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

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Introduction

- Technological progress has made recreation goods and services extremely cheap
  - Television, streaming subscriptions, video games
- As a result,
  - Leisure time is becoming more enjoyable
  - Work time is becoming relatively less enjoyable
- Did the decline in recreation prices contribute to the decline in work hours?

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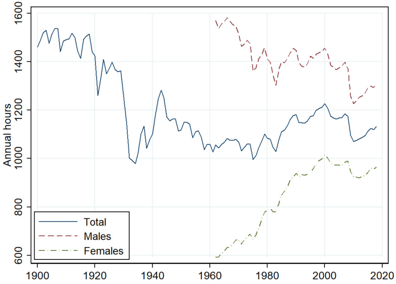
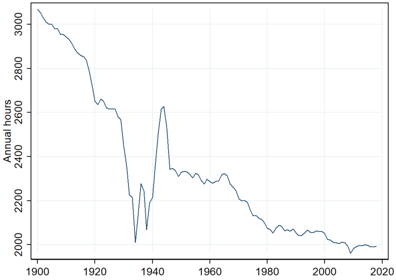
Motivation

- 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 et al., 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).

- Decline in market + nonmarket work hours for men and women also visible in time use survey data

ATUS

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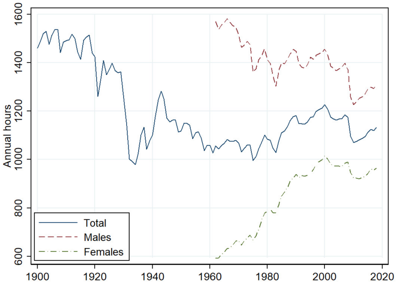
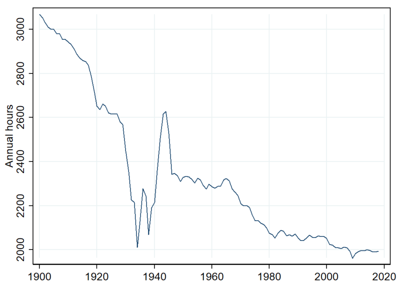


(c) Hours per capita



(d) Hours per worker

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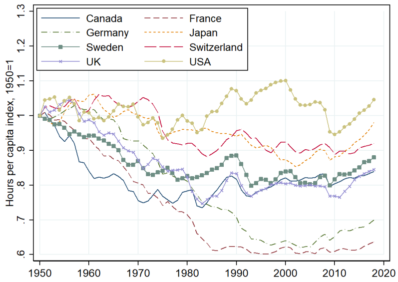
- Decline in market + nonmarket work hours for men and women also visible in time use survey data

▸ 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



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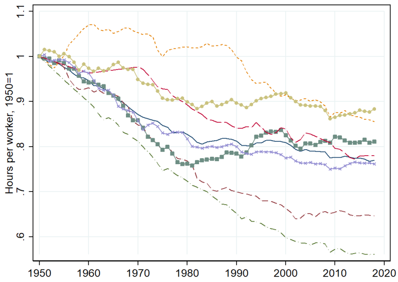

(b) Hours per worker

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

- One explanation: Higher wages lead to fewer hours worked (Keynes, 1930)
  - Average growth rate: 1.88% per year

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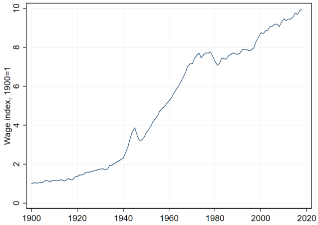
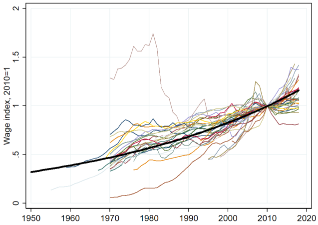


(a) U.S.



(b) All countries

Panel (a): Real labor productivity. Source: Kendrick et al., 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

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

Motivation

- Alternative explanation: Leisure is becoming cheaper (and better!)
  - Real price of a television divided by 1000 since 1950 (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

▸ c.s. wages

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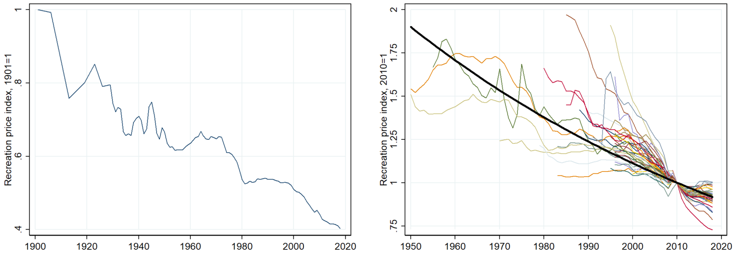
Motivation

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



(a) U.S. (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.

▸ Recreation items ▸ Selected countries

This paper

Did the decline in recreation prices contribute to 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 recreation 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, recreation prices, consumption
  - Structural estimation of the model
  - Still strong effect of 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).
- **Balanced growth path declining hours:** Boppart and Krusell (2020)

Reduced-form evidence

Outline:

1. U.S. regressions using cross-region variation over time
2. U.S. regressions using variation across localities 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

Reduced-form evidence: United States

- Regress hours per capita h_{lt} on recreation prices p_{lt} (include wages w_{lt} as control)

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

where l is 1 of 4 census regions, t is the year.

- Smooth out high-frequency fluctuations by taking growth rates Δ over (non-overlapping) n-year windows. Benchmark $n = 3$ but robustness with different n.

Def. Δ

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United States: regions

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	(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 worker and metropolitan-area-level price data

▸ Hours per worker ▸ Cities

United States: regions

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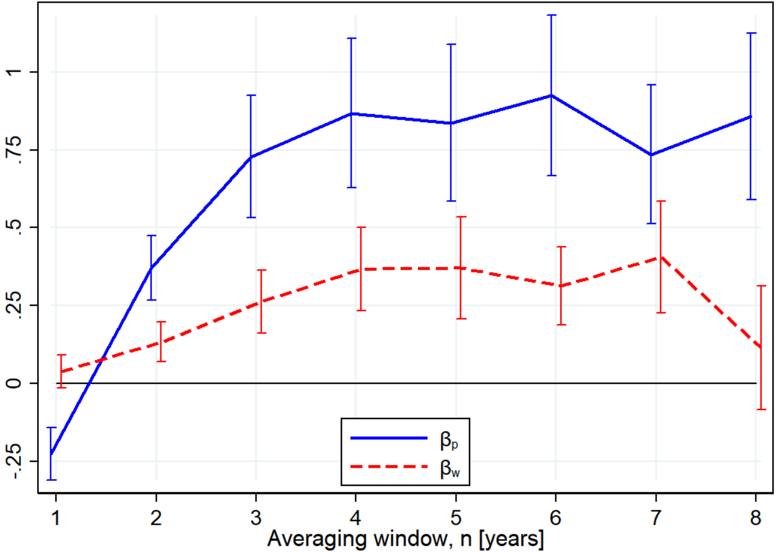
United States

- Vary the size 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
  - Increase in preference for leisure leads to fewer hours worked and increases demand for recreation items
  - Technological changes lead to cheaper recreation goods and loss of jobs
- Solution: Use disaggregated data and construct instruments
  - Different demographic groups and localities have large variations in:
    - the types of recreation goods consumed
    - the types of industries in which they work
  - Use this variation together with *national* changes in prices and wages to construct instruments (Bartik, 1991)
- Data:
  - Census data on wages and hours across (34 industries, 15 education/age groups, 543 localities)
  - CE Survey data on recreation consumption (7 categories of recreation items, 15 education/age groups)
  - BLS data on recreation prices by categories

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Recreation price instrument

- Recreation prices instrument: variation in *types* of recreation items consumed across demographic groups together with *national* movements in the price of these items.
- Example:
  - 25-34 yrs old without high-school dipl. consume a lot of audio-video items.
  - Decline in the national price of these items leads to a cheaper recreation basket for these people.
  - Since national movements are unlikely to directly affect local hours worked (after controls), we can use that instrument to tease out causality.
- The instrument is

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

  where c_{jg} is consumption of recreation of item j by demographic group g.
- The shares are over 1980-1988; growth rates are between 1990 and 2010.

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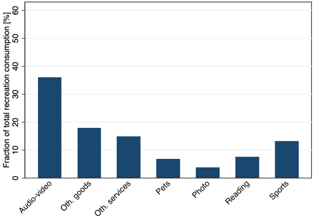
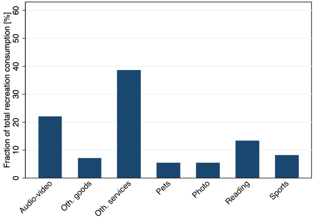
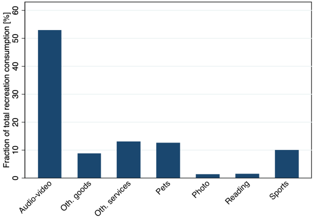
Recreation good bundles across groups, CEX



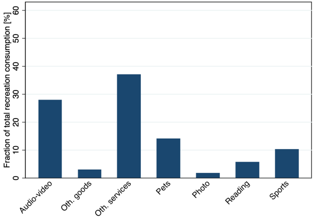
(a) No high school diploma, 25-34 years old, 1980-1988



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



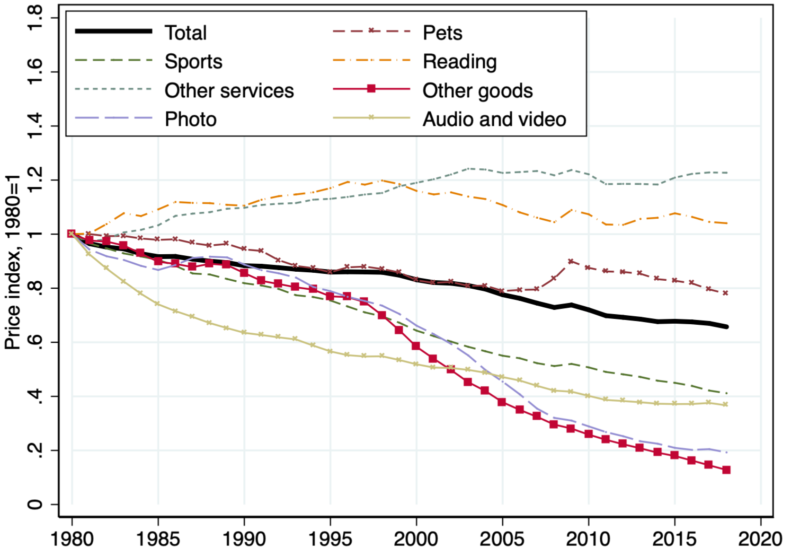
(c) No high school diploma, 25-34 years old, 2010-2018



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

Prices of leisure goods over time

Trends vary widely across categories:



United States: instrumental variables

- Wage instrument: 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 directly affect local hours worked (after controls), we can use that instrument to tease out causality.
- The instrument is

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

  where e is earnings, h is hours worked, i is an industry, g is a demographic group, and l is a locality.
- The shares are over 1980-1988; growth rates are between 1990 and 2010.

Details Derivation

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▸ Details ▸ Derivation

United States: IV regression

- Instrumental variable estimation in the cross-section only

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

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 (fraction of males, married and whites). Errors are clustered at location level. F-statistics are Kleibergen-Paap. *, **, *** indicate significance at the 10%, 5%, and 1% levels

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

Data: International sample

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

International sample

Regress hours per capita h_{lt} on recreation prices p_{lt} (include wages w_{lt} as control)

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

where l is a country and t is the year.

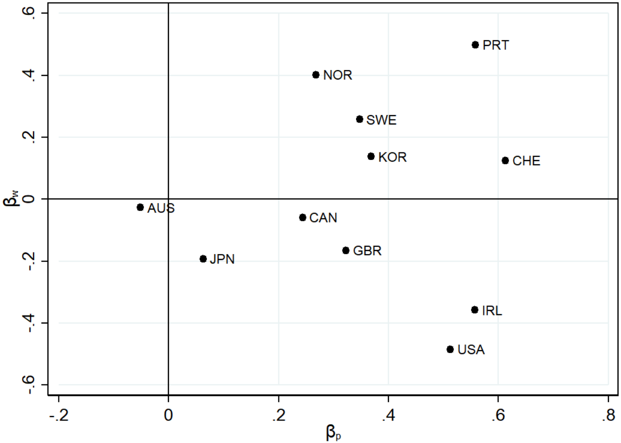
	(1)	(2)	(3)	(4)	(5)
Dep. var.	Growth rate of hours per capita $\Delta \log h$				
$\Delta \log p$	0.28^{***}		0.25^{***}	0.14^{*}	0.30^{***}
$\Delta \log w$		0.17^{***}	0.15^{**}	-0.18^{***}	
$\Delta \log y/h$					-0.24^{**}
B.C. controls	N	N	N	Y	N
Country FE	Y	Y	Y	Y	Y
R^2	0.10	0.12	0.15	0.46	0.14
#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

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?
- Theoretical contribution: general form that a utility function must take to be consistent with a balanced-growth path with two consumption goods (Boppart and Krusell, 2020)

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
- Theoretical contribution: general form that a utility function must take to be consistent with a balanced-growth path with two consumption goods (Boppart and Krusell, 2020)

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Model

- Build on standard balanced growth path framework
- Household maximizes

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

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

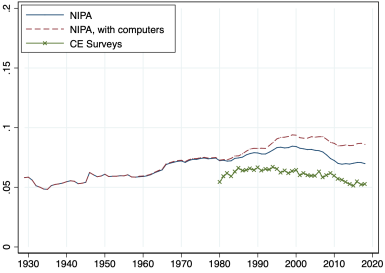
where c_t is nonrecreation goods, d_t is recreation goods, p_{dt} is their price, and h_t is hours worked

- ▸ Balanced-growth path assumptions on primitives
  - p_{dt} 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

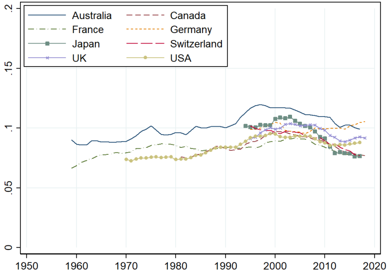
▸ BGP U.S. ▸ BGP All Countries ▸ Production ▸ Price index

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:

$$g_c = \gamma_w^{\eta} \gamma_{p_d}^{\tau},$$
$$g_h = \gamma_w^{\eta-1} \gamma_{p_d}^{\tau},$$
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Model

Definition 1 (Balanced-growth path preferences)

The utility function u is *consistent with a balanced-growth path* if it has the following properties: for any $w > 0$, $p_d > 0$, $c > 0$, $\gamma_w > 0$ and $\gamma_{p_d} > 0$, 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 $\tau > 0$.

Model

Proposition 1

The utility function $u(c,h,d)$ is consistent with a balanced-growth path if and only if 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 function and where $\eta > 0$ and $\tau > 0$.

- General form that u must take to be consistent with BGP
- η and τ are preference parameters
- Utility of King et al. (1988) and Boppart and Krusell (2020) are special cases

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Structural estimation

- Structural system to be estimated

$$\log g_c = \eta \log \gamma_w + \tau \log \gamma_p$$
$$\log g_d = \eta \log \gamma_w + (\tau - 1) \log \gamma_p$$
$$\log g_h = (\eta - 1) \log \gamma_w + \tau \log \gamma_p$$

  - Key advantage: invariant to a broad class of utility functions
  - Additional equations impose discipline on the estimation

- We add potential fixed effects and intercepts

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

Elasticities

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▸ Elasticities

Three equations MLE: United States

	(1)	(2)	(3)	(4)
τ (rec. price)	0.31	0.54	0.57	0.73
	$(0.08, 0.54)$	$(0.27, 0.81)$	$(0.30, 0.84)$	$(0.55, 0.91)$
$\eta - 1$ (wage)	-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

All data from CE Survey except for recreation prices (BLS). 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:
  - Declining 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

Eq. by eq. est. After tax

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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 (rec. price)	0.28
	$(0.15, 0.42)$
$\eta - 1$ (wage)	-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. 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:

- Declining recreation prices always have a negative effect on hours
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	(1)	(2)	(3)	(4)
τ (rec. price)	0.11	0.26	0.34	0.37
	$(0.04, 0.18)$	$(0.16, 0.36)$	$(0.19, 0.49)$	$(0.11, 0.63)$
$\eta - 1$ (wage)	0.03	-0.03	-0.05	-0.02
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Country FE	N	N	Y	Y

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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
  - $\eta = 0.8$ and $\tau = 0.6$ imply annual growth rate of hours of -0.63% (decline in recreation price accounts for 2/3 of the effect)

Robustness

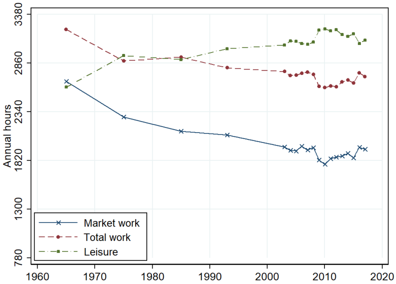
- Some robustness tests:
  - Estimate model using hours per workers instead of hours per capita
  - Include price of durable goods as proxy for home technology improvements
  - Control for housing prices to control for some changes in wealth
  - Use data for household heads instead of all individuals
  - Use after tax data for wages
- In all cases, the effect of recreation prices on hours worked remains strongly significant.

Conclusion

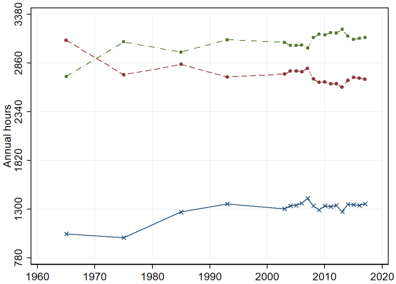
- Using multiple datasets and regressions, we show that the decline in leisure prices is strongly associated with the decline in hours worked
- We derive the general form that a utility function must take to be consistent with a balanced-growth path
- Estimating key structural parameters of these preferences 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

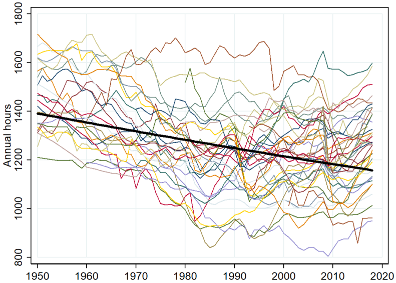


(b) Female

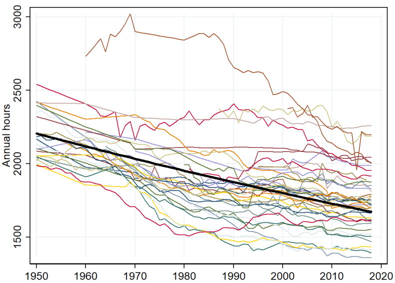
Weekly hours spent on market work, total work and leisure. Market work includes any work-related activities, travel related to work, and job search activities. Total work includes market work, home production, shopping, and non-recreational childcare. Leisure is any time not allocated to market and nonmarket 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).

Back

Hours in all countries



(a) Hours per capita

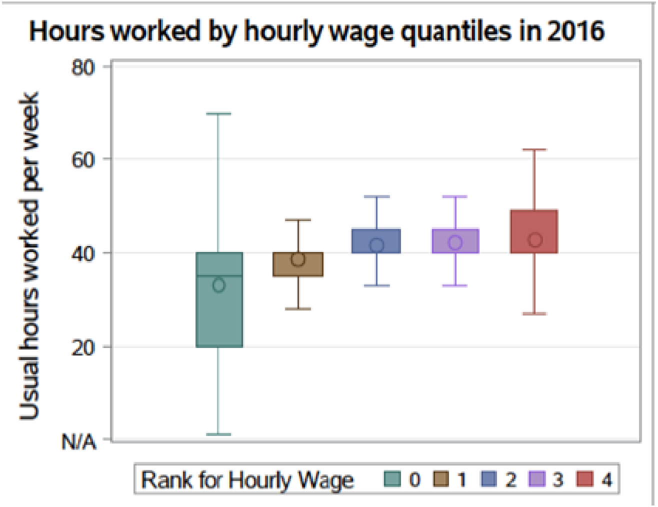


(b) Hours per worker

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.

Back

Hours by income



Source: American Community Survey.

Back

Real prices

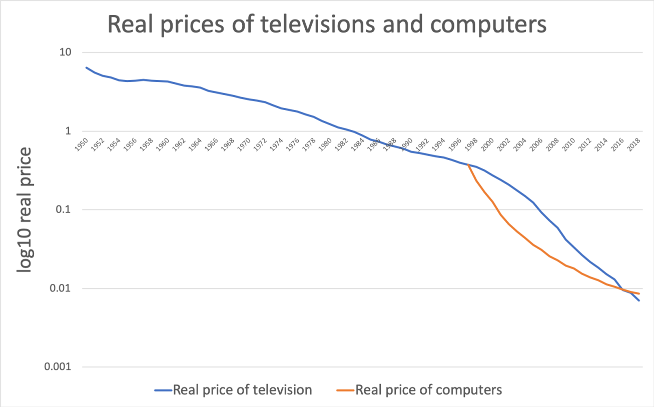
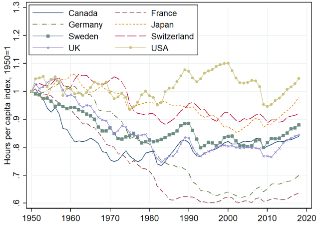


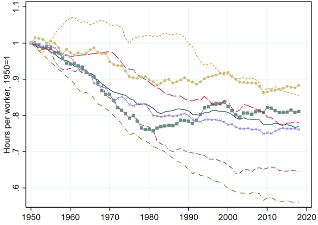
Figure: Source: BLS CPI, All Urban Consumers, U.S. city average

Back

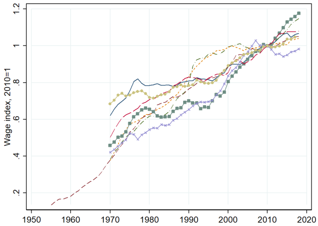
Time series for selected countries



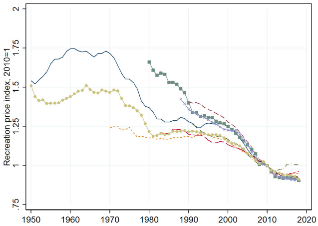
(a) Hours per capita



(b) Hours per worker



(c) Real compensation per hour



(d) Real recreation price

BLS: Basket of recreation goods and services

- Recreation commodities
  - Video and audio products (Televisions, Other video equipment, Audio equipment, Recorded music and music subscriptions)
  - Pets and pet products (Pet food, Purchase of pets, pet supplies, accessories)
  - Sporting goods (Sports vehicles including bicycles, Sports equipment)
  - Photographic equipment and supplies (Film and photographic supplies, Photographic equipment)
  - Recreational reading materials (Newspapers and magazines, Recreational books)
  - Other recreational goods (Toys, Toys, games, hobbies and playground equipment, Sewing machines, fabric and supplies, Music instruments and accessories)
- Recreation Services
  - Video and audio services (Cable and satellite television service, Video discs and other media, including rental of video)
  - Pet services including veterinary (Pet services, Veterinarian services)
  - Photographers and photo processing (Photographer fees, Photo processing)
  - Other recreation services (Club membership for shopping clubs, fraternal, or other organizations, or participant sports fee, Admissions, Fees for lessons or instructions)

◂ Back

Averaging window

- Definition of Δ

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

◂ Back

United States, hours per worker

- **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

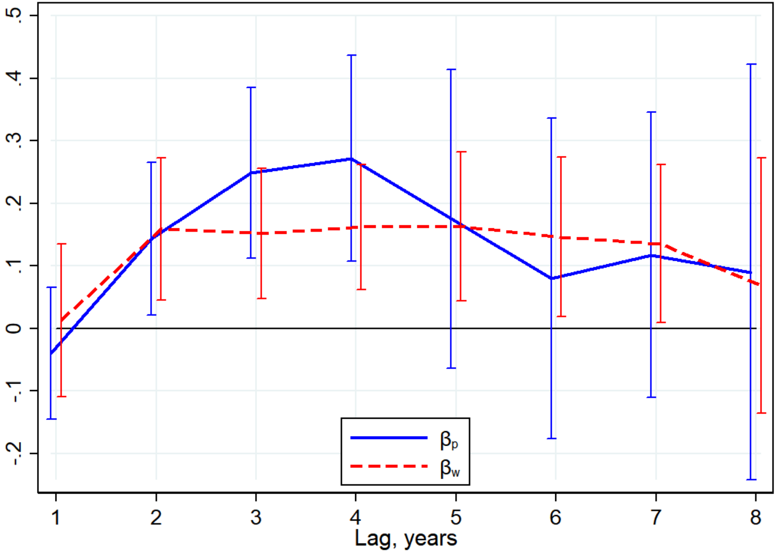
$$\Delta \log w_{glt}^{IV} = \log \left(1 + \sum_i \frac{e_{iglt}}{\sum_j e_{jglt}} \frac{e_{igt+1} - e_{igt}}{e_{igt}} \right) - \log \left(1 + \sum_i \frac{h_{iglt}}{\sum_j h_{jglt}} \frac{h_{igt+1} - h_{igt}}{h_{igt}} \right)$$

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

◂ Back

Changing n

- Vary the width of averaging window n



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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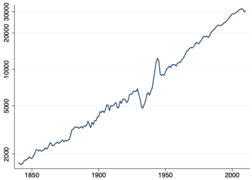
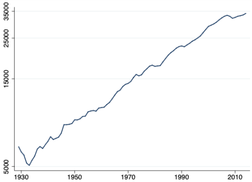
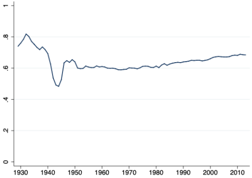
BGP facts: United States



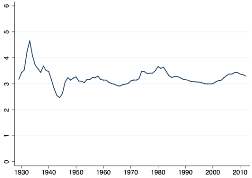
(a) GDP per capita



(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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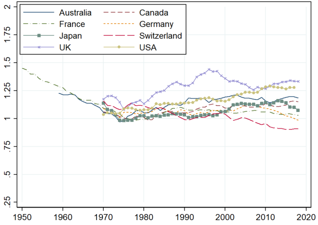
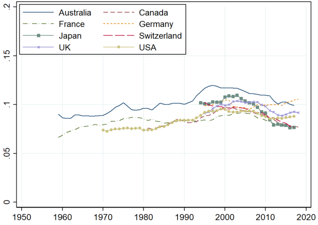
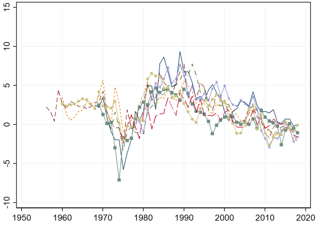
BGP facts: International sample



(a) Total consumption over output



(b) Recreation consumption share



(c) Real interest rate [%]

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

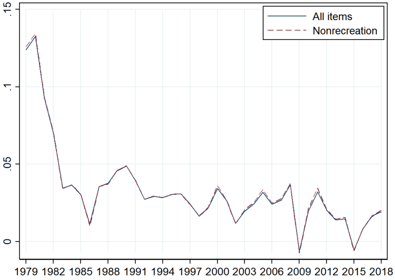


Figure: Inflation rates, Midwest region

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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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Equation by equation

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.	$\Delta \log c$		$\Delta \log d$		$\Delta \log h$	
$\Delta \log p$	0.22	0.37^{*}	0.16	0.33	0.60^{***}	0.79^{***}
$\Delta \log w$	0.28^{**}	0.65^{***}	0.43^{***}	0.86^{***}	-0.08	0.12
Av. window	$n = 3$	$n = 5$	$n = 3$	$n = 5$	$n = 3$	$n = 5$
Region FE	Y	Y	Y	Y	Y	Y
R^2	0.12	0.50	0.11	0.28	0.23	0.74
# obs	48	24	48	24	48	24

All data from CE Survey except for recreation prices (BLS). Dependent variables are growth in non-recreation consumption per capita, growth in recreation consumption per capita and growth in hours per capita. Growth rates are constructed using averaging windows of $n = 3$ and $n = 5$ years. Errors are robust to heteroscedasticity. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table: Regressions across U.S. regions: impact of wage and recreation price growth on hours per capita, recreation and non-recreation consumption.

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Using after tax income

All data from Customer Expenditure Survey except for recreation prices (BLS), after tax income per hour for wages

	(1)	(2)	(3)	(4)
τ (rec. price)	0.27	0.53	0.56	0.75
	$(0.03, 0.51)$	$(0.25, 0.82)$	$(0.28, 0.84)$	$(0.54, 0.95)$
$\eta - 1$ (wage)	-0.36	-0.38	-0.37	-0.05
	$(-0.48, -0.23)$	$(-0.49, -0.26)$	$(-0.48, -0.26)$	$(-0.21, 0.10)$
α_h	—	0.006	0.006	0.006
		$(0.003, 0.010)$	$(0.001, 0.012)$	$(0.002, 0.010)$
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, constructed using errors clustered an the country level, are reported between parentheses. The parameters are estimated using pseudo-maximum-likelihood approach assuming that the error terms are jointly normal with a diagonal variance-covariance matrix.

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