	0.62	0.38	0.30

Model						
	f_{EU}	f_{EN}	f_{UE}	f_{UN}	f_{NE}	f_{NU}
$std(x)$	0.089	0.057	0.088	0.029	0.051	0.076
$corr(x,Y)$	-0.79	0.21	0.69	0.47	0.57	-0.96
$corr(x,x_{-1})$	0.76	0.21	0.70	0.34	0.66	0.87

- EU and UE flows come from λ_u and σ fluctuations.
- NE and NU are affected by λ_n fluctuations.

Cyclical properties of gross flows

- Procyclical EN: Within E, there are more workers at the boundary of participation in booms. There are more ‘recently employed’ workers who are close to the boundary, because in booms there are more movement from U and N to E.
- Procyclical UN: Within U, there are more workers at the boundary of participation in booms. In recession, there are more ‘poor’ and ‘high-productivity’ workers who have been in U for a long time, and has a large z.
- The labor supply intuition (except for the wealth effect) goes the opposite direction, as working becomes more attractive in booms.

The Labor Wedge and Labor Demand

Bils, Klenow, Malin: “Resurrecting …”

Decomposing the Labor Wedge

Hours worked appear to be inefficiently low in recessions.

- Labor Wedge is high: $\mu \equiv \frac{mpn}{mrs}$

Labor Wedge is the product of:

1. Labor Market Wedge: $\mu^w \equiv \frac{w/p}{mrs}$
2. Product Market Wedge: $\mu^p \equiv \frac{mpn}{w/p} \equiv \frac{p}{mc}$

The Standard Decomposition Approach

Uses (aggregate) wage data

- E.g., Gali, Gertler, Lopez-Salido (2007), Karabarbounis (2014)
- Measure of Price of Labor: $w/p =$ average wage
- Key Assumption: all workers employed in spot markets.
- Conclusion: μ^w accounts for nearly all cyclicality of μ.

BUT, conclusion depends critically on wage measure used.

- Alternative theories emphasize durable nature of employment and wage smoothing.
- w/p can be much more procyclical using other wage measures.

This Paper

Decomposes Labor Wedge μ without using wage data.

Recall: $\mu^p \equiv \frac{p}{mc}$

Consider 2 alternative inputs:

1. Self-Employed
   - $\frac{p}{mc} = \frac{p}{p \cdot mrs/mpn} = \frac{mpn}{mrs}$, or $\mu^p = \mu$
2. Intermediate Inputs
   - $\frac{p}{mc} = \frac{p}{p_m/mpm}$

Preview of Findings

Our point estimates: μ^p accounts for the cyclical variation in μ

- Self-Employed μ is just as cyclical as all-worker μ
- Intermediate Inputs μ^p is just as cyclical as μ

Thus, countercyclical price markups deserve a central place in business cycle research, alongside labor market frictions.

Outline for Remainder of Talk

Measuring the Labor Wedge

- Focus on Intensive Margin
- Decompose using Wage Data

Our 2 Alternative Decompositions

1. Self-Employed
2. Intermediate Inputs

Representative-Agent Labor Wedge

Preferences:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{c_t^{1-1/\sigma}}{1-1/\sigma} - \nu \frac{n_t^{1+1/\eta}}{1+1/\eta} \right\}$$

Production:

$$y_t = z_t k_t^{\alpha} n_t^{1-\alpha}$$

Labor Wedge:

$$\begin{aligned} ln(\mu_t) &\equiv ln(mpn_t) - ln(mrs_t) \\ &= ln\left(\frac{y_t}{n_t}\right) - \left[\frac{1}{\sigma} ln(c_t) + \frac{1}{\eta} ln(n_t)\right] \end{aligned}$$

Extensive and Intensive Margin Labor Wedges

- Consider extensive and intensive margins of labor supply
- Why?
  - Can base Frisch elasticity on micro estimates using hours margin
  - Self-employed wedge will be on intensive margin only
  - Product market distortions should impact wedge on both margins
    - If wedge is only important on one margin, product market distortions must have little cyclical importance.

Theory with Both Extensive and Intensive Margins

Preferences:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{c_t^{1-1/\sigma}}{1-1/\sigma} - \nu \left(\frac{h_t^{1+1/\eta}}{1+1/\eta} + \psi \right) e_t \right\}$$

Production:

$$y_t = z_t k_t^{\alpha} (e_t h_t)^{1-\alpha}$$

Search Frictions:

- Matching Technology: $m_t = v_t^{\phi} f(u_t)$
- Vacancy-posting cost: κ
- Separation rate: δ

Intensive-Margin Wedge

$$\begin{aligned} ln(\mu_t) &\equiv ln(mpn_t) - ln(mrs_t) \\ &= ln\left(\frac{y_t}{n_t}\right) - \left[\frac{1}{\sigma} ln(c_t) + \frac{1}{\eta} ln(h_t)\right] \end{aligned}$$

- h_t = hours per *worker*
- $\eta = 0.5$
- $\sigma = 0.5$

Cyclicality of Intensive-Margin Labor Wedge

$$ln(\mu_t) = \alpha + \beta \cdot ln(cyc_t) + \epsilon_t$$

	Elasticity wrt GDP
Labor Wedge	-1.91 (0.13)
Labor Productivity	-0.10 (0.08)
Cons per capita	0.61 (0.03)
Hours per worker	0.30 (0.07)

- Quarterly data, 1987-2012 with $\sigma = 0.5$, $\eta = 0.5$

Extensive Margin Wedge

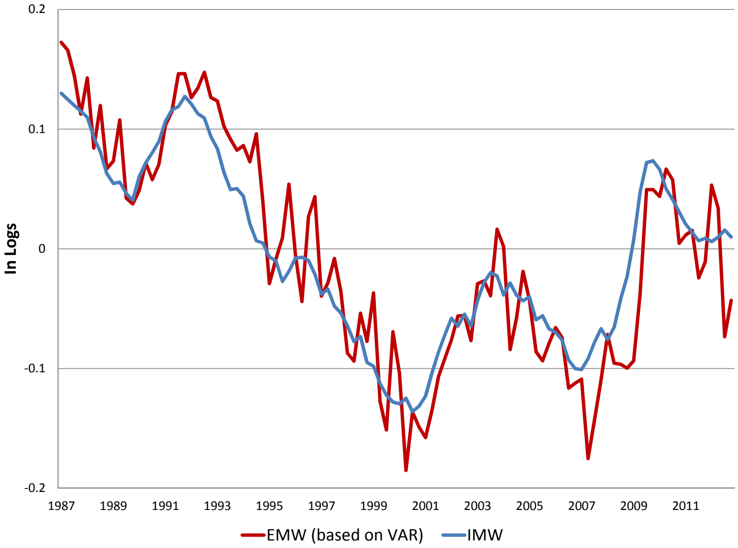
Consider spending today to generate one more matched worker, then reduce spending next period to cut matches by $1-\delta$ workers:

$$EMW \approx ln(y/n) - 1/\sigma \cdot ln(c) - \textit{dynamic cost of vacancy matching}$$

So:

$$EMW - IMW = \frac{1}{\eta} ln(h) - \textit{dynamic cost of vacancy matching}$$

EMW vs. IMW


0.2
0.1
0
-0.1
-0.2
In Logs
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
EMW (based on VAR)
IMW

Cyclicality of EMW and IMW

	Elasticity wrt GDP	Total Hours
EMW	-1.89	-1.54
	(0.28)	(0.15)
IMW	-1.91	-1.38
	(0.13)	(0.05)

- Quarterly data, 1987-2012
- $\sigma = 0.5$, $\eta = 0.5$
- $\delta = 0.105$, $r = 0.004$, $\phi = 0.5$, $\frac{\kappa V}{m} = 0.4$, $\gamma = 0.16$
- Expectational terms in EMW constructed using VAR approach

Decomposing the Wedge

Decomposition:

$$\begin{aligned} ln(\mu_t) &= \left[ln\left(\frac{y_t}{n_t}\right) - ln\left(\frac{w_t}{p_t}\right)\right] + \left[ln\left(\frac{w_t}{p_t}\right) - \frac{1}{\sigma}ln(c_t) - \frac{1}{\eta}ln(h_t)\right] \\ &= ln(\mu_t^p) + ln(\mu_t^w) \end{aligned}$$

Cyclicality:

$$\begin{aligned} ln(\mu_t) &= \alpha + \beta \cdot ln(cyc_t) + \epsilon_t \\ ln(\mu_t^p) &= \alpha^p + \beta^p \cdot ln(cyc_t) + \epsilon_t \\ ln(\mu_t^w) &= \alpha^w + \beta^w \cdot ln(cyc_t) + \epsilon_t \end{aligned}$$

Note: $\beta = \beta^p + \beta^w$.

Wedge Decomposition: Standard Approach

	Elasticity wrt GDP
μ	-1.91 (0.13)
$\mu^p \left(\frac{w}{p} = AHE\right)$	-0.04 (0.13)

Alternative Wage Measures

Semi-elasticities wrt the Unemployment Rate (s.e.'s):

Average Hourly Earnings	-1.8 (0.7)
New-hire Wage	-3.0 (0.8)
User Cost of Labor	-5.2 (0.8)

Source: Kudlyak (2015) using the NLSY

Kudlyak (2014) User Cost of Labor

- **Question? What is wage cost of employing one more worker today?**
- **Typically treated as the flow wage rate, typically measured by average hourly earning**
- **But employment relationships are often long-lasting: wages reflect installment payments (Lazear, 1976, Hall, 1980)**
- **User cost is impact of hiring now, vs. next period on PDV of wage bill:**

$$UC_t^W \equiv E_t(PDV_t - \beta(1-\delta)PDV_{t+1}),$$

$$UC_t^W = w_{t,t} + E_t \sum_{\tau=t+1}^{\infty} (\beta(1-\delta))^{\tau-t}(w_{t,\tau} - w_{t+1,\tau}).$$

Measurement based on NLS fixed-effect regresssions

			With industry controls	
	Full sample	New hires only	Full sample	New hires only
	(1)	(2)	(3)	(4)
$u_{current}$	-1.78**	-3.00***	-2.02**	-2.99***
	(0.72)	(0.78)	(0.93)	(0.92)
Grade	7.98***	12.52***	7.42***	11.67***
	(1.52)	(1.65)	(1.55)	(1.98)
Experience	4.22**	8.28***	3.71*	7.77***
	(1.66)	(1.75)	(1.84)	(2.10)
Experience^2	-0.13***	-0.14***	-0.14***	-0.15***
	(0.02)	(0.02)	(0.02)	(0.02)
Tenure	3.55***	4.02	3.71***	7.57
	(0.23)	(4.60)	(0.29)	(4.95)
Tenure^2	-0.11***	3.29	-0.13***	-0.29
	(0.02)	(4.30)	(0.02)	(4.64)
Trend	1.03	-3.52**	1.55	-2.95
	(1.74)	(1.70)	(1.86)	(2.04)
Union dummy	0.19***	0.17***	0.16***	0.15***
	(0.01)	(0.02)	(0.01)	(0.02)
Industry dummies	x	x	yes	yes
Observations	52593	19406	46753	16963
R-squared	0.529	0.472	0.558	0.507

Note – The data in Columns 1 and 2 are from NLSY79, men only, 1978 - 2004. The sample of new hires is restricted to observations with tenure less than 1 year. The dependent variable is the natural logarithm of real hourly wage. All regressions are estimated with fixed effects using sampling weights. Unemployment rate is the annual unemployment rate. Columns 3 and 4 include controls for 14 industries, and are estimated on the 1978 - 2002 sample because of the change in the industry classification between 2002 and 2004. The estimated standard errors are in parentheses, clustered by time. The coefficients and standard errors are multiplied by 100. P-values: ***p<0.01, ** p<0.05, * p<0.1.

Cyclicality of User Cost vs. Ave. Hrly Earnings

Cyclicality of the user cost of labor.

	Semi-elasticity with respect to unemployment	
Measure	Estimate	95% Confidence Interval
User cost of labor, UC_t^W	−5.20*** (0.76)	−6.69 … −3.71
Wage of new hires	−3.00*** (0.78)	−4.61 … −1.40
Average wage	−1.78** (0.72)	−3.26 … −0.30

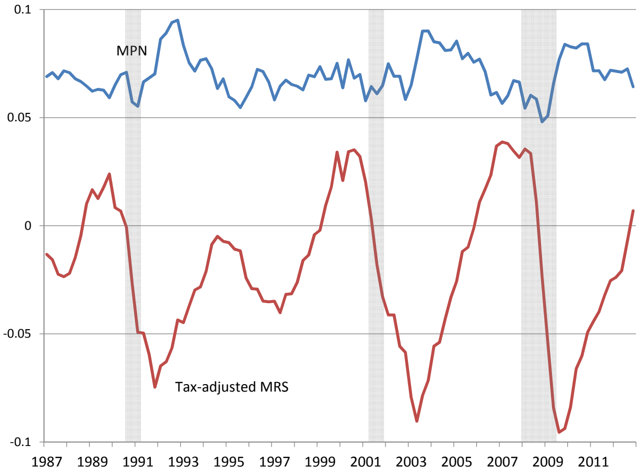
Note: The semi-elasticity is the coefficient on the unemployment rate from the regression of the (natural logarithm of the) respective series on the contemporaneous unemployment rate and other controls. The estimates for the user cost of labor are from the regression of the (natural logarithm of the) user cost of labor on the unemployment rate and a time trend (annual). There are 20 observations in the regression of the wage component of the user cost – from 1978 to 1997. The bootstrapped standard errors are in parentheses (1000 replications). All coefficients and standard errors are multiplied by 100.

Robustness

	# of years in calculating UC_t^W		
	5 years	7 years	9 years
UC_t^W, $\delta_t = const$	-5.03	-5.24	-5.33
	(0.77)	(0.81)	(0.83)
UC_t^W, δ_t	-5.02	-5.19	-5.27
	(0.80)	(0.76)	(0.81)
UC_t^W, $\delta_{t0,t}$	-4.79	-4.91	-4.89
	(0.16)	(0.59)	(0.70)

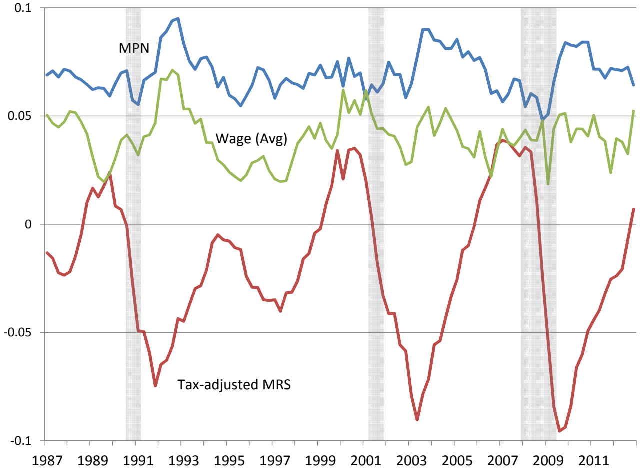
Note - The estimates are from the regression of the natural logarithm of the wage component of the user cost of labor on the unemployment rate and a time trend (annual). There are 18 observations in each regression - from 1978 to 1995. The bootstrapped standard errors are in parentheses (1000 replications). All coefficients and standard errors are multiplied by 100. The three rows reflect different ways of treating the separation rates in the construction of the wage component of the user cost of labor: 1) constant separation rate, $\delta_t = const$; 2) separation rate that depends on the current period, δ_t; and 3) separation rate that depends both on the current period and the period when the job started, $\delta_{t0,t}$.

Wedge

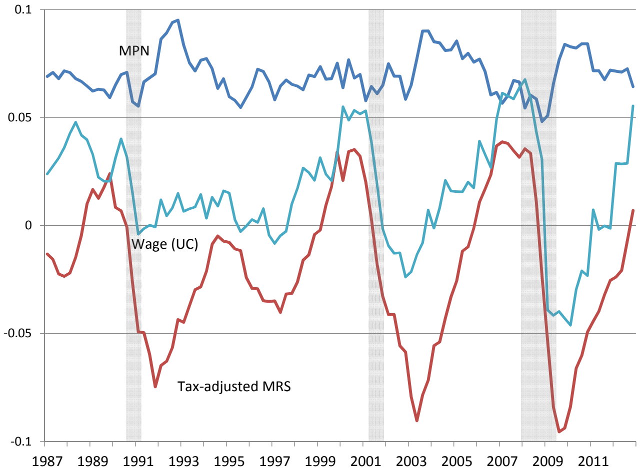


0.1
0.05
0
-0.05
-0.1
MPN
Tax-adjusted MRS
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011

Wedge Decomposition: Avg Wage



Wedge Decomposition: User Cost of Labor



EMW and IMW Decomposition

$$EMW = \left[ln\left(\frac{y/n}{w/p}\right) - \tilde{S}\right] + \left[ln\left(\frac{w}{p}\right) + \tilde{S} - S - \frac{1}{\sigma}ln(c) - ln(\Omega)\right],$$

where $\tilde{S} = S$, but with $\phi = 1$.

$$IMW = \left[ln\left(\frac{y/n}{w/p}\right)\right] + \left[ln\left(\frac{w}{p}\right) - \frac{1}{\sigma}ln(c) - \frac{1}{\eta}ln(h)\right]$$

Elasticity wrt GDP	EMW	IMW
μ	-1.89 (0.28)	-1.91 (0.13)
$\mu^p\left(\frac{w}{p} = AHE\right)$	-0.32 (0.13)	-0.04 (0.13)
$\mu^p\left(\frac{w}{p} = NH\right)$	-0.98 (0.16)	-0.70 (0.16)
$\mu^p\left(\frac{w}{p} = UC\right)$	-2.17 (0.21)	-1.89 (0.21)

Outline

Measuring the Labor Wedge

- Fous on Intensive Margin
- Decompose using Wage Data

Our 2 Alternative Decompositions

1. Self-Employed
2. Intermediate Inputs

Approach 1: Self-Employed

Idea:

- Compare the wedge for the self-employed (μ_{se}) to the wedge for all workers (μ).
- Assuming $\mu_{se} = \mu_{se}^{p} = \mu^{p}$, comparison yields μ^{p} vs. μ.

Focus on intensive (hours) margin

- Extensive movements could reflect costs of starting business

Data on Self-Employed

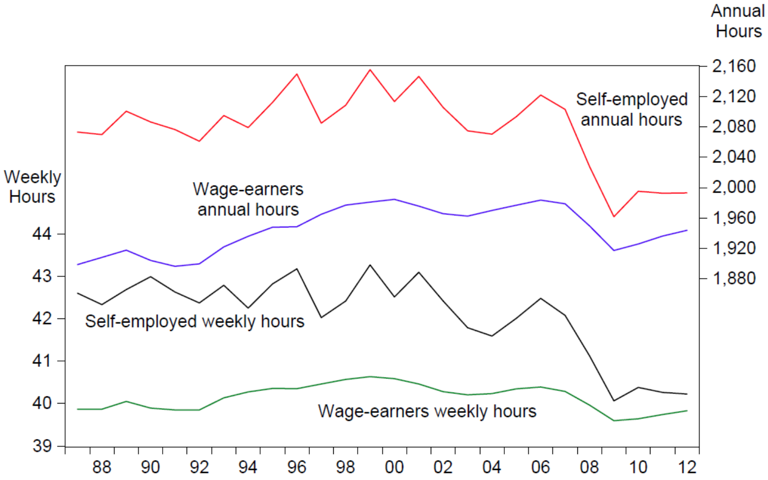
Hours and Earnings: March CPS

- "Self-employed"
  - Primary job is (nonag) self-employment.
  - 95% of earnings from primary job
- Trim sample to deal with top and bottom coding
- Hours: usual weekly hours (also total annual hours)
- Earnings from primary job
- Examine year-to-year changes for "matched" workers

Consumption: Consumer Expenditure Survey

- Construct *relative* consumption of self-employed

Hours: Self-Emp vs. Wage-Earn (Repeated CPS)



Weekly Hours cyclicality (wrt GDP): 0.37 (0.14), 0.20 (0.02)

Annual Hours cyclicality (wrt GDP): 0.57 (0.18), 0.39 (0.04)

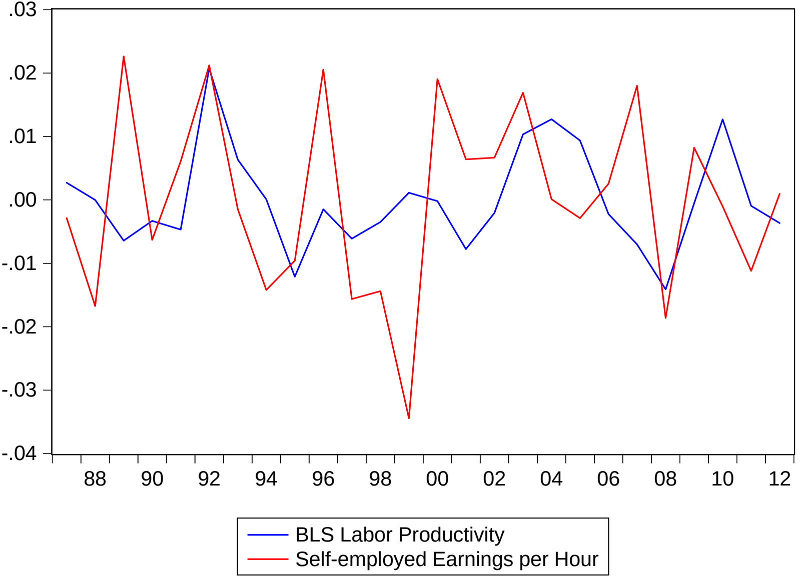
Annual Hours: Self-Emp vs. Wage Earn (Matched)

Cyclicality (wrt GDP): 0.54 (0.13), 0.57 (0.07)

Weekly Hours: Wage-Earn vs. Self-Emp (Matched)

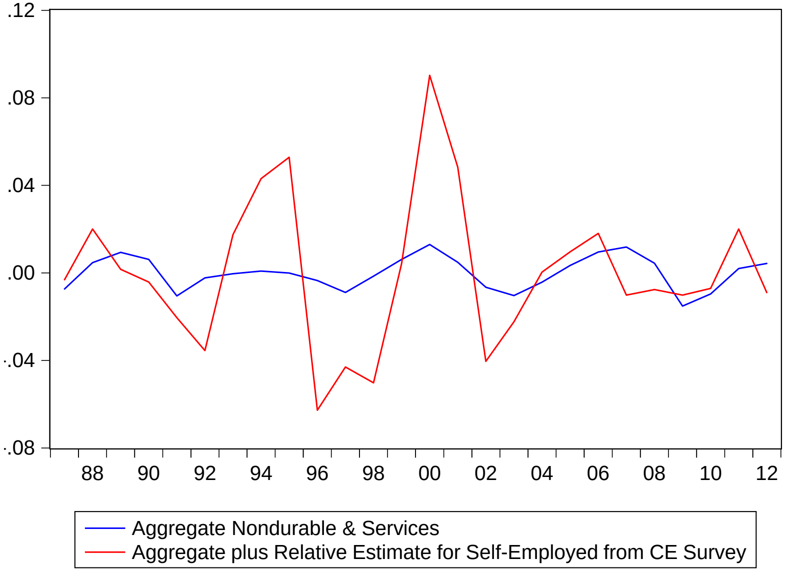
Cyclicality (wrt GDP): 0.17 (0.03), 0.28 (0.07)

Productivity: All Workers vs. Self-Emp



Cyclicality (wrt GDP): -0.21 (0.07), -0.13 (0.19)

Consumption: All Workers vs. Self-Emp



Cyclicality (wrt GDP): 0.64 (0.04), 1.27 (0.56)

Cyclicality of the Labor Wedge: All vs. Self-Employed

	Labor Wedge			
Elasticity wrt	(1)	(2)	(3)	(4)
Real GDP	-1.87 (0.10)	-2.06 (0.17)	-1.97 (0.25)	-3.23 (1.00)
Hours	All	SE	SE	SE
MPN	Agg. y/n	Agg. y/n	SE earn/hr	SE earn/hr
Consumption	NIPA PCE	NIPA PCE	NIPA PCE	NIPA PCE + CE adj.

Labor Wedge for Self-Employed vs. All Workers

Self-Employed Conclusions

(Baseline) self-employed wedge is at least as countercyclical as all-worker wedge.

Robustness:

1. Use only *unincorporated* self-employed
2. Weight CPS observations by industry
3. Weight CPS observations by share of self-employed in industry-occupation that have employees

Conclusion: μ^p accounts for the bulk of cyclical variation in μ.

Outline

Measuring the Labor Wedge

- Focus on Intensive Margin
- Decompose using Wage Data

Our 2 Alternative Decompositions

1. Self-Employed
2. Intermediate Inputs

Approach 2: Intermediate Inputs

Production function:

$$y = \left[\theta m^{\frac{\varepsilon-1}{\varepsilon}} + (1-\theta)\left[z_v\left[\alpha k^{\frac{\omega-1}{\omega}} + (1-\alpha)(z_n n^{\frac{\omega-1}{\omega}})\right]^{\frac{\omega}{\omega-1}}\right]^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}$$

Marginal Product wrt Intermediates:

$$mpm_t = \theta\left(\frac{y_t}{m_t}\right)^{\frac{1}{\varepsilon}}$$

Product Market Wedge:

$$\mu_t^p = \frac{p_t}{mc_t} = \frac{p_t}{p_{mt}/mpm_t}$$

Constructing μ_i^p

Product Market Wedge

$$\mu_{it}^{p} = \frac{p_{it}\, y_{it}}{p_{m,it} m_{it}} \left(\frac{y_{it}}{m_{it}} \right)^{\frac{1}{\varepsilon}-1}$$

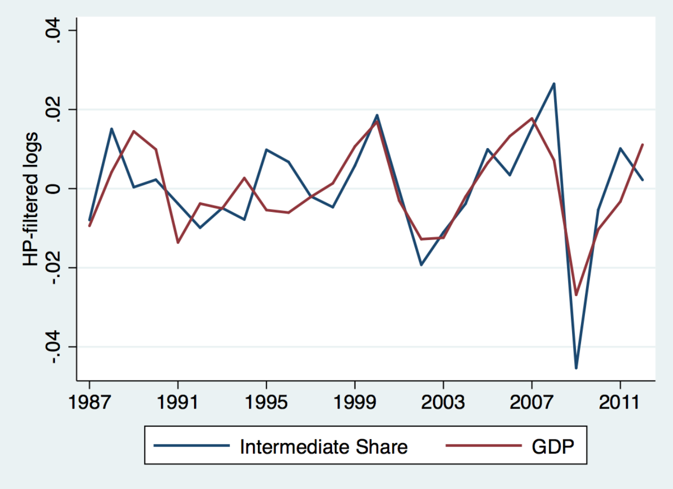
BLS Multifactor Productivity Database

- Annual data, 1987-2012
- 60 industries (18 manufacturing)
- Output and KLEMS inputs, nominal and real

Baseline: $\varepsilon = 1$

- Robustness: $\varepsilon < 1$

Cyclicality of Intermediate Share



Cyclicality of Intermediates-based μ^p

$$ln\left(\mu_{it}^p\right) = \alpha_i + \beta^p \cdot ln(cyc_t) + \epsilon_{it}$$

	Elasticity wrt GDP
All Industries	-0.94 (0.24)
Manufacturing	-0.95 (0.32)
Non-Manufacturing	-0.94 (0.24)

- Baseline estimates with $\varepsilon = 1$.

Intuition for Intermediates Results

- If w and p_m reflect true shadow prices, then (for $\varepsilon = 1$)

$$\frac{w\,n}{p_m m} = const.$$

- But empirically, intermediate expenditures more procyclical than labor expenditures $\Rightarrow$ intermediates-based μ^p is more countercyclical.

$$ln\left(\mu^p\right) = ln\left(\frac{p\,y}{p_m m}\right) = ln\left(\frac{p\,y}{w\,n}\right) + ln\left(\frac{w\,n}{p_m m}\right)$$

- Possible reconciliation: w doesn't reflect true shadow price.

Industry-level Labor Wedge (μ_i)

Preferences:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{c_t^{1-1/\sigma}}{1-1/\sigma} - \nu \sum_i \left[\left(\frac{h_{it}^{1+1/\eta}}{1+1/\eta} + \psi \right) e_{it} \right] \right\}$$

Marginal Product wrt Labor (for $\varepsilon = \omega = 1$):

$$mpn_{it} = \frac{y_{it}}{n_{it}}$$

Labor Wedge (intensive-margin):

$$ln\,(\mu_{it}) = ln \left(\frac{p_{it}\, mpn_{it}}{p_t\, mrs_{it}} \right) = ln \left(\frac{p_{it}}{p_t} \frac{y_{it}}{n_{it}} \right) - \left[\frac{1}{\sigma} ln(c_t) + \frac{1}{\eta} ln(h_{it}) \right]$$

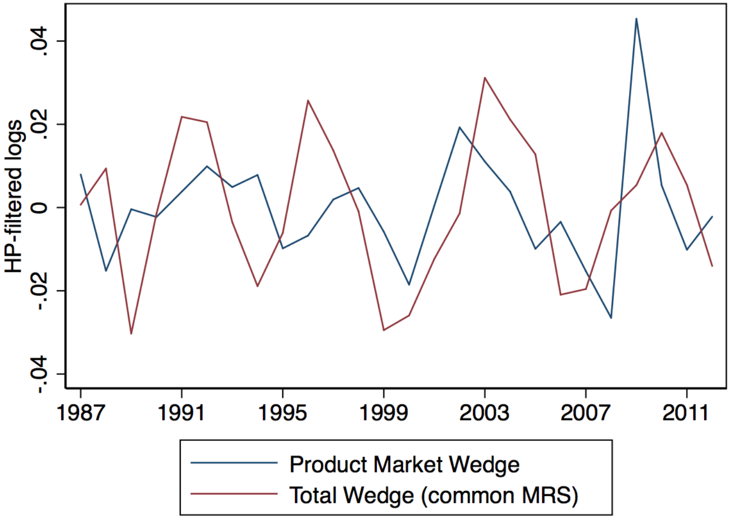
Cyclicality of *Industry-level* Labor Wedge (μ_i)

$$ln(\mu_i) = ln\left(\frac{p_i v_i}{p n_i}\right) + ln\left(\frac{y_i}{v_i}\right) - \left[\frac{1}{\sigma} ln(c) + \frac{1}{\eta} ln(h_i)\right]$$

	Elasticity wrt GDP
All Industries	-0.89 (0.26)
Manufacturing	-0.72 (0.39)
Non-Manufacturing	-0.93 (0.24)

- Baseline estimates with $\varepsilon = 1$.

Intermediates-based μ^p vs. Total Labor Wedge μ



Role of μ^p in μ, with $\varepsilon < 1$

- $\varepsilon < 1 \Rightarrow \mu_i^p$ *more* countercyclical

$$ln\left(\mu_{it}^p\right) = ln\left(\frac{p_{it}\; y_{it}}{p_{m,it} m_{it}}\right) + \left(\frac{1}{\varepsilon} - 1\right) ln\left(\frac{y_{it}}{m_{it}}\right)$$

- $\varepsilon < 1 \Rightarrow \mu_i$ *less* countercyclical

$$ln\left(\mu_{it}\right) = ln\left(\frac{p_{it}}{p_t}\frac{y_{it}}{n_{it}}\right) + \left(\frac{1}{\varepsilon} - 1\right) ln\left(\frac{y_{it}}{v_{it}}\right) - ln\left(mrs_{it}^h\right)$$

- $\therefore \varepsilon < 1 \Rightarrow \mu^p$ accounts for > 100% of cyclicality of μ.

Outline

Measuring the Labor Wedge

- Examine both Extensive and Intensive Margins
- Decompose using Wage Data

Our 2 Alternative Decompositions

1. Self-Employed
2. Intermediate Inputs

Discuss Other *Non-Wage* Decompositions

Other ways to get price markups without wage data

- Capital expenditures (Galeotti and Schiantarelli, 1998)
- Advertising (Hall, 2014)
- Inventories
  - Finished goods inventories
    - Bils and Kahn, 2000
    - Kryvtsov and Midrigan, 2012
  - Work-in-process inventories (appendix)

Summary of other ways to get price markups

- Capital expenditures $\Rightarrow$ countercyclical markups
- Advertising $\Rightarrow$ acyclical markups (maybe)
- Inventories $\Rightarrow$ countercyclical markups

All involve dynamics, requiring one to measure any adjustment costs and the stochastic discount factor.

Self-Employed and Intermediates require only static measurements.

Conclusion

Our point estimates: μ^p accounts for the cyclical variation in μ

- Self-Employed μ is just as cyclical as all-worker μ
- Intermediate Inputs μ^p is just as cyclical as μ

Countercyclical price markups deserve a central place in business cycle research, alongside labor market frictions.

- Sticky prices
- Customer base and/or learning-by-doing + financial shocks
- Countercyclical risk or risk-aversion

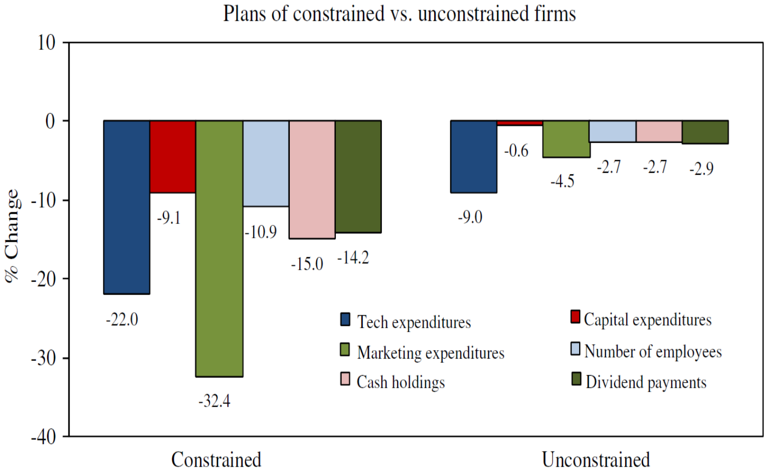
Some approaches to Cyclical L^D

- Financial Frictions and Fluctuations in Volatility, by Arellano, Bai, and Kehoe

- Asset Prices and Unemployment Fluctuations, by Kehoe, Lopez, Midrigan, and Pastorino

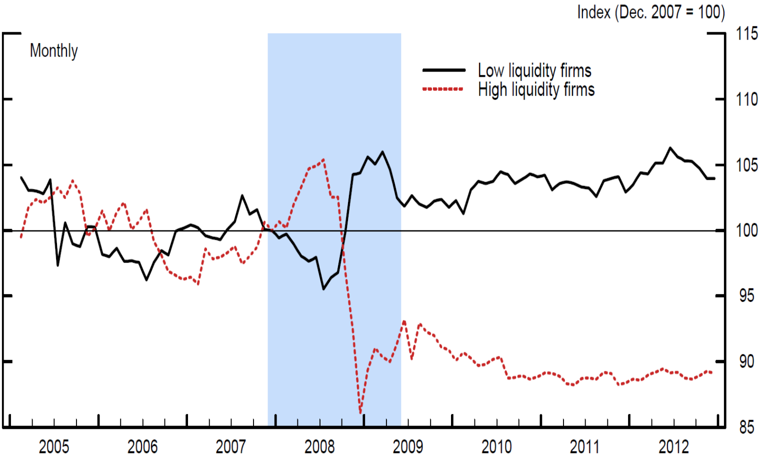
- Cyclicality in Markup, some examples
  - Rotemberg and Woodfood (1999 Handbook)
  - Gilchrist, Schoenle, Sim and Zakrajsek (2015)

Evidence for financial constraints



Source: Campello, Graham and Harvey (2010)

Evidence on relative prices



Source: Gilchrist, Schoenle, Sim and Zakrajšek (2015)

Financial Frictions and Fluctuations in Volatility
by Arellano, Bai, and Kehoe (2017)

Motivation

Recent recession

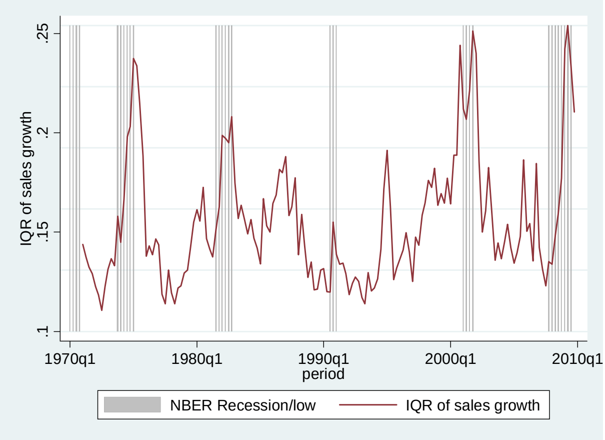
- Output and labor drop, accounted for
  - Mainly by a worsening of labor wedge
  - Less by a fall in TFP

Popular story

- Increase in “uncertainty” at firm level
- Interacts with financial frictions

$\Rightarrow$ Firms shrink level of employment

Interquartile range sales growth 1970-2010



- Dispersion has increased in many recessions
- Not arguing that recessions driven solely by uncertainty shocks

Key Elements in Model

- Firms produce before knowing current idiosyncratic demand shock
  - In high states 'too small' and in low states 'too big'
- Firms have limited ability to insure idiosyncratic shock
  - If scale too big, can't pay wage bill and might default
- Costly default
  - Liquidated, so lose future profits that are covering entry cost

$\Longrightarrow$ Labor wedge

- Risk of default create a wedge between MPL and wage

Volatility shock generates labor-wedge driven recession

- Increase in volatility
  - Increases risk of default for a given scale
  - Induces firms to choose smaller scale
  - So increases wedge between MPL and wage

Simple Example

Simple Example

- Period 1:
  - Firms hire labor and produce before the productivity shock z
  - Firms are liquidated if dividend is negative
- Period 2:
  - Firms get future value V only if not liquidated

Complete financial markets

- Firms choose ℓ to maximize the expected value

$$\max_{\ell} \int_0^{\infty} \left[z\ell^{\theta} - w\ell + V \right] f(z) dz$$

- Optimal scale chosen to maximize short term profits

$$\underbrace{\theta \ell^{\theta-1} E z}_{\text{value } MPL} = w$$

- Use state-contingent debt to pay dividends and avoid liquidation

Incomplete financial markets

- Firms are liquidated when demand shocks are low ($z < \hat{z}$)
  - For each ℓ, $\hat{z}$ is lowest z s.t. $z\ell^\theta \geq w\ell$
- Firms choose $(\ell, \hat{z})$ to maximize the expected value

$$\max_{\ell,\hat{z}} \int_{\hat{z}}^{\infty} \left[z\ell^\theta - w\ell\right] f(z)dz + \int_{\hat{z}}^{\infty} V f(z)dz$$

s.t

$$z\ell^\theta - w\ell = 0$$

- Optimal scale chosen to maximize short term profits *and* future value

$$\underbrace{\theta\ell^{\theta-1}E[z|z \geq \hat{z}]}_{MPL} = w + \underbrace{V\frac{f(\hat{z})}{1-F(\hat{z})}\frac{d\hat{z}}{d\ell}}_{\text{Wedge}}$$

Incomplete financial markets

$$\underbrace{\theta \ell^{\theta-1} E[z|z \geq \hat{z}]}_{MPL} = w + \underbrace{V \frac{f(\hat{z})}{1-F(\hat{z})} \frac{d\hat{z}}{d\ell}}_{\text{Wedge}}$$

- Optimal labor may higher than the efficient case since $E(z|z \geq \hat{z}) \geq Ez$
- When V is large enough, incomplete market has lower scale than the complete market model
- Increased volatility reduces labor and output and worsens labor wedge

Model

Our model

Dynamic general equilibrium model with

- Households (standard)
  - Provide labor
  - Sell uncontingent debt to firms
  - Own firms
- Final goods firms
  - Aggregate intermediate goods with CES aggregator
- Firms

Financial frictions

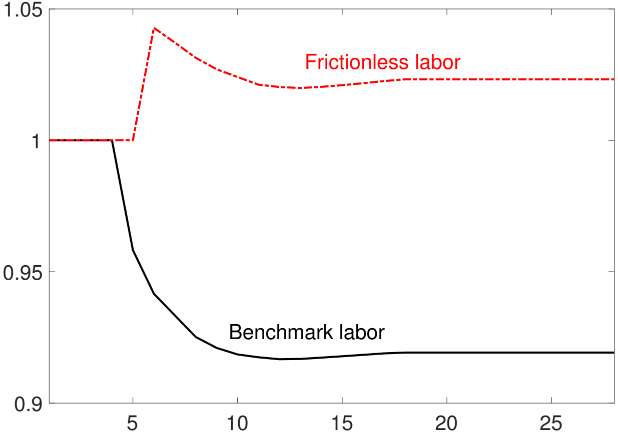
- Limited liability, dividend has to be nonnegative
- Firm can only borrow state uncontingent bond, but can default
  - Defaulting firms receive zero value and exit
  - If output is less than labor costs, the government pays the gap
- Agency friction as in Jensen (1986)
  - Manager may secretly borrow the unused credit and use for his own benefit
  - Shareholders understand this incentive of diverting and prefer overborrowing

Experiments and Results

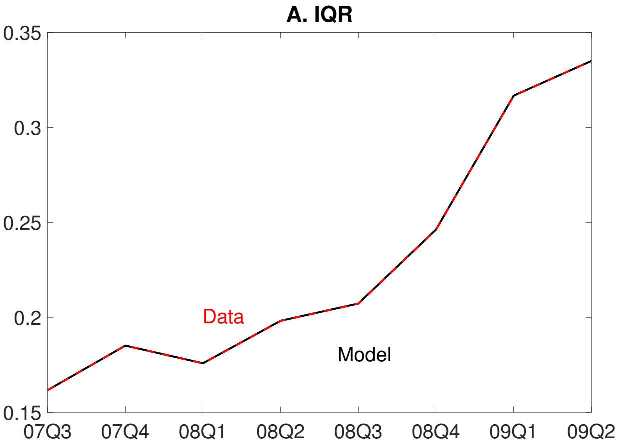
Quantifying volatility shocks

- Use cross-section firm dispersion to parameterize volatility shocks
- As in Bloom (2009), we restrict the sample for firms to those with at least 100 quarters of observations since 1970
- Firm dispersion:
  - Interquartile range of sales growth (differences between 75% and 25%)

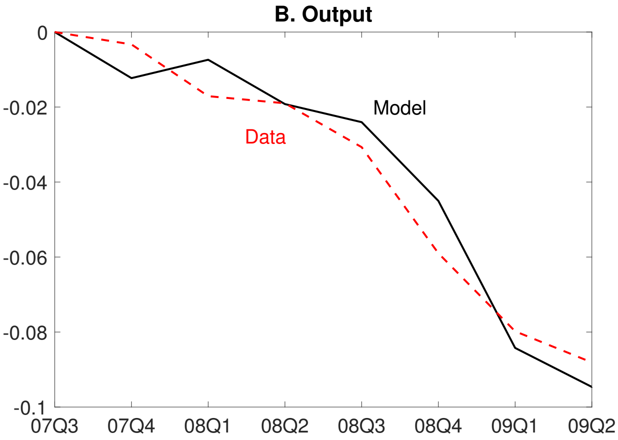
Firm Labor Impulse Responses



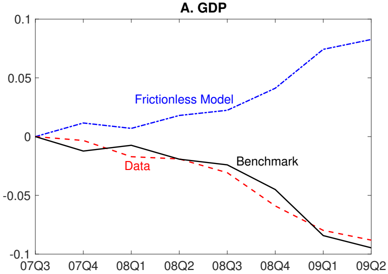
Great Recession Event



Great Recession Event



Great Recession Event, Frictionless Financial Markets



Conclusion

- Framework that combines volatility shocks with financial markets imperfections
- Generates movements in output, labor, and the labor wedge linked to financial frictions