Cheap Thrills: the Price of Leisure and the Decline of Work Hours

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Motivation

- Large decline in work hours observed in the United States

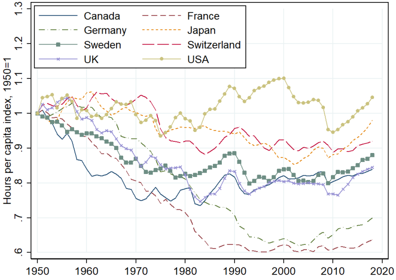
(a) Hours per capita (b) Hours per worker

Panel (a): Annual hours worked over population of 14 years and older. Source: Kendrick, 1961 (hours, 1990-1947); Kendrick et al., 1973 (hours, 1948-1961); Carter et al., 2006 (population, 1900-1961); ASEC (total, male and female hours per capita, 1962-2018). Panel (b): Annual hours worked over number of employed. Source: Bureau of the Census, 1975 (1900-1947); FRED (1947-2018).

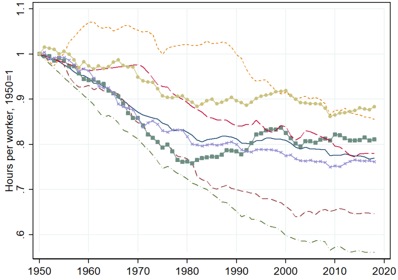
▸ ATUS

Motivation

- Pattern holds in a cross-section of countries
  - Hours per capita: average growth -0.27% per year
  - Hours per worker: average growth -0.41% per year



(a) Hours per capita



(b) Hours per worker

Panel (a): Annual hours worked over population between 15 and 64 years old. Source: Total Economy Database and OECD. Panel (b): Annual hours worked over number of employed. Source: Total Economy Database.

All countries

Motivation

- Understanding why hours are declining is critical for forecasting, policy evaluation, welfare computations, etc.
- One explanation: Higher wages lead to fewer hours worked (Keynes, 1930)
  - Average growth rate: 1.88% per year

- If income effect dominates the substitution effect $\rightarrow$ Decline in hours

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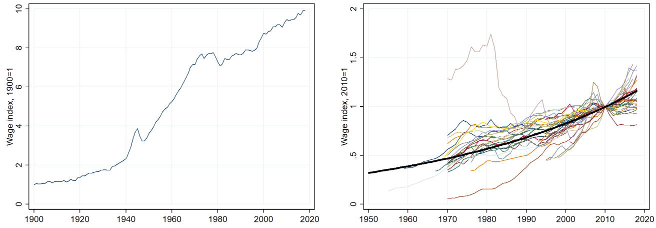

(a) U.S. (b) All countries

Panel (a): Real labor productivity. Source: Kendrick, 1961 (real gross national product divided by hours, 1900-1928); FRED (1929-2018).
Panel (b): OECD Real compensation of employees divided by hours worked.

Figure: Real employee compensation per hour

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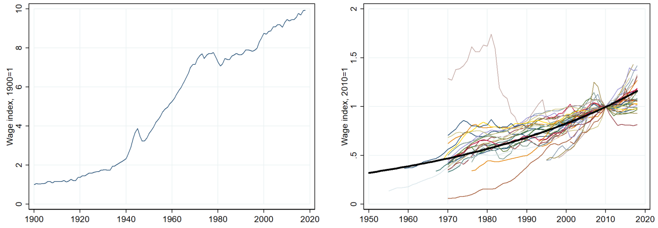

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Motivation

- But in the cross-section: high-income people work more (in wealthy countries)
  - Bick, Fuchs-Schundeln, and Lagakos (2018) ▸ Evidence
- Alternative explanation: Leisure is becoming cheaper (and better!)
  - Real price of a television divided by 1000 since 1950 (CPI BLS) ▸ Details
  - Real price of a computer divided by 50 since 1997 (CPI BLS) ▸ Details
  - Now
    - Netflix: $8.99/month for unlimited movies/shows watching
    - Spotify: $9.99/month for unlimited music listening
    - Apple iOS Store: 900,000 games, 2/3 are free

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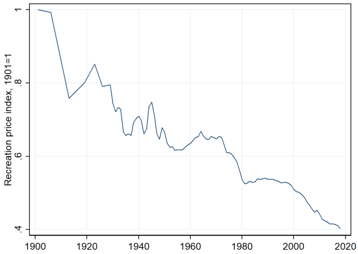
Motivation

- Real price of recreation goods and services are declining in all countries
  - Average growth rate: -1.07% per year



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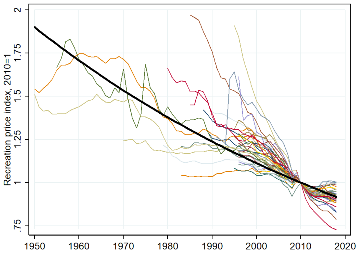

(b) All countries

Figure: Real price of recreation goods and services

Panel (a): Real price of recreation goods and services. Source: Owen, 1970 (real recreation price, 1900-1934); Bureau of the Census, 1975 (real price of category 'Reading and recreation', 1935-1966); BLS (real price of category 'Entertainment', 1967-1992); BLS (real price of category 'Recreation', 1993-2018). Series coming from different sources are continuously pasted. Panel (b): Price of consumption for OECD category "Recreation and culture", normalized by price index for all consumption items. Eurostat, Statistics Canada. Base year = 2010.

▸ Selected countries

This paper

We investigate whether this decline in recreation prices can account for (part of) the decline in hours worked

- Reduced-form empirical evidence using various datasets
  - Across U.S. regions and demographic groups, across countries, country by country
    - Impact of wages is mixed: sometimes income effect dominates, sometimes substitution effect dominates
    - Impact of leisure prices unambiguously pushes for fewer hours
- Build a model of labor supply in a balanced-growth path framework
  - Keep utility function as general as possible
  - Derive structural relationships between hours, wages and leisure prices
  - Structural estimation of the model
  - Still strong effect on recreation prices on hours worked

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Literature

- *Trends in hours and leisure*: Prescott (2004), Greenwood and Vandenbroucke (2005), Rogerson (2006), Aguiar and Hurst (2007), Ramey and Francis (2009), Aguiar, Bils, Charles, and Hurst (2017), Boppart and Krusell (2020).

- *Recreation prices and hours*: Owen (1971), Gonzalez-Chapela (2007), Vandenbroucke (2009), Kopecky (2011).

- This paper: role of recreation prices in long-run decline of hours

Reduced-form evidence

Outline:

1. U.S. regressions using cross-region variation over time
2. U.S. regressions using variation across regions and demographic groups over time
3. Cross-country regressions
4. Country-by-country regressions

Data: United States

- Annual data from 1978 to 2018
- Hours worked and labor income from the ASEC supplement to CPS, as well as from the Census/ACS.
- Recreation price data is from BLS, available for four Census regions (Northeast, Midwest, South, and West)
- Consumption data is from the CE Surveys (1980–2018); classification of expenditures on recreation and nonrecreation components follows Aguiar and Bils (2015)
- All nominal values are adjusted for inflation using regional consumer prices indices from BLS

▸ Price index

Data: International sample

- Annual data for 38 countries from 1950 (varies by country) to 2018
- Hours worked from the Total Economy Database
- Compensation of employees (from the OECD database) divided by hours as measure of wage
- Recreation prices are from the OECD database, Eurostat, and national statistical agencies
- Consumption data is from the OECD database
- All nominal values are adjusted for inflation using country-level consumer prices indices from the OECD database

Reduced-form evidence: United States

- Baseline regression

$$\Delta \log h_{lt} = \beta_0 + \beta_p \Delta \log p_{lt} + \beta_w \Delta \log w_{lt} + \gamma_l + \epsilon_{lt},$$

where h is hours per capita, p is the real recreation price, w is the real wage, l is a region, t is the year.

- We smooth out high-frequency fluctuations by averaging over n-period windows (benchmark $n = 3$)

$$\Delta \log x_t \equiv \frac{1}{n} \left[\log \left(\frac{1}{n} \sum_{\tau=t+n+1}^{t+2n} x_\tau \right) - \log \left(\frac{1}{n} \sum_{\tau=t}^{t+n} x_\tau \right) \right]$$

- Uses cross-sectional and time-series variation
- Interpretation: Growth rates of prices and wages receive occasional (unexpected) shocks

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United States: regions

$$\Delta \log h_{lt} = \beta_0 + \beta_p \Delta \log p_{lt} + \beta_w \Delta \log w_{lt} + \gamma_l + \epsilon_{lt},$$

	(1)	(2)	(3)	(4)
Dep. var.	Growth rate of hours per capita			
$\Delta \log p$	0.76^{***}		0.67^{***}	0.52^{***}
$\Delta \log w$		0.40^{***}	0.20^{**}	-0.34^{***}
B.C. controls	N	N	N	Y
Region FE	Y	Y	Y	Y
R^2	0.42	0.18	0.45	0.75
# observations	48	48	48	48

Notes: Growth rates are constructed using averaging windows of $n = 3$ years. Real per capita output is used as a business cycle control. Errors are robust to heteroscedasticity. $^{*}, ^{**}, ^{***}$ indicate significance at the 10%, 5%, and 1% levels, respectively.

Results:

- Higher growth in recreation prices is associated will lower growth in hours
- Effect of wages depends on specification
- Robust to using hours per workers and city-level price data

▸ Hours per workers ▸ Cities

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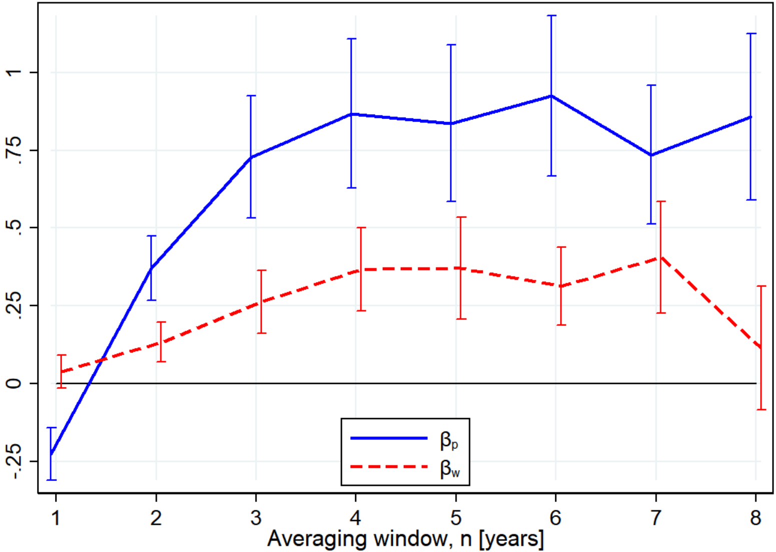
United States

- Vary the width of averaging window *n* (same regression as column 3)



United States: instrumental variables

- Identification concerns: omitted variables? measurement error?
- Potential issues:
  - A local shock destroys jobs which pushes people to purchase cheaper recreation goods
  - A local shock destroys jobs and lower wages at the same time
- Solution: use disaggregated data and create two instruments
  - One instrument for recreation prices that takes advantage of variation in the *types* of recreation items consumed by different demographics.
  - One instrument for wages that takes advantage of industrial composition across location and demographic groups.

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United States: instrumental variables

- Recreation prices instrument: Use variation in the *types* of recreation items consumed across demographic groups together with national movements in the price of these items.
- Example:
  - 25-34 years old without high-school diploma consume a lot of audio-video items.
  - A decline in the *national* price of these items will lead to a cheaper recreation basket for these people.
  - Since national movements are unlikely to be correlated with *local* shocks affecting labor supply/demand, we can use that instrument to tease out causality (we control for location FE).
- The instrument is

$$\Delta \log p_g^{IV} = \sum_j \underbrace{\frac{c_{jg}^0}{\sum_i c_{ig}^0}}_{\text{shares}} \Delta \log p_j^{US},$$

where c_{jg} denotes the nominal consumption expenditure of recreation items of type j by individuals in demographic group g.
- The shares are from 1980, before the period over which the growth rates are computed (1990 to 2010).

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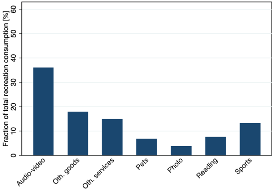
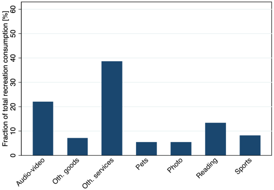
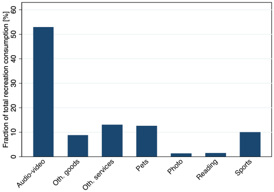
Recreation good bundles across groups, CEX



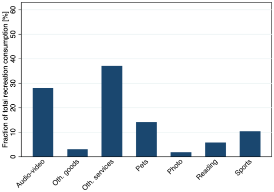
(a) No high school diploma, 25-34 years old, 1980-1988



(b) More than college, 50-64 years old, 1980-1988



(c) No high school diploma, 25-34 years old, 2010-2018

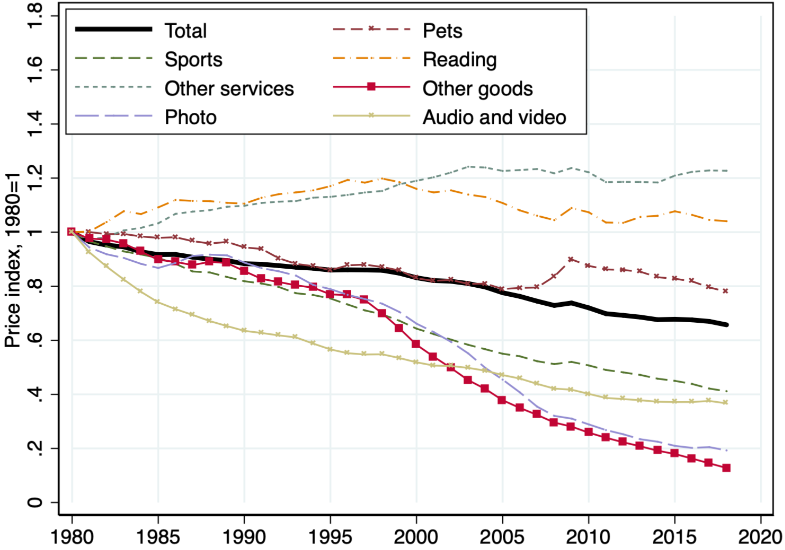


(d) More than college, 50-64 years old, 2010-2018

Shares of different items in total recreation consumption, constructed by pooling observations for the two periods, 1980-1988 and 2010-2018. Source: Consumer Expenditure Survey.

Prices of leisure goods over time

Trends vary widely across categories:



United States: instrumental variables

- Wage instrument (Bartik, 1991): Use variation in industry composition in location/demographic groups together with national movement in industry wages.
- Example:
  - 25-34 years old with advanced degree in Ithaca work disproportionately in Education
  - National movements in Education wages will affect their wages
  - Since national movements are unlikely to be correlated with *local* shocks affecting labor supply/demand, we can use that instrument to tease out causality (we control for location FE).
- Construct instrument for wages of 25-34 years old in Ithaca as

$$\Delta \log w_{gl}^{IV} = \sum_i \underbrace{\frac{e_{igl}^0}{\sum_j e_{jgl}^0}}_{\text{shares}} \Delta \log e_{ig}^{US} - \sum_i \underbrace{\frac{h_{igl}^0}{\sum_j h_{jgl}^0}}_{\text{shares}} \Delta \log h_{ig}^{US}$$

  where e is earnings, h is hours worked, i is an industry (34 in total), g is a demographic group (15 education/age groups), and l is a locality (543 Census locations).
- The shares are computed in 1980 to precede the period over which the growth rates are computed (1990 to 2010)

▸ Details ▸ Derivation

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▸ Details ▸ Derivation

United States: regional/demographic groups

Instrumental variable estimation:

$$\Delta \log h_{gl} = \beta_0 + \beta_p \Delta \log p_g + \beta_w \Delta \log w_{gl} + \gamma X_{gl} + \epsilon_{gl}$$

g is demographic group, l is geographic region.

	(1): IV	(2): IV	(3): IV
Dep. variable.	Growth in hours per capita $\Delta \log h$ between 1990 and 2010		
$\Delta \log p$	0.78^{***}	0.69^{***}	0.57^{***}
$\Delta \log w$	0.12^{**}	0.27^{***}	0.13
1980 manuf. empl.			-0.24^{***}
Locality F.E.	Y	Y	Y
Addtl. dem. cont.	N	Y	Y
F-statistics	295.4	312.4	136.4
# obs.	8145	8145	8145

Controls include manufacturing hours share in 1980, and a set of additional demographic controls. Errors are clustered at location level. F-statistics are Kleibergen-Paap. *,** ,*** indicate significance at the 10%, 5%, and 1% levels

Results:

- Strong impact of recreation prices on hours workers
- Limited evidence for a role for wages

International sample

Baseline regression

$$\Delta \log h_{It} = \beta_0 + \beta_p \Delta \log p_{It} + \beta_w \Delta \log w_{It} + \gamma_I + \epsilon_{It}$$

h is hours per capita, p is real recreation price, w is real wage, i is country, t is the year

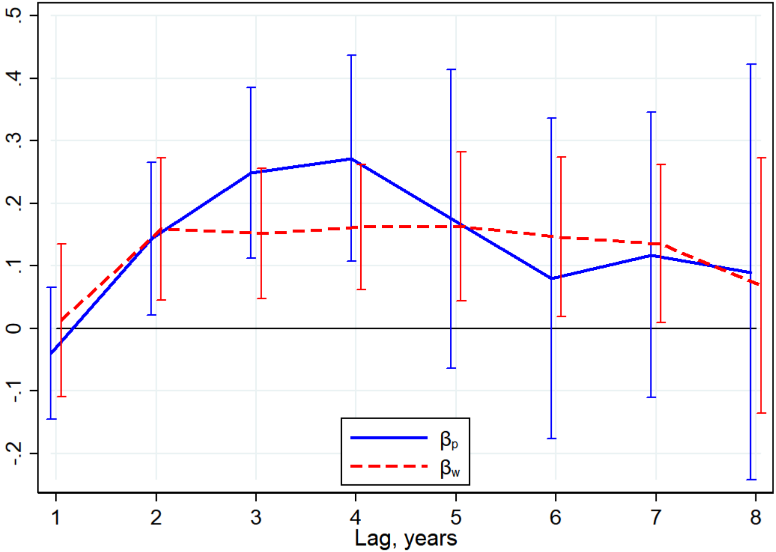
	(1)	(2)	(3)	(4)	(5)
Dep. var.	Growth rate of hours per capita $\Delta \log h$				
$\Delta \log p$	0.28^{***}		0.25^{***}	0.14^{*}	0.30^{***}
$\Delta \log w$		0.17^{***}	0.15^{**}	-0.18^{***}	
$\Delta \log y/h$					-0.24^{**}
B.C. controls	N	N	N	Y	N
Country FE	Y	Y	Y	Y	Y
R^2	0.10	0.12	0.15	0.46	0.14
# observations	290	290	290	290	290

Growth rates are constructed using averaging windows of $n = 3$ years. Country-specific growth in real per capita GDP is used as a business cycle control. Errors are clustered at the country level. $^{*}, ^{**}, ^{***}$ indicate significance at the 10%, 5%, and 1% levels, respectively.

Table: Cross-country regressions: impact of wage and recreation price growth on hours worked.

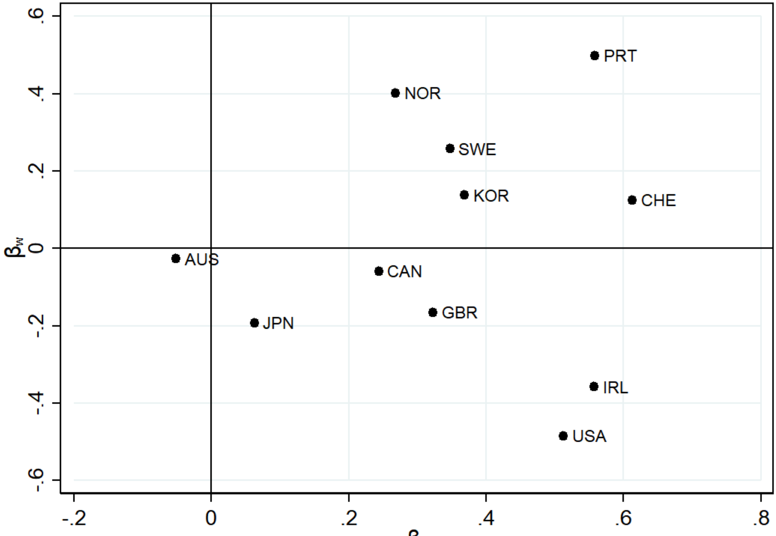
International sample

- Vary the width of averaging window n



Country-by-country regressions

- Run the same regression country by country
- Include only countries with at least 30 years of data available



Model

- Why do we need a model?
  - Are the relationships that we have estimated the correct ones?
  - How general are these relationships?
  - Are the coefficients that we estimated stable?
  - How do we interpret the coefficients?
  - Can we use information from other equations to better discipline the estimation?

Model

- Why do we need a model?
  - Are the relationships that we have estimated the correct ones? Yes
  - How general are these relationships? Quite a bit
  - Are the coefficients that we estimated stable? Yes
  - How do we interpret the coefficients? Part of preferences
  - Can we use information from other equations to better discipline the estimation? Yes

Model

- Household maximizes

$$\sum_{t=0}^{\infty} \beta^t u(c_t, d_t, h_t)$$

$$\text{s.t. } c_t + p_{dt} d_t + a_{t+1} = w_t h_t + a_t (1 + r_t)$$

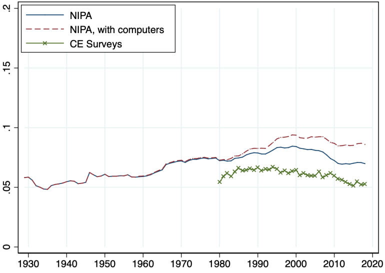
where d_t is recreation goods, p_{dt} is their price, and h_t is hours worked

  - Balanced-growth path assumptions on primitives
    - p_t and w_t grow at constant rates γ_{p_d} and γ_w
    - interest rate $r_t > 0$ is constant
    - straightforward to write down production sector microfound these
  - Balanced-growth path outcomes
    - c_t, d_t and h_t grow at constant (but perhaps different) rates

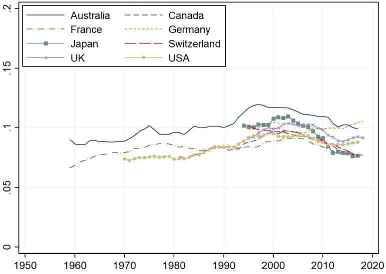
▸ BGP U.S. ▸ BGP All Countries ▸ Production

Model

- In addition to standard BGP assumption our model has constant recreation consumption shares.



(a) Recreation consumption share: United States



(b) Recreation consumption share: International sample

Panel (a): Fraction of recreation consumption in total consumption for the United States. Source: NIPA and CE Surveys. Panel (b): Fraction of recreation consumption in total consumption for a selected group of countries. Source: OECD.

Figure: Income, consumption, and recreation consumption.

Model

- The budget constraint

$$c_t + p_{dt} d_t + a_{t+1} = w_t h_t + a_t \left(1 + r_t\right)$$

imposes restrictions on growth rates

$$g_c = \gamma_{p_d} g_d = \gamma_w g_h$$

- Another restriction must come from preferences.
  - King et al. (1988): $g_c = \gamma_w$
  - Boppart and Krusell (2020): $g_c = \gamma_w^{1-\nu}$
  - Here: $g_c = \gamma_w^{\eta} \gamma_{p_d}^{\tau}$,where η and τ are constants
- Putting the restrictions together:

$$g_c = \gamma_w^{\eta} \gamma_{p_d}^{\tau},$$
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Definition 1 (Balanced-growth path preferences)

The utility function u is *consistent with a balanced-growth path* if it is twice continuously differentiable and has the following properties: for any $w > 0$, $p > 0$, $c > 0$, $\gamma_w > 0$ and $\gamma_p > 0$, there exist $h > 0$, $d > 0$ and $r > -1$ such that for any t

$$-\frac{u_h\left(c\left(\gamma_w^{\eta}\gamma_{p_d}^{\tau}\right)^t, h\left(\gamma_w^{\eta-1}\gamma_{p_d}^{\tau}\right)^t, d\left(\gamma_w^{\eta}\gamma_{p_d}^{\tau-1}\right)^t\right)}{u_c\left(c\left(\gamma_w^{\eta}\gamma_{p_d}^{\tau}\right)^t, h\left(\gamma_w^{\eta-1}\gamma_{p_d}^{\tau}\right)^t, d\left(\gamma_w^{\eta}\gamma_{p_d}^{\tau-1}\right)^t\right)} = w\gamma_w^t,$$

$$\frac{u_d\left(c\left(\gamma_w^{\eta}\gamma_{p_d}^{\tau}\right)^t, h\left(\gamma_w^{\eta-1}\gamma_{p_d}^{\tau}\right)^t, d\left(\gamma_w^{\eta}\gamma_{p_d}^{\tau-1}\right)^t\right)}{u_c\left(c\left(\gamma_w^{\eta}\gamma_{p_d}^{\tau}\right)^t, h\left(\gamma_w^{\eta-1}\gamma_{p_d}^{\tau}\right)^t, d\left(\gamma_w^{\eta}\gamma_{p_d}^{\tau-1}\right)^t\right)} = p_d\gamma_{p_d}^t,$$

and

$$\frac{u_c\left(c\left(\gamma_w^{\eta}\gamma_{p_d}^{\tau}\right)^t, h\left(\gamma_w^{\eta-1}\gamma_{p_d}^{\tau}\right)^t, d\left(\gamma_w^{\eta}\gamma_{p_d}^{\tau-1}\right)^t\right)}{u_c\left(c\left(\gamma_w^{\eta}\gamma_{p_d}^{\tau}\right)^{t+1}, h\left(\gamma_w^{\eta-1}\gamma_{p_d}^{\tau}\right)^{t+1}, d\left(\gamma_w^{\eta}\gamma_{p_d}^{\tau-1}\right)^{t+1}\right)} = \beta\left(1+r\right),$$

where $\eta > 0$ and $\tau > 0$.

Proposition 1

The utility function $u(c,h,d)$ *is consistent with a balanced-growth path (Definition 1) if and only if (save for additive and multiplicative constants) it is of the form*

$$u(c,h,d) = \frac{\left(c^{1-\varepsilon} d^{\varepsilon} v\left(c^{1-\eta-\tau} h^{\eta} d^{\tau}\right)\right)^{1-\sigma} - 1}{1-\sigma},$$

for $\sigma \neq 1$,

$$u(c,h,d) = \log\left(c^{1-\varepsilon} d^{\varepsilon}\right) + \log\left(v\left(c^{1-\eta-\tau} h^{\eta} d^{\tau}\right)\right),$$

for $\sigma = 1$, *and where* v *is an arbitrary twice continuously differentiable function and where* $0 < \eta$ *and* $0 < \tau$.

Implications of this proposition:

- Under our assumptions, the utility function must take that form
- Under this utility η and τ are preference parameters

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Model

- Structural relationships between growth rates are invariant to a broad class of utility functions

$$
\begin{aligned}
\log g_c &= \eta \log \gamma_w + \tau \log \gamma_{p_d}\,, \\
\log g_d &= \eta \log \gamma_w + (\tau - 1) \log \gamma_{p_d}\,, \\
\log g_h &= (\eta - 1) \log \gamma_w + \tau \log \gamma_{p_d}\,.
\end{aligned}
$$

- Key equation for us

$$
\log g_h = \underbrace{(\eta - 1) \log \gamma_w}_{(1)} + \underbrace{\tau \log \gamma_p}_{(2)}\,.
$$

Two channels:

1. Impact of growth in wages
   - If $\eta - 1 < 0$, income effect dominates substitution effect
2. Impact of growth in leisure prices
   - If $\tau > 0$, cheaper leisure leads to decline in hours growth

▸ Elasticities

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Elasticities

Structural estimation

- We estimate the three-equation system jointly

$$\begin{aligned}
\log g_c &= \eta \log \gamma_w + \tau \log \gamma_p \\
\log g_d &= \eta \log \gamma_w - (1-\tau) \log \gamma_p \\
\log g_h &= -(1-\eta) \log \gamma_w + \tau \log \gamma_p
\end{aligned}$$

- The third equation is the one we estimated earlier but the other two impose additional structure that help the estimation

- We had potential fixed effects and intercepts

$$\begin{aligned}
\Delta \log c_{lt} &= \alpha_c + \eta \Delta \log w_{lt} + \tau \Delta \log p_{lt} + \gamma_l + \epsilon_{lt}^c, \\
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  where l is location (U.S. region or country), t is time.

- Estimation by maximum likelihood

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- Estimation by maximum likelihood

Three equations MLE: United States

	(1)	(2)	(3)	(4)
τ	0.31	0.54	0.57	0.73
	$(0.08, 0.54)$	$(0.27, 0.81)$	$(0.30, 0.84)$	$(0.55, 0.91)$
$\eta - 1$	-0.22	-0.26	-0.25	0.00
	$(-0.39, -0.05)$	$(-0.42, -0.10)$	$(-0.41, -0.09)$	$(-0.20, 0.19)$
α_h	—	0.005	0.005	0.005
		$(0.002, 0.008)$	$(0.000, 0.011)$	$(0.002, 0.009)$
Av. window	$n = 3$	$n = 3$	$n = 3$	$n = 5$
Intercepts	N	Y	Y	Y
Region FE	N	N	Y	Y

Growth rates are constructed using averaging windows of $n = 3$ (columns 1 to 3) and $n = 5$ (column 4) years. 90% confidence intervals, constructued using heteroscedasticity-robust standard errors, are reported between parentheses. The parameters are estimated using maximum-likelihood approach assuming that the error terms are jointly normal with a diagonal variance-covariance matrix.

- Key findings:
  - Recreation prices always have a negative effect on hours
  - Some more robust evidence of an income effect
    - The additional equations are important for this result

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- Key findings:
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Three equations IV-GMM: United States

Again, we might worry about endogeneity issues:

- Use our earlier instruments $\Delta \log w_{gc}^{IV}$ and $\Delta \log p_g^{IV}$ with the three-equation system

$$\Delta \log c_g = \alpha_c + \eta \Delta \log w_{gl} + \tau \Delta \log p_g + \epsilon_{gl}^c,$$
$$\Delta \log d_g = \alpha_d + \eta \Delta \log w_{gl} + (\tau - 1) \Delta \log p_g + \epsilon_{gl}^d,$$
$$\Delta \log h_{gl} = \alpha_h + (\eta - 1) \Delta \log w_{gl} + \tau \Delta \log p_g + \epsilon_{gl}^h,$$

  where j is demographic group (15 groups), i is geo. region, t is time

- Only cross-sectional variation
- We estimate that system with GMM

Three equations IV-GMM: United States

	(1)
τ	0.28
	$(0.15, 0.42)$
$\eta - 1$	-0.37
	$(-0.47, -0.27)$
α_h	0.003
	$(0.001, 0.005)$
J-statistic	9.19
p-value	0.056

Estimates from a two-step GMM procedure with instrument variables (see Section **??** for the definition of the instruments). Weight matrix accounts for arbitrary correlation within education-age groups. 90% confidence intervals are reported in parentheses. The last two rows report results of a test of the validity of over-identifying restrictions (Hansen's J-statistic and its p-value).

Table: GMM estimation of the system of equations using instruments.

Key findings:

- Rising recreation prices lower the growth rate in hours
- Income effect of rising wages dominates

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Three equations MLE: International sample

- Specification:

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$$\Delta \log d_{lt} = \alpha_d + \eta \Delta \log w_{lt} + (\tau - 1) \Delta \log p_{lt} + \gamma_l + \epsilon^d_{lt},$$
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where l is country, t is time

	(1)	(2)	(3)	(4)
τ	0.11	0.26	0.34	0.37
	$(0.04, 0.18)$	$(0.16, 0.36)$	$(0.19, 0.49)$	$(0.11, 0.63)$
$\eta - 1$	0.03	-0.03	-0.05	-0.02
	$(-0.05, 0.09)$	$(-0.12, 0.06)$	$(-0.14, 0.05)$	$(-0.13, 0.08)$
α_h	—	0.005	0.007	0.007
		$(0.003, 0.007)$	$(0.004, 0.009)$	$(0.004, 0.011)$
Av. window	$n = 3$	$n = 3$	$n = 3$	$n = 5$
Intercepts	N	Y	Y	Y
Country FE	N	N	Y	Y

Growth rates are constructed using averaging windows of $n = 3$ (columns 1 to 3) and $n = 5$ (column 4) years. 90% confidence intervals, constructed using errors clustered an the country level, are reported between parentheses. The parameters are estimated using pseudo-maximum-likelihood approach.

Implications

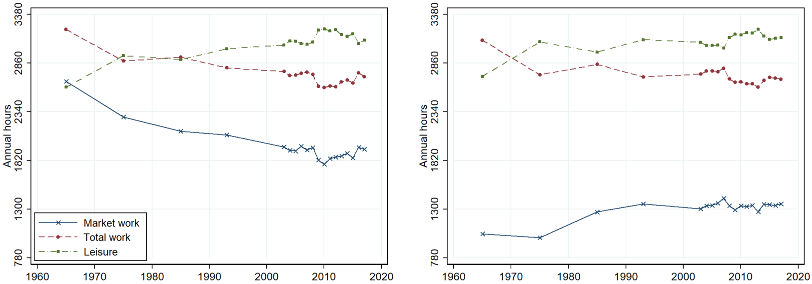
- Cross-country data: $\eta \approx 1$, $\tau \approx 0.3$
  - $\eta = 1$: income and substitution effects offset each other
  - $\tau > 0$: hours are shrinking due to declining recreation prices
  - $\eta = 1$ and $\tau = 0.3$ imply annual growth rate of hours of -0.33% (close to the data)
- U.S. data: $\eta \in (0.5; 0.8)$, $\tau \approx 0.6$
  - $\eta < 1$: income effect dominates (Boppart and Krusell, 2019)
  - $\eta = 0.8$ and $\tau = 0.6$ imply annual growth rate of hours of -0.63% (decline in recreation price accounts for 2/3 of the effect)

Conclusion

- Using multiple datasets and regressions, we show that the decline in leisure prices is strongly associated with the decline in hours worked
- We derive the general form that a utility function must take to be consistent with a balanced-growth path
- Estimating key structural parameters of these preferences reveals a central role for the leisure-price effect
  - Ambiguous role of a wealth/income effect
- Implications:
  - Wages are stagnating in many countries but leisure prices keep falling
  - We can expect further decline in hours worked

Appendix

American Time Use Surevy



(a) Male (b) Female

Weekly hours spent on market work, total work and leisure. Market work includes any work-related activities, travel related to work, and job search activities. Total work includes market work, home production, shopping, and non-recreational childcare. Leisure is any time not allocated to market and nonmarket work, net of time required for fulfilling biological necessities (8 hours per day). Sample includes people between 16 and 64 years old who are not full-time students. Source: ATUS, Aguiar and Hurst (2007) and Aguiar et al. (2017).

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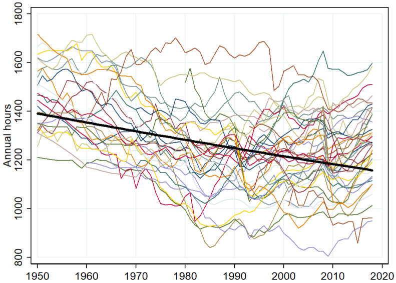
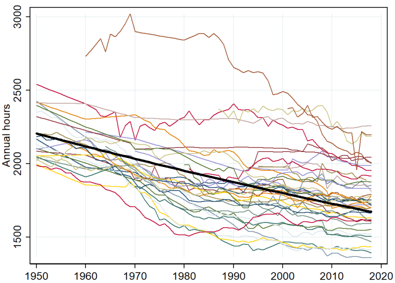
Hours in all countries



(a) Hours per capita



(b) Hours per worker

Panel (a): Annual hours worked over population between 15 and 64 years old. Source: Total Economy Database and OECD. Panel (b): Annual hours worked over number of employed. Source: Total Economy Database.

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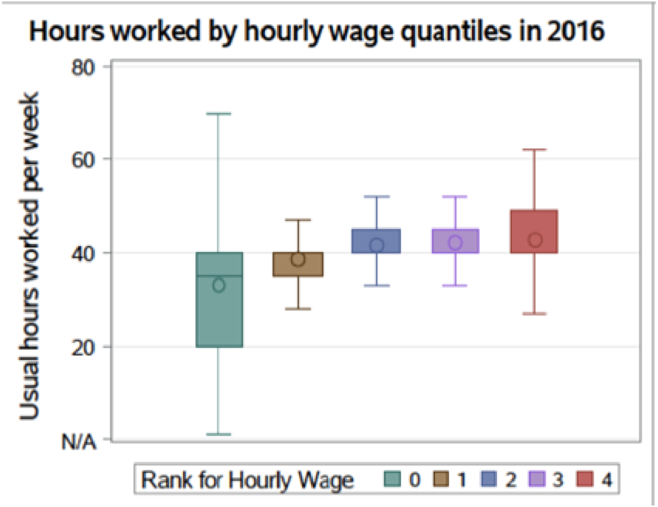
Hours by income



Source: American Community Survey.

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Real prices

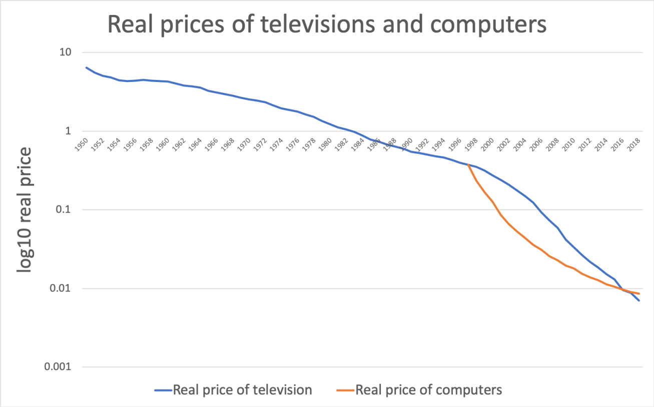

Figure: Source: BLS CPI, All Urban Consumers, U.S. city average

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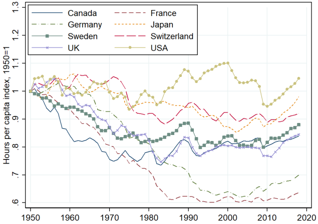
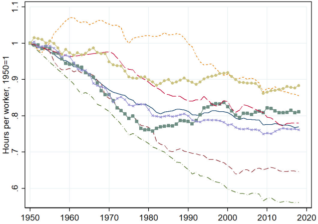
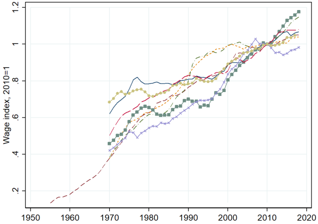
Time series for selected countries



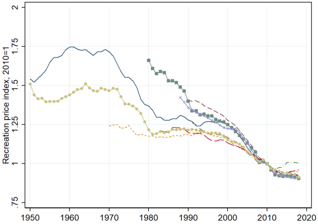
(a) Hours per capita



(b) Hours per worker



(c) Real compensation per hour

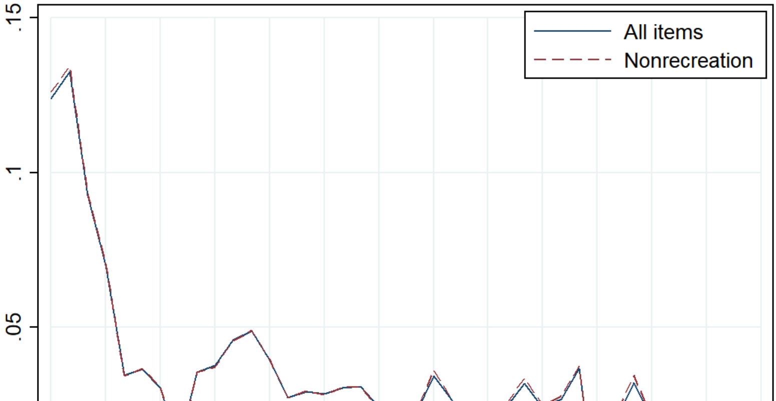


(d) Real recreation price

Nonrecreation price index

- In the model, the numeraire is nonrecreation consumption
- In the empirical analysis, we deflate nominal values by all-item price index
- Recreation consumption is a small component of the consumption basket ($< 10\%$) $\Rightarrow$ the difference between all-item and non-recreation inflation rates is tiny

Inflation rates, Midwest region



United States, intensive margin of hours adjustment

- Hours per worker as the dependent variable instead of hours per capita

	(1)	(2)	(3)	(4)
Dep. variable	Growth rate of hours per worker $\Delta \log h$			
$\Delta \log p$	0.18^{***}	0.12^{***}	0.19^{***}	0.16^{***}
$\Delta \log w$	0.07^{*}	-0.16^{***}	0.03	-0.18^{***}
Av. window	$n = 3$	$n = 3$	$n = 5$	$n = 5$
B.C. controls	N	Y	N	Y
Region FE	Y	Y	Y	Y
R^2	0.33	0.81	0.43	0.78
# obs.	48	48	28	28

Growth rates are constructed using averaging windows of $n = 3$ and $n = 5$ years. Real per capita output is used as a business cycle control. Errors are robust to heteroscedasticity. $^{*}, ^{**}, ^{***}$ indicate significance at the 10%, 5%, and 1% levels, respectively.

Back

United States, more granular geographical data

- Benchmark: 4 large geographic regions (Midwest, Northeast, South, West)
- Use price data for 29 BLS metropolitan areas instead:

	(1)	(2)	(3)	(4)
Dep. variable	Growth rate of hours per capita $\Delta \log h$			
$\Delta \log p$	0.13^{**}	0.09^{*}	0.35^{***}	0.33^{***}
$\Delta \log w$	-0.00	-0.08^{**}	-0.00	-0.05
Av. window	$n = 3$	$n = 3$	$n = 5$	$n = 5$
B.C. controls	N	Y	N	Y
Area FE	Y	Y	Y	Y
R^2	0.03	0.12	0.22	0.25
# obs.	337	337	178	178

Growth rates are constructed using averaging windows of $n = 3$ and $n = 5$ years. Real per capita output is used as a business cycle control. Errors are clustered at the area level. $^{*}, ^{**}, ^{***}$ indicate significance at the 10%, 5%, and 1% levels, respectively.

◂ Back

Details for wage instrument

- Hours and earnings at the locality-demographic-industry level: data from the U.S. Census (years 1980 and 1990) and the Census' American Community Surveys (2009-2011 three-year sample, which we refer to as 2010). The key advantage of these data over the ASEC is that they cover a much larger sample of the U.S. population, which allows us to exploit variation across the 543 finely-defined Census-identified geographic locations.
- Individuals between the ages of 25 and 64. Split into 15 demographic groups based on age (25-34 years old, 35-49 years old, 50-64 years old) and education (less than high school, high school, some college, four years of college, more than college), excluding those serving in the armed forces.
- 34 industries. We construct initial industry shares (the base year) using the data for 1980; growth rates are then constructed by comparing 1990 outcomes to their 2010 counterparts.

◂ Back

Details for wage instrument

Start from wages in a locality c for a demographic group d at time t:

$$w_{glt} = \frac{\sum_i e_{iglt}}{\sum_i h_{iglt}}.$$

It follows that we can write the growth rate of wages as

$$\frac{w_{glt+1}}{w_{glt}} = \frac{\frac{\sum_i e_{iglt+1}}{\sum_i e_{iglt}}}{\frac{\sum_i h_{iglt+1}}{\sum_i h_{iglt}}} = \frac{\sum_i \frac{e_{iglt}}{\sum_j e_{jglt}} \frac{e_{iglt+1}}{e_{iglt}}}{\sum_i \frac{h_{iglt}}{\sum_j h_{jglt}} \frac{h_{iglt+1}}{h_{iglt}}}.$$

Key idea: replace the *local* growth in earnings and hours by their national equivalent.

$$\Delta \log w_{glt}^{IV} = \log \left(\frac{w_{glt+1}}{w_{glt}} \right)^{IV} = \log \left(\sum_i \frac{e_{iglt}}{\sum_j e_{jglt}} \frac{e_{igt+1}}{e_{igt}} \right) - \log \left(\sum_i \frac{h_{iglt}}{\sum_j h_{jglt}} \frac{h_{igt+1}}{h_{igt}} \right)$$

We can also write that expression as

$$\Delta \log w_{glt}^{IV} = \log \left(1 + \sum_i \frac{e_{iglt}}{\sum_j e_{jglt}} \frac{e_{igt+1} - e_{igt}}{e_{igt}} \right) - \log \left(1 + \sum_i \frac{h_{iglt}}{\sum_j h_{jglt}} \frac{h_{igt+1} - h_{igt}}{h_{igt}} \right)$$

$$\approx \sum_i \frac{e_{iglt}}{\sum_j e_{jglt}} \Delta \log e_{igt+1} - \sum_i \frac{h_{iglt}}{\sum_j h_{jglt}} \Delta \log h_{igt+1}$$

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Production

The model is agnostic about how prices are determined in equilibrium. One way to close the model:

- Two competitive industries producing non-leisure c and leisure d goods

$$\max_{k_{jt}, l_{jt}} p_{jt} A_{jt} l_{jt}^{\alpha} k_{jt}^{1-\alpha} - w_t l_{jt} - R_t k_{jt}$$

  - $p_{ct} = 1$: non-leisure good is numeraire

- Competitive industry produces investment goods

$$\max_{k_{it}} \underbrace{p_{it} A_{it} k_{it}}_{=y_{it}} - R_t k_{it}$$

- Law of motion of aggregate capital: $K_{t+1} = y_{it} + (1-\delta) K_t$

Proposition 2

The growth rates of p_{dt} and w_t are

$$\log \gamma_p = \log \gamma_{A_c} - \log \gamma_{A_d},$$
$$\log \gamma_w = \alpha \log \gamma_{A_c}.$$

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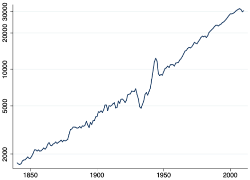
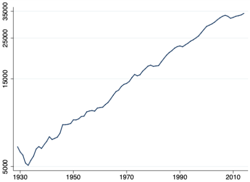
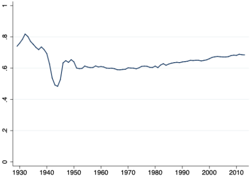
BGP facts: United States



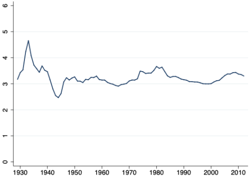
(a) GDP per capita



(b) Consumption per capita



(c) Consumption-output ratio



(d) Capital-output ratio

Source: Boppart and Krusell (2020), BEA and Maddison project

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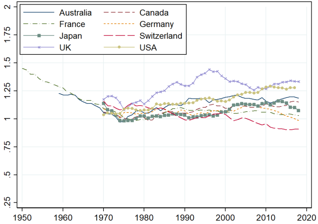
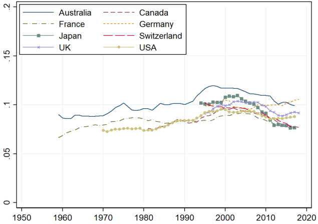
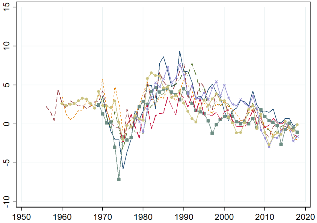
BGP facts: International sample



(a) Total consumption over output



(b) Recreation consumption share



(c) Real interest rate [%]

Elasticities

- Frisch elasticity is constant along the BGP

$$\epsilon = \frac{1}{h} \frac{u_h u_{cc}}{u_{hh} u_{cc} - u_{hc}^2} = f\left(c^{1-\eta-\tau} h^{\eta} d^{\tau}\right)$$

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