Measuring and Explaining International Differences in Hours Worked

Alexander Bick, Arizona State University
Nicola Fuchs-Schündeln, Goethe University Frankfurt, CFS and CEPR
David Lagakos, UC San Diego and NBER

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How do Average Hours Worked Vary with Income Per Capita?

- No clear conclusion thus far; limited by lack of data
- This paper: answer using new data set
  - Harmonize 85 countries of all income levels
  - Draw on nationally representative household surveys
  - Challenge: surveys not already standardized
  - Large efforts to maximize international comparability

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Relevant for Welfare

- Standard utility function: $U(c, 1-h)$
- Consumption per capita, c, widely studied
- Labor input per capita, h, not studied much
- Example: welfare of average Africans & North Americans

  - c roughly $\sim 5\%$ as high for Africans (e.g. Penn World Tables)

  - If h lower too, welfare differences may be smaller

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Main Empirical Findings

- Average hours worked per adult are higher in poor countries
- True for both sexes, all age groups
- Magnitudes substantial: 29 hours/week in poorest countries, compared to 19 hours per week in richest
- Low vs middle income countries: accounted for by *employment rates*

  Middle vs high income countries: accounted for by *hours per worker*

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Theory of our Findings

- Ingredients

  - Subsistence consumption requirements in preferences

  - Individuals vary in marginal disutility of work

  - Countries differ only in productivity

- Mechanism:

  - When productivity low, marginal utility of c very high
    Those with low time endowment work, but few hours

  - As productivity rises, those with high disutility of work drop out
    hours of those working fall

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Measuring Hours Worked

Constructing Our Data Set

- Use surveys from 2005 or closest available year
- Use only nationally representative surveys of households
  World Bank's Living Standards Measurement Studies (15), the European Union Labor Force Surveys (26), IPUMS (6), other individual surveys (36)
- Challenge: surveys not standardized; required large efforts to harmonize
- Full data set: 85 countries; focus on 43 "core countries" with most comparable data

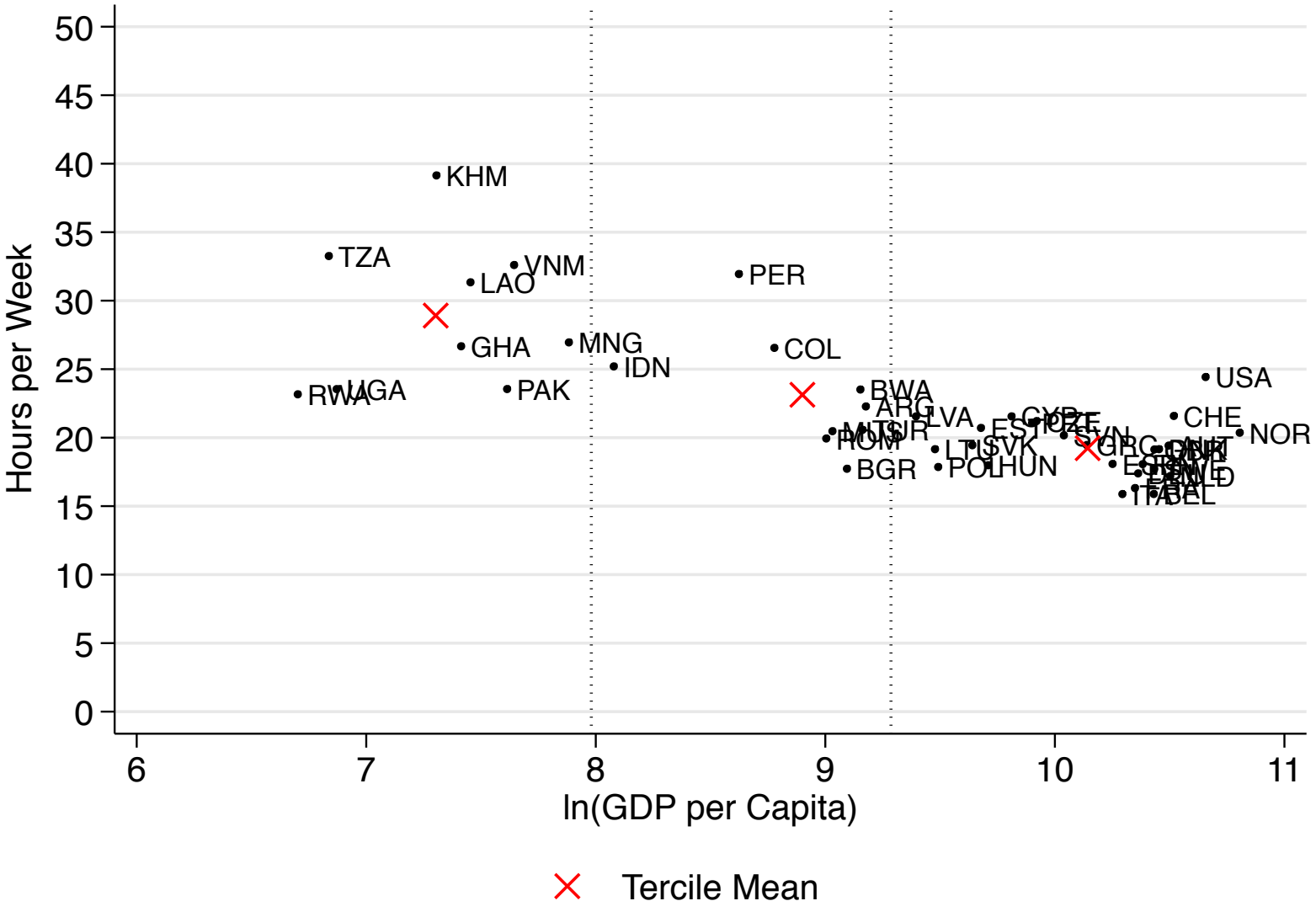
Core Countries

We define core countries as those that meet the following criteria

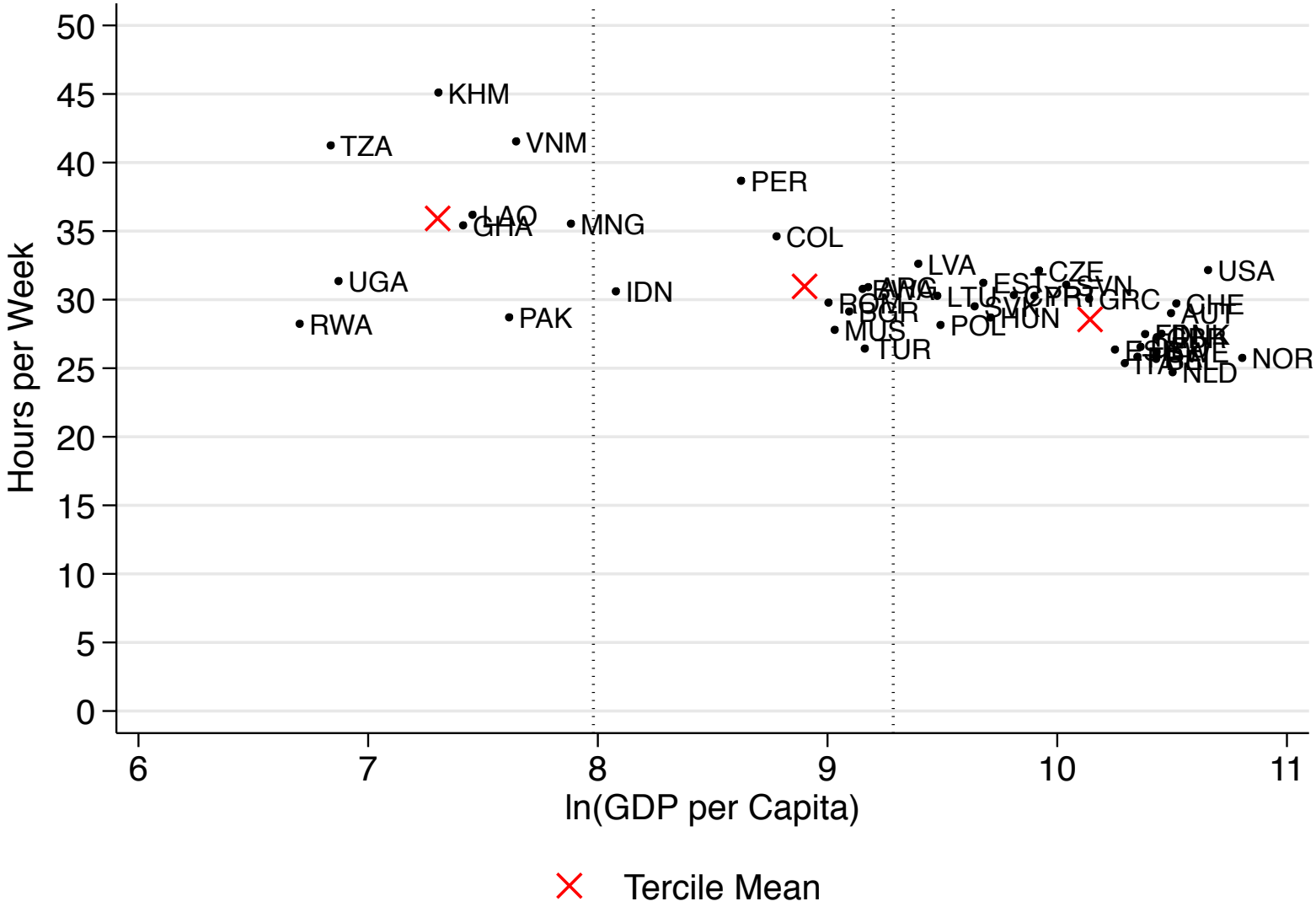
1. Survey covers whole calendar year, 5,000+ individuals
2. Actual hours worked (not usual) at all jobs (not just primary job)
3. In the last week, or recent reference week
4. Producing output counted in NIPA (not e.g. home child care)

Empirical Findings

Average Weekly Hours per Adult



Average Hours per **Prime** (Aged 25-55)



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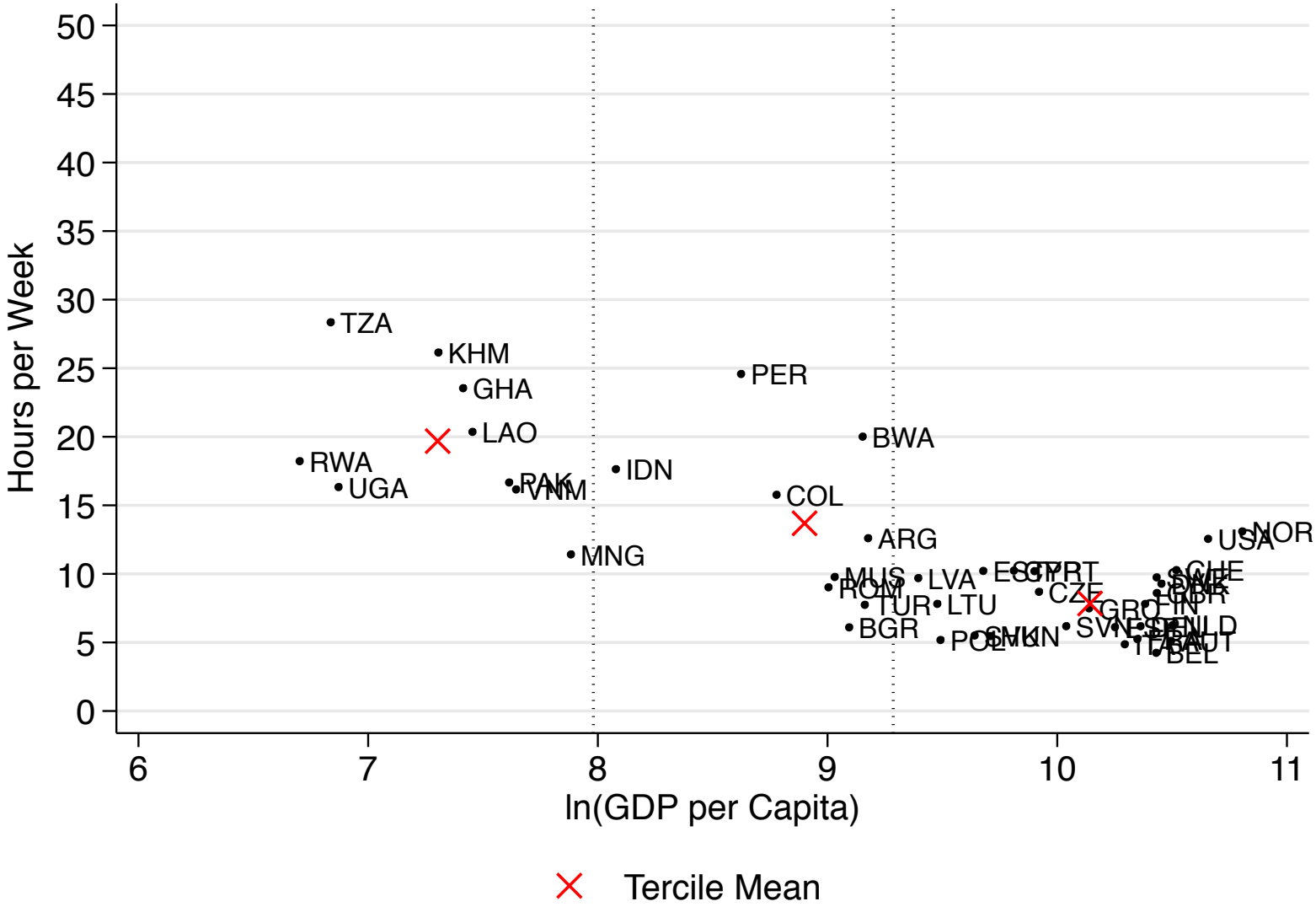
Average Hours per **Old** (Aged 55+)



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Average Hours per Adult

Permutation Tests of Differences in Means

Age Group	Differences in Mean Hours		
	Low - Middle	Middle - High	Low - High
All	6.7***	3.0***	9.7***
Young	7.5***	1.6*	9.1***
Prime	6.2***	1.1	7.3***
Old	6.8***	5.1***	11.9***

*** means a P-value less than 0.01, ** less than 0.05, * less than 0.10.

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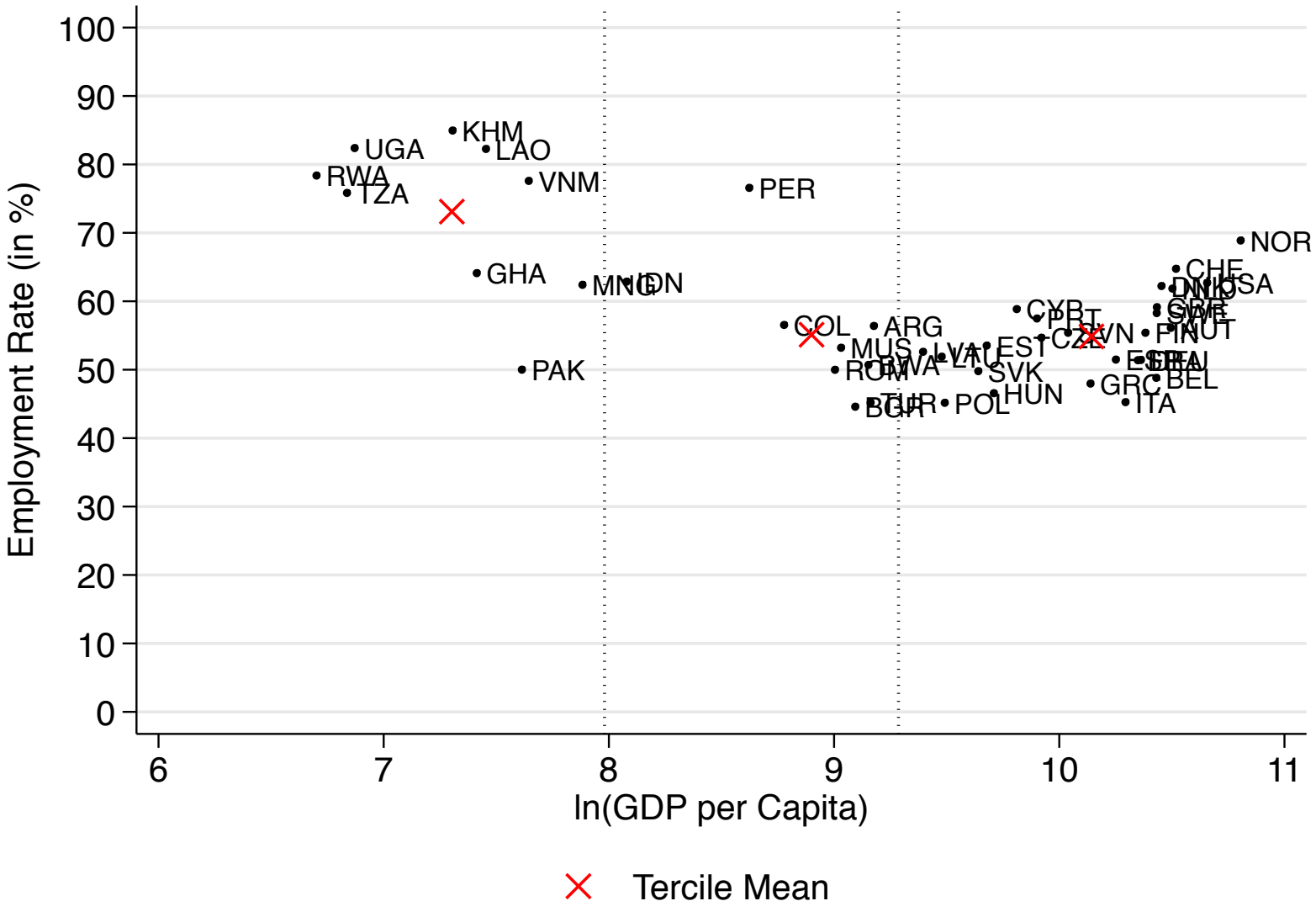
Accounting for Differences in Hours Per Adult

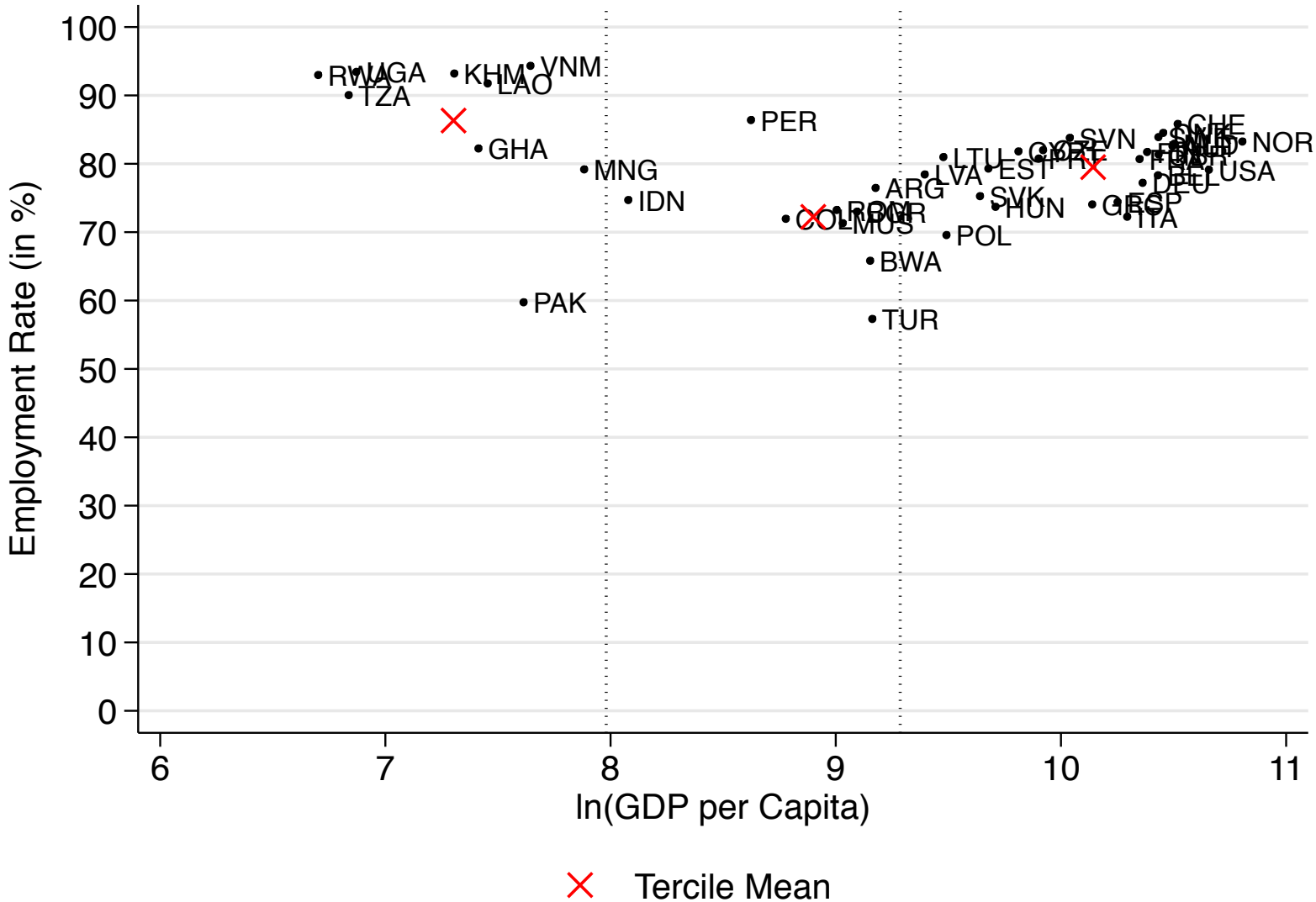
- Higher employment rates in poor countries?
- Greater hours worked per *worker* in poor countries?
- We'll look first in the aggregate, then separately by males and females

Employment Rates



Details

Employment Rates, Prime-Aged



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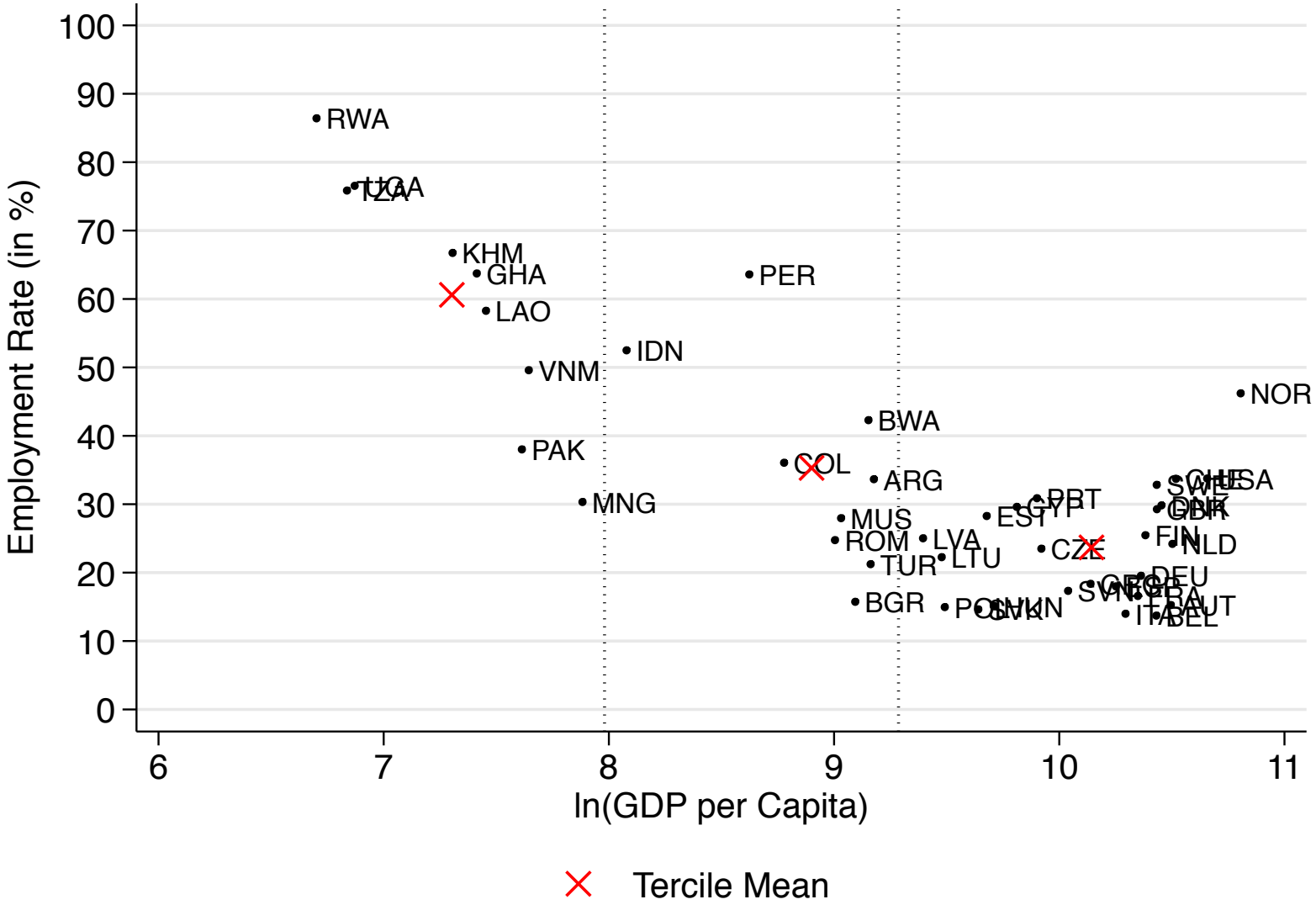
Employment Rates, Old



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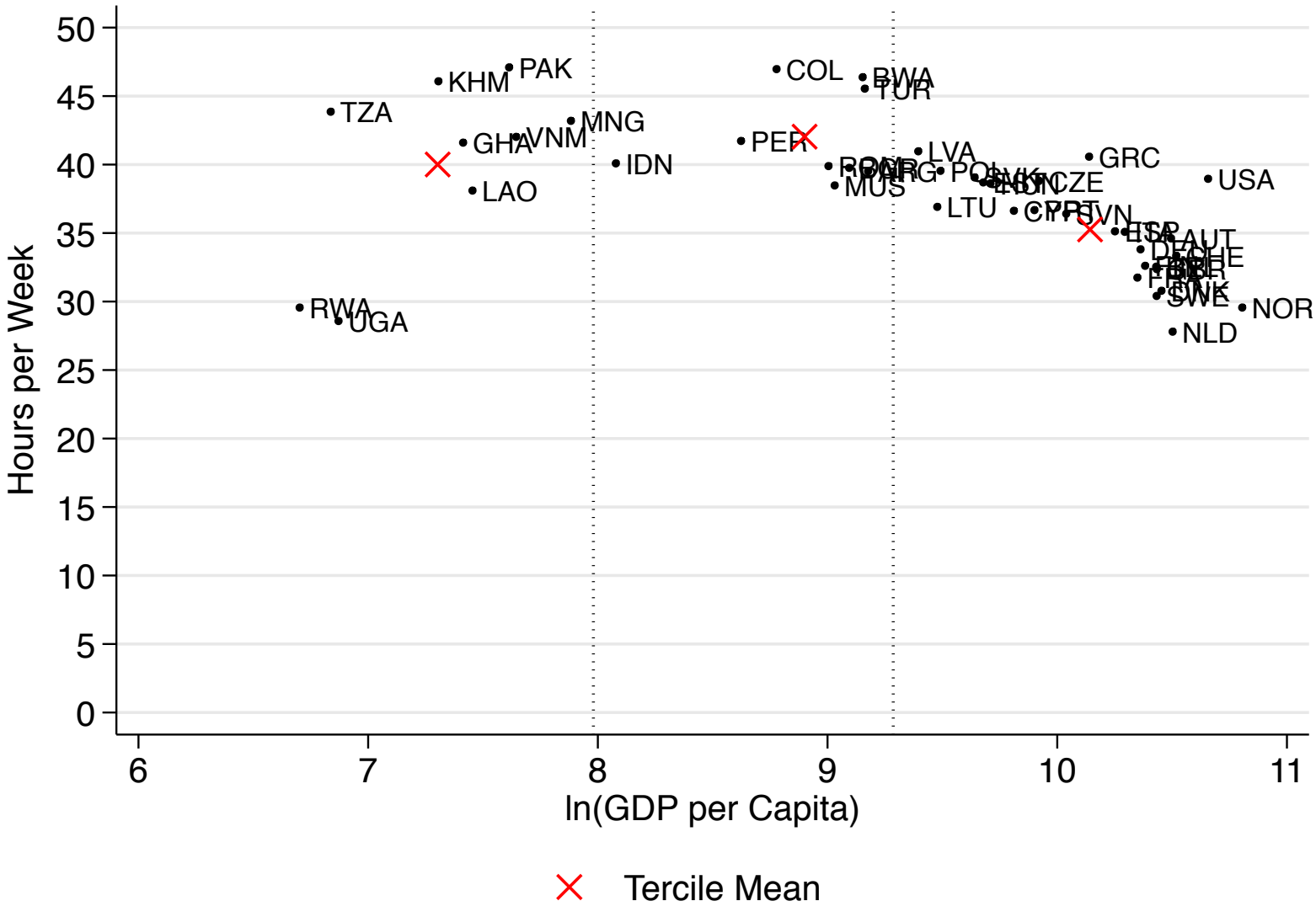
Employment Rates by Age

Age Group	Differences in Mean Employment Rates		
	Low - Middle	Middle - High	Low - High
All	0.20***	-0.02	0.18***
Young	0.23***	-0.04	0.18***
Prime	0.17***	-0.10	0.07***
Old	0.27***	0.10**	0.37***

Average Weekly Hours Per Worker



Details

Hours Per Worker by Age

Age Group	Differences in Mean Hours		
	Low - Middle	Middle - High	Low - High
All	-1.7	6.5***	4.8***
Young	-2.8	8.0***	5.2***
Prime	-0.6	6.6***	6.0***
Old	-4.5	4.8***	0.3

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Model

Quantitative Theory

- Subsistence consumption requirements in preferences

- Countries differ only in productivity

$\Rightarrow$ Naturally predicts decreasing hours per adult

$\Rightarrow$ Challenge: different patterns for the extensive & intensive margin

Model Environment

- Each country has measure one of individuals

- Each member endowed with one unit of time,
  but the marginal disutility of working varies across individuals

  - Heterogeneity represented by $\eta \in [0, 1]$

  - Denote the PDF of η by $f(\eta)$ and the CDF by $F(\eta)$

- "Grandpa" decides hours of market work $h(\eta)$ for all individuals,
  assigns the same consumption c to all individuals.

Household Problem

- Household's problem

$$\max_{c,\{h(\eta)\}_{\eta=0}^{1}} log(c-\bar{c}) - \alpha \int_0^1 \frac{\epsilon}{1+\epsilon}(\eta + h(\eta))^{\frac{1+\epsilon}{\epsilon}} f(\eta) d\eta$$

  such that $c = A\int_0^1 h(\eta) f(\eta) d\eta$.

- Who should work at all?

  - Cutoff, $\overline{\eta}$, s.t. those with $\eta_i < \overline{\eta}$ work

- Conditional on working, how many hours should each work?

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- Conditional on working, how many hours should each work?

Household Problem

- Result: all those working must have same leisure, $\ell = 1 - (\eta + h(\eta))$
- Why? First-order condition for $h(\eta) \Rightarrow$

$$\frac{1}{c - \overline{c}} \cdot A = \alpha(\eta + h(\eta))^{1/\epsilon}$$

- Thus $\eta + h(\eta)$ same for all η s.t. $h(\eta) \geq 0$

$\Rightarrow$ Household's problem is reduced to choosing cutoff, $\overline{\eta}$, and leisure, ℓ, for those working

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Solution to Household Problem

- Result II: Household's solution must have $\ell = 1 - \overline{\eta}$
- Why? If cutoff chosen optimally, then worker at cutoff must work zero hours
- Thus, given optimal cutoff $\overline{\eta}$, ℓ equals $1 - (\overline{\eta} + 0)$

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Equilibrium Properties

- Equilibrium $\bar{\eta}$ satisfies

$$\{\bar{\eta} - E(\eta|\eta < \bar{\eta})\} F(\bar{\eta}) = \left[\alpha \bar{\eta}^{1/\epsilon}\right]^{-1} + \frac{\bar{c}}{A}$$

  - Hours per adult: $H(\bar{\eta}) = \{\bar{\eta} - E(\eta|\eta < \bar{\eta})\} F(\eta)$
  - Employment rate: $E(\bar{\eta}) = F(\bar{\eta})$
  - Hours per worker: $\tilde{H}(\bar{\eta}) = \frac{H}{E} = \bar{\eta} - E(\eta|\eta < \bar{\eta})$

- Equilibrium $\bar{\eta}$ is decreasing in A

- As $A \to \infty$, or when $\bar{c} = 0$, $\bar{\eta}$ independent of A

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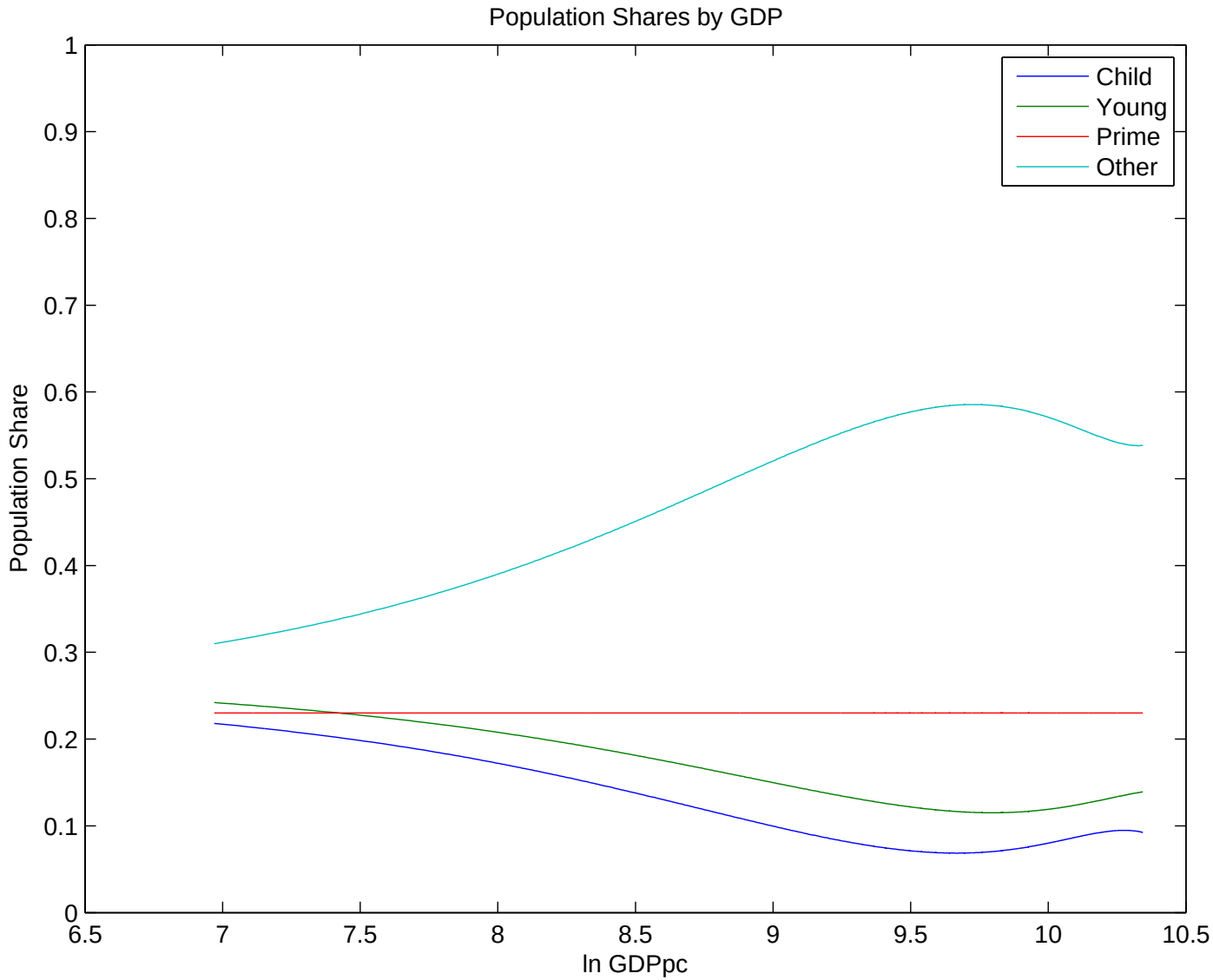
Quantitative Analysis

Extended Model for Quantitative Analysis

- Each country has 4 demographic groups
  - Exogenous labor supply
    - k: Children (ages 0-14, both sexes) – do not work at all
    - y: Young (ages 15-24, both sexes) – work predetermined hours
  - Endogenous labor supply (extensive and intensive margin)
    - p: Prime men (ages 25-54)
    - o: Women (ages 25+) and Older Men (ages 55+)
- $\psi_i(A)\ \forall\ i \in \{k, y, p, o\}$: share of each group with $\sum_i \psi_i(A) = 1$

Population Shares ψ



Household Problem for the Extended Model

$$\max_{c,\{h_p(\eta)\}_{\eta=0}^{1},\{h_o(\eta)\}_{\eta=0}^{1}} log(c-\bar{c}) - \alpha \sum_{i=p,o} \psi_i(A) \int_0^1 \frac{1}{1+\frac{1}{\epsilon}} (\eta + h_i(\eta))^{1+\frac{1}{\epsilon}} f_i(\eta) d\eta$$

$$\text{s.t. } c = A \left[\psi_y(A) \hat{H}_y + \sum_{i=p,o} \psi_i(A) \int_0^1 h_i(\eta) f_i(\eta) d\eta \right]$$

Extended Model for Quantitative Analysis

- Parameterize model to match moments for low-income group
- Model's predictions across world income distribution for varying A
- Focus on two groups: prime males and "others" (prime women+old)
  - "Others" have lower employment rates and hours per worker
  - Employment decreases much faster for the "others"

Parameterization

- Normalize $A = 1$ in high-income countries
  $\hookrightarrow$ $A = 0.03$ in low-income countries

- Let one unit of time represent 112 hours per week

- Fix Frisch elasticity $\epsilon = 1$

  - micro estimates: " ≤ 1"

  - macro estimates: "≥ 1"

Distribution of η

- Prime male draw from $F_1(\eta)$
- "Others" draw from $F_1(\eta)$ with prob. ϕ, from $F_2(\eta)$ with $1 - \phi$
- $f_i(\eta)$ and $F_i(\eta)$ $\forall$ $i = 1, 2$ set as beta distributions

Moments to Match (Low-Income Group)

1. Subsistence consumption is 50% percent of total consumption
   - consistent with estimates of Rozenzweig & Wolpin (1993), Atkeson & Ogaki (1996) and food expenditure shares.

Prime:

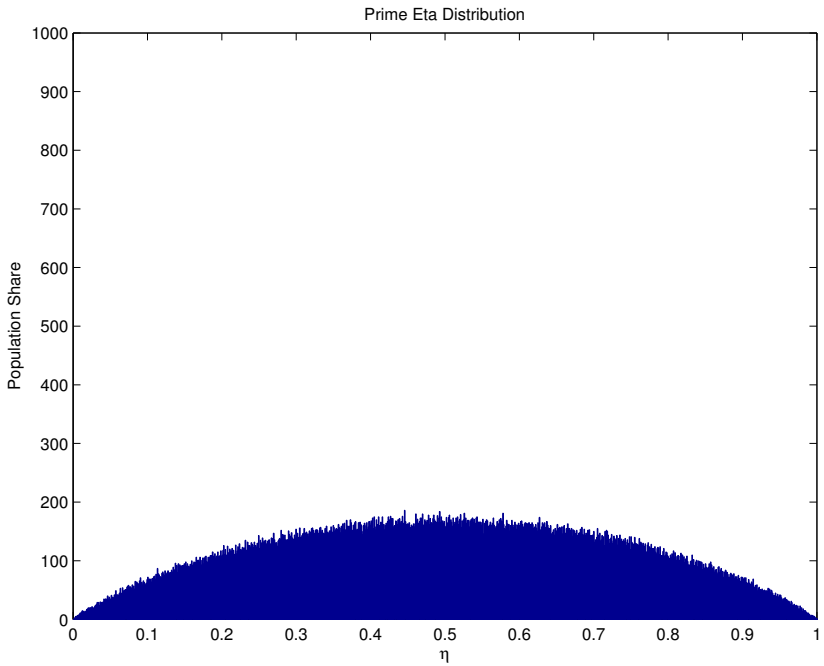
2. Employment rate
3. Hours per worker
4. Std deviation of hours per worker

Others:

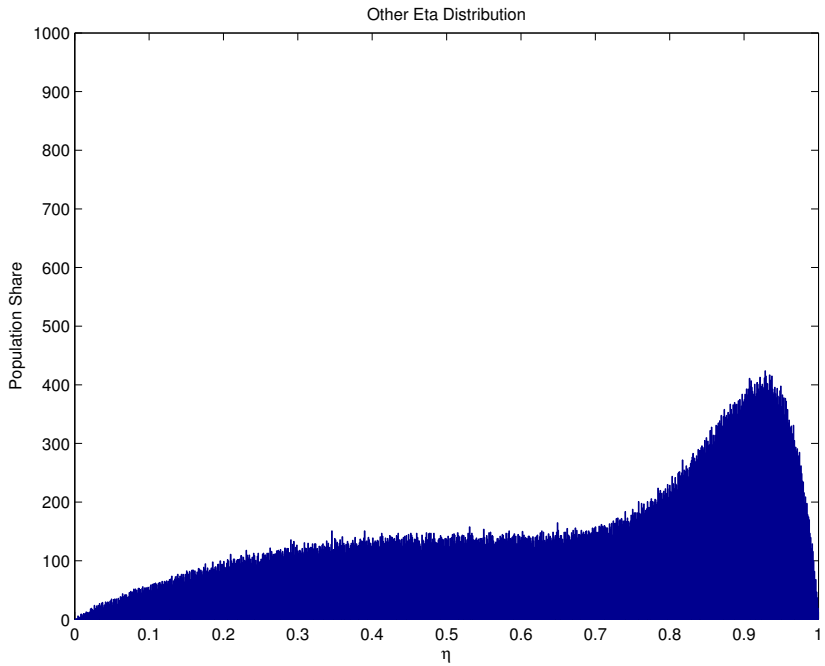
5. Employment rate
6. Hours per worker
7. Std deviation of hours per worker

Distribution of η

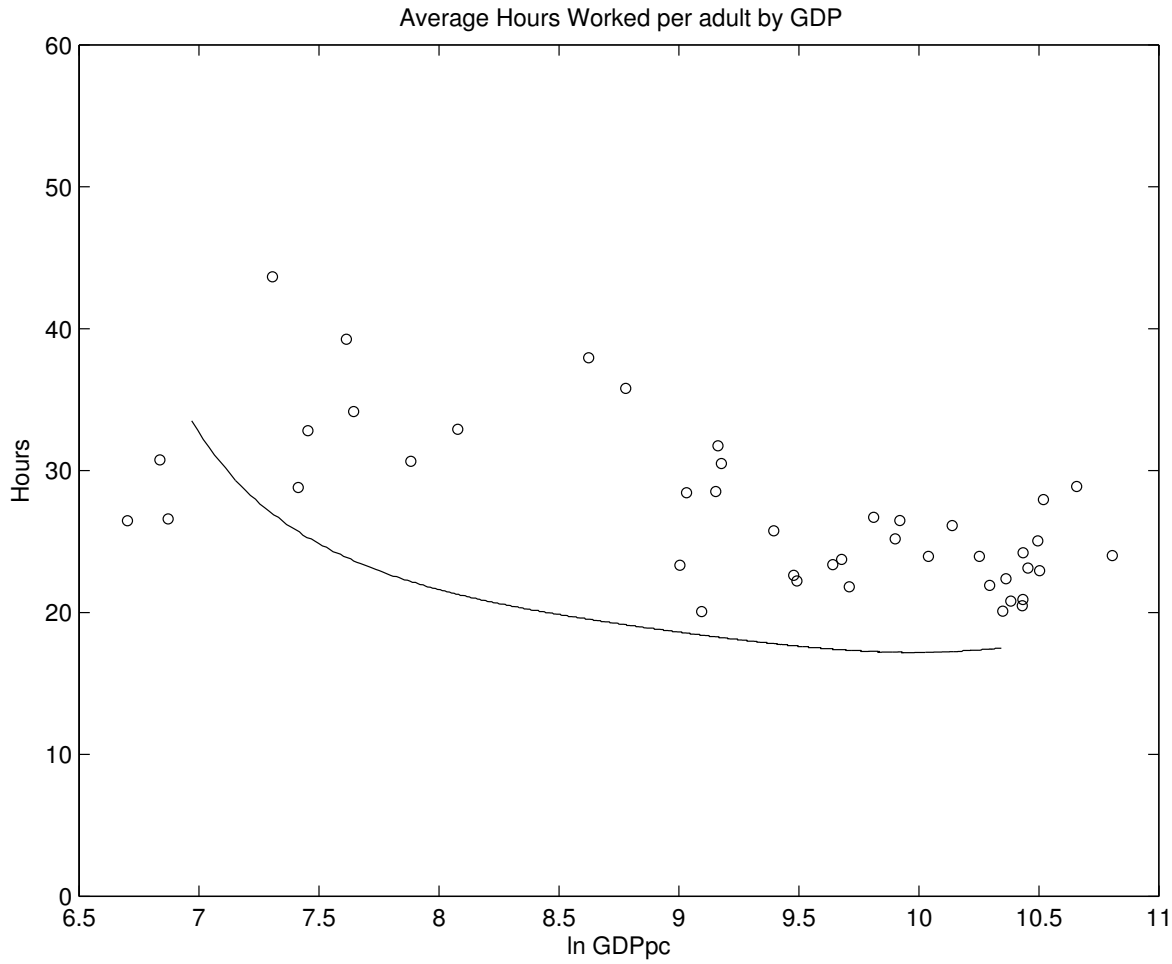
Prime Males



Others



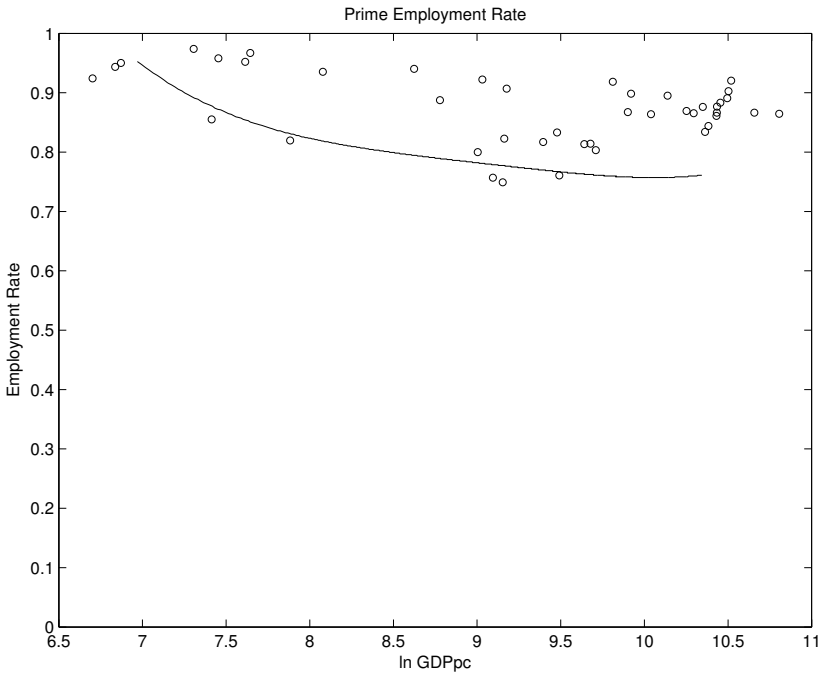
Average Hours per Adult



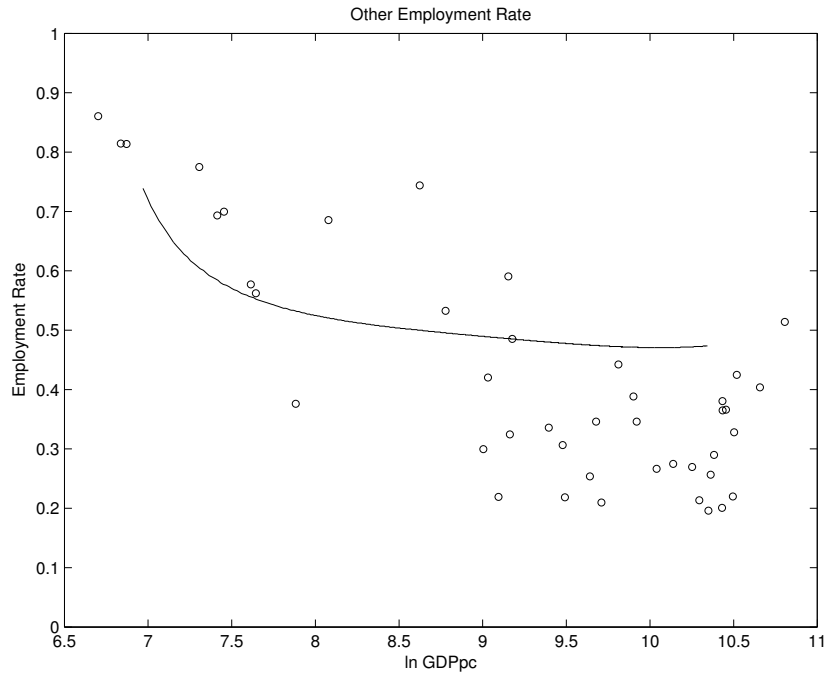
- Success: Hours per adult decrease in GDP pc
- Failure: Hours per adult are too convex

Employment Rates by Type

Prime Males



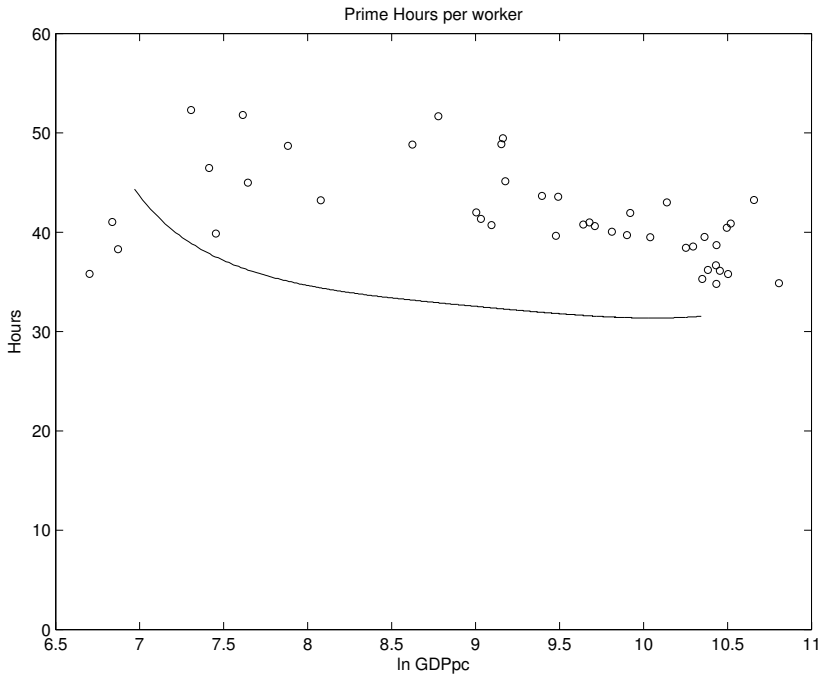
Others



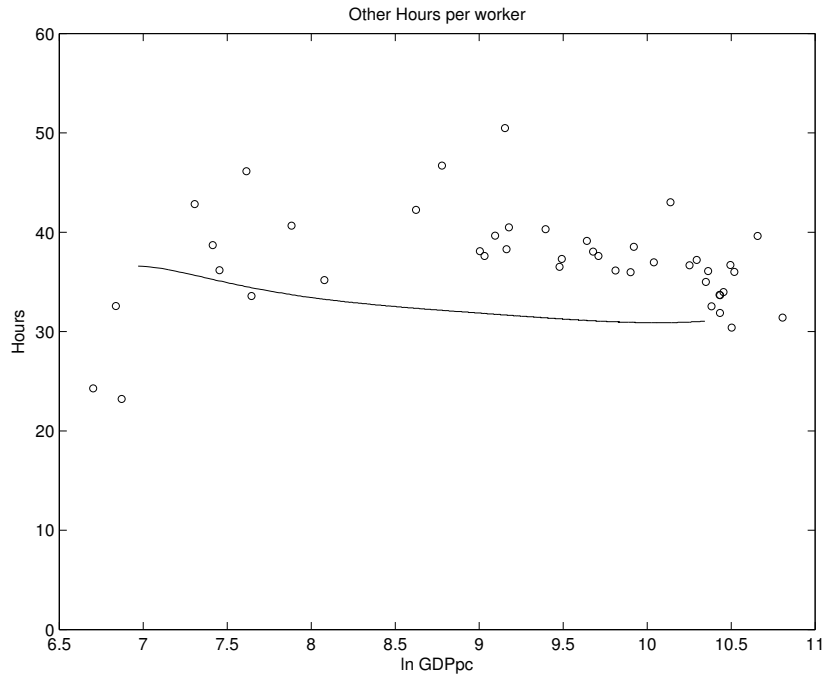
- Success: Employment rate declines much more for the "others"
- Failure: Employment rate declines
  - too much for prime males
  - too little for the others

Average Hours per Worker by Type

Prime Males



Others



- Success: Hours per worker for the "others" decrease much less than the employment rate
- Failure: Hours per worker are convex

Relevance for Welfare Differences Across Countries

- Welfare measured based on Jones & Klenow (2011)
- Option 1: Work average h_H & get fraction λ of average c_H in high-income countries (H)
- Option 2: Work average h_j and get average c_j in country j
- Welfare of j is λ that satisfies

$$U(\lambda \cdot c_H, h_H) = U(c_j, h_j)$$

where

$$U(c, h) = log(c - \bar{c}) - \alpha \frac{\epsilon}{1+\epsilon}(\eta + h)^{\frac{1+\epsilon}{\epsilon}}$$

Welfare as Percent of High-Income Group

	Country Income Group			
	Low	Middle	High	High/Low
Consumption	6.4	27.9	100	15.6
+ Non-homothetic Prefs	5.6	27.3	100	17.9
+ Hours Worked	2.8	23.4	100	36.0

Average Hours per Week on Home Production

	Country Income Group		
	Low	Middle	High
Cooking	8.9	8.1	6.1
	(5)	(6)	(9)
Cleaning	6.0	7.1	5.7
	(5)	(6)	(9)
Childcare	6.0	6.4	2.6
	(7)	(6)	(9)
Shopping	2.0	2.2	3.7
	(5)	(6)	(9)
Collecting Water	3.5	2.0	0.0
	(8)	(2)	(0)
Total Hours	**26.4**	**25.8**	**18.1**

Conclusions

- On average, adults work about 50% more hours in poorest countries than in richest
- Accounted for mostly by employment rates
- Consistent with simple model of subsistence consumption needs + heterogeneity in disutility of work
- Welfare differences across countries larger than previously thought

Extra Slides

An Aggregate Model: Setup

- Standard Neo-Classical Growth Model with log-log preferences:

$$u = (c + G - \bar{c}) + \alpha \ln(1 - h)$$

1. Marginal rate of substitution b/w leisure & cons. = the price ratio

$$\frac{\alpha/(1-h)}{1/(c+G-\bar{c})} = (1-\tau)w$$

2. Profit-maximization: wage = marginal product of labor

$$w = (1-\theta)k^{\theta}h^{-\theta} = (1-\theta)y/h$$

$\Rightarrow$ Combining both yields:

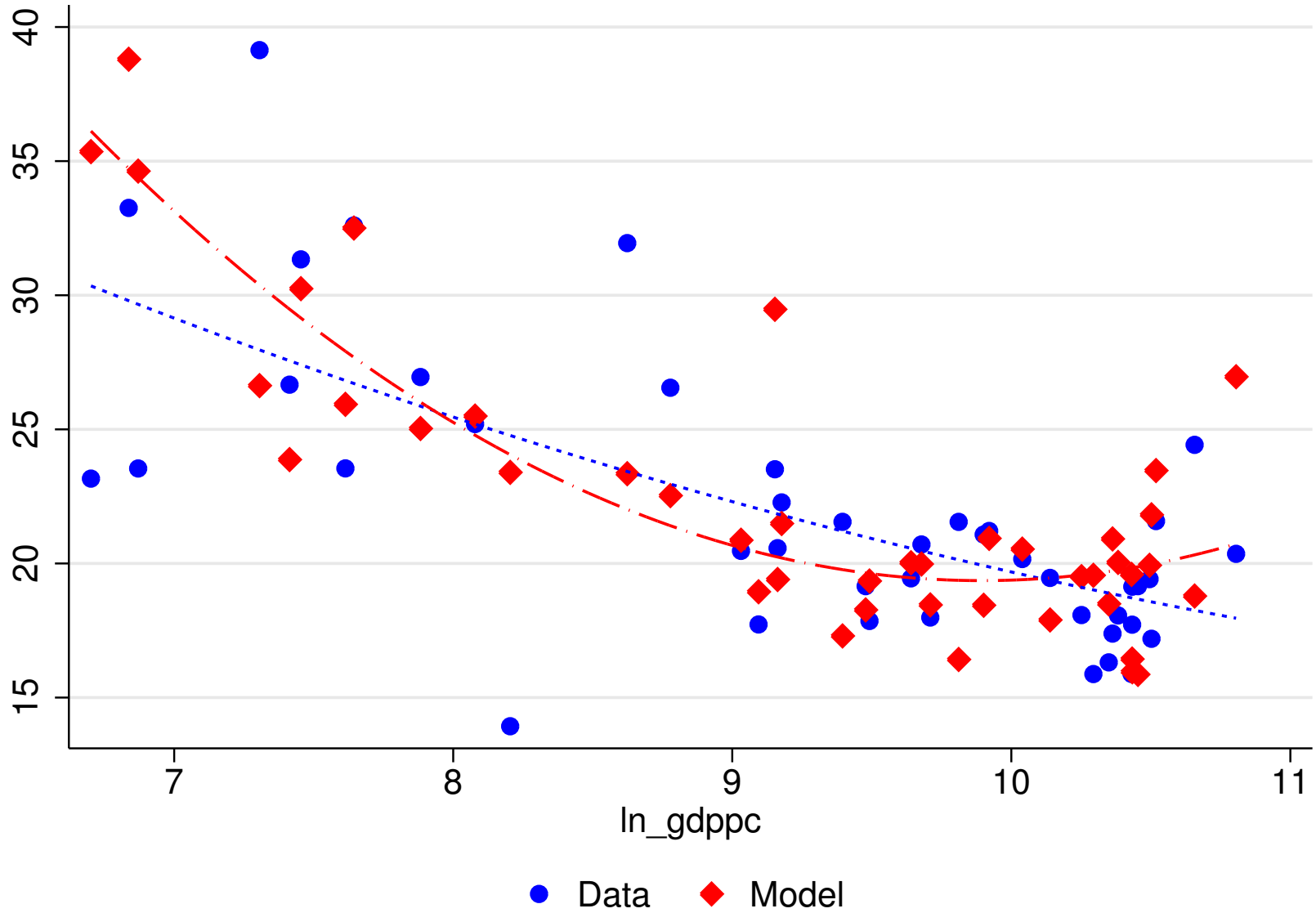
$$h = \frac{(1-\theta)}{(1-\theta) + \left(\frac{c}{y} + \frac{G}{y} - \frac{\bar{c}}{y}\right)\frac{\alpha}{1-\tau}}$$

An Aggregate Model: Calibration

$$h = \frac{(1-\theta)}{(1-\theta) + \left(\frac{c}{y} + \frac{G}{y} - \frac{\bar{c}}{y}\right)\frac{\alpha}{1-\tau}}$$

- Set $\theta = 0.3224$ & normalize time endowment to 100 hours per week
- $\frac{c}{y}$ (private cons.) and $\frac{G}{y}$ (government cons.) from PWT
- $\bar{c}$: average over $0.5 \cdot c$ in core countries in the lowest income tercile
- τ: tax to GDP ratio from IFS
- Take mean of $\frac{c}{y}$, $\frac{G}{y}$, $\frac{\bar{c}}{y}$, τ for countries in the highest income tercile, set α to match mean of hours per person in the highest inc. tercile
- Given α solve model for each country with country-specific inputs

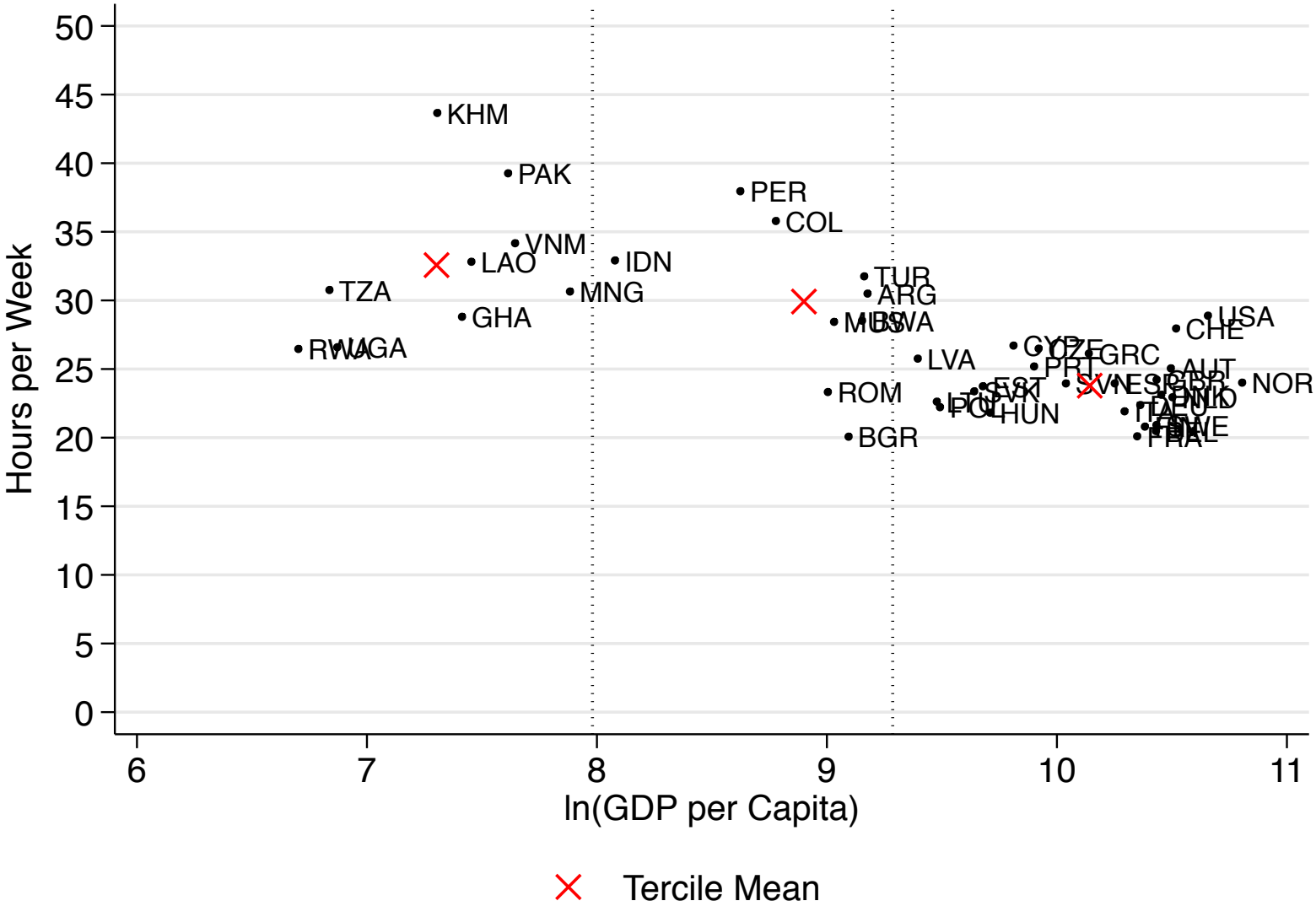
An Aggregate Model: Predictions



An Aggregate Model: Predictions

	Mean Hours	$\frac{\bar{h} \text{ low inc.}}{\bar{h} \text{ high inc.}}$	$\frac{\bar{h} \text{ middle inc.}}{\bar{h} \text{ high inc.}}$	R^2
Data	21.9	1.52	1.18	–
Model				
All inputs country-specific	22.6	1.56	1.18	0.39
Only $\frac{c}{y}$ country-specific	19.3	0.98	0.98	0.03
Only $\frac{G}{y}$ country-specific	19.2	0.96	1.02	0.01
Only $\frac{\bar{c}}{y}$ country-specific	22.2	1.66	1.07	0.22
Only τ country-specific	20.1	1.13	1.10	0.27

Average Hours per Adult **Men**



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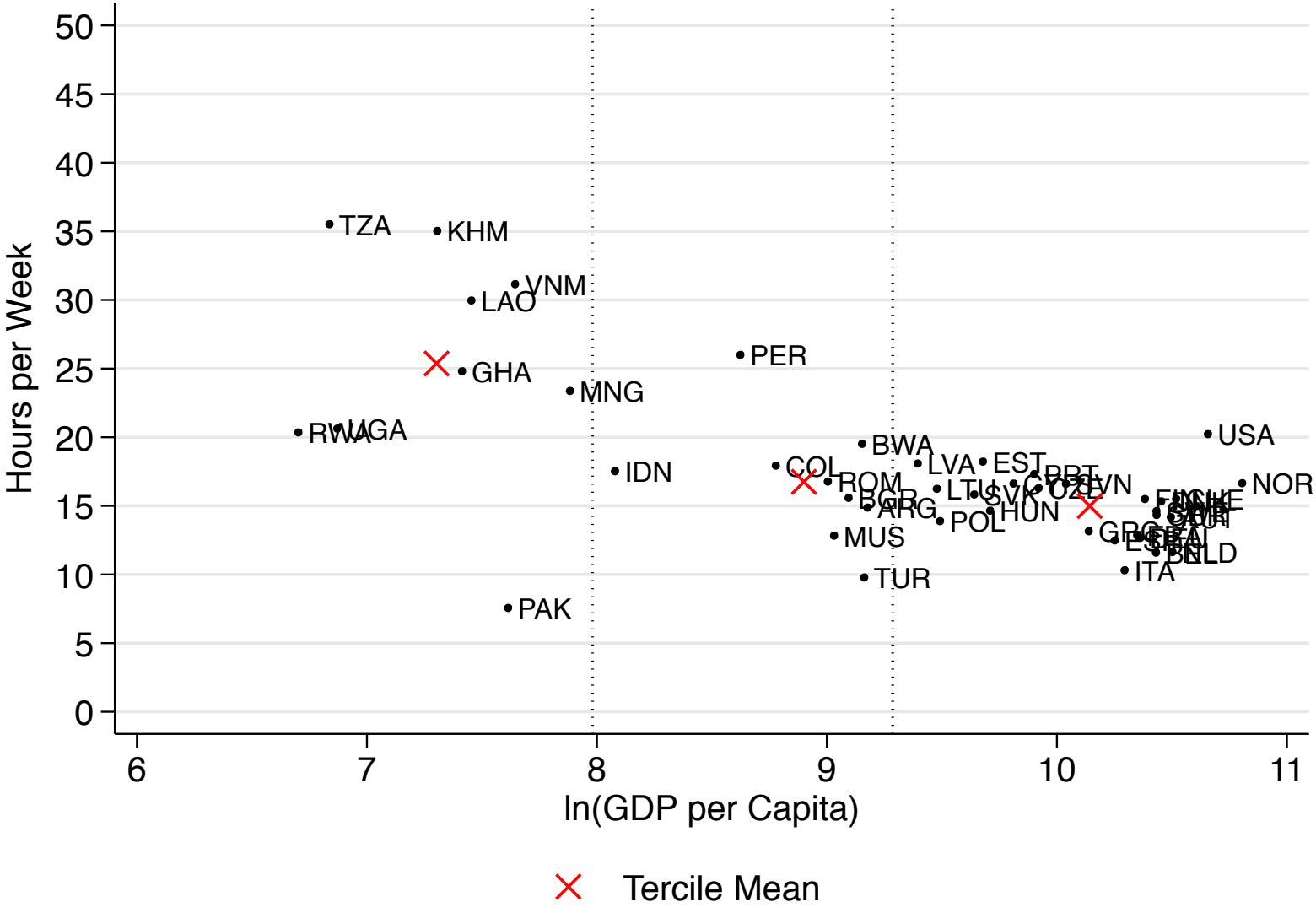
Average Hours per **Woman**



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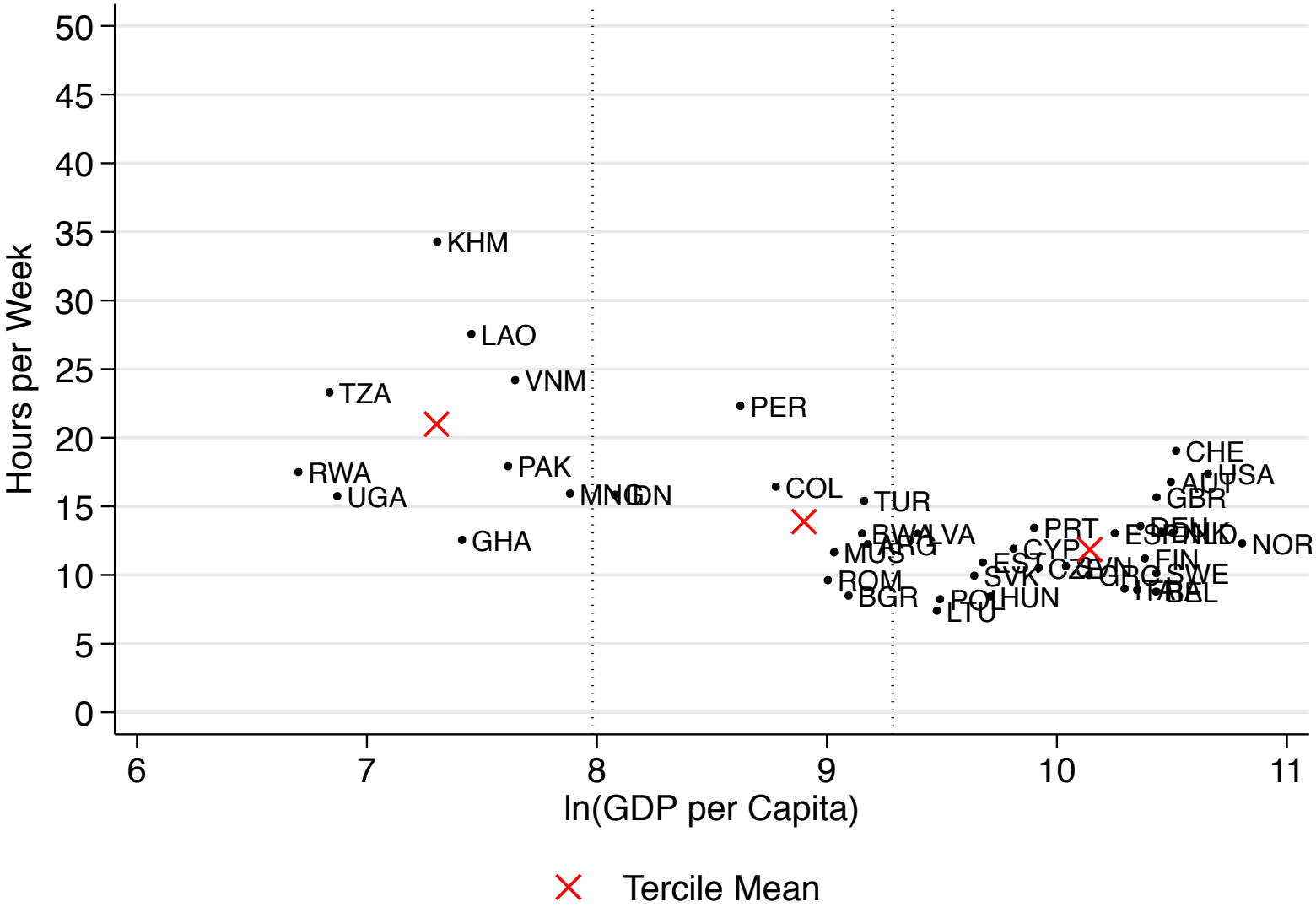
Average Hours per **Young** (Aged <25)



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Average Weekly Hours Per Adult: Broader Sets of Countries

Set of Countries	Country Income Group			
	Low	Middle	High	N
Core Countries	28.9	22.2	19.2	43
+ Partial-Year Surveys	26.1	22.5	19.6	76
+ All Hours Measures	26.1	22.9	20.0	83

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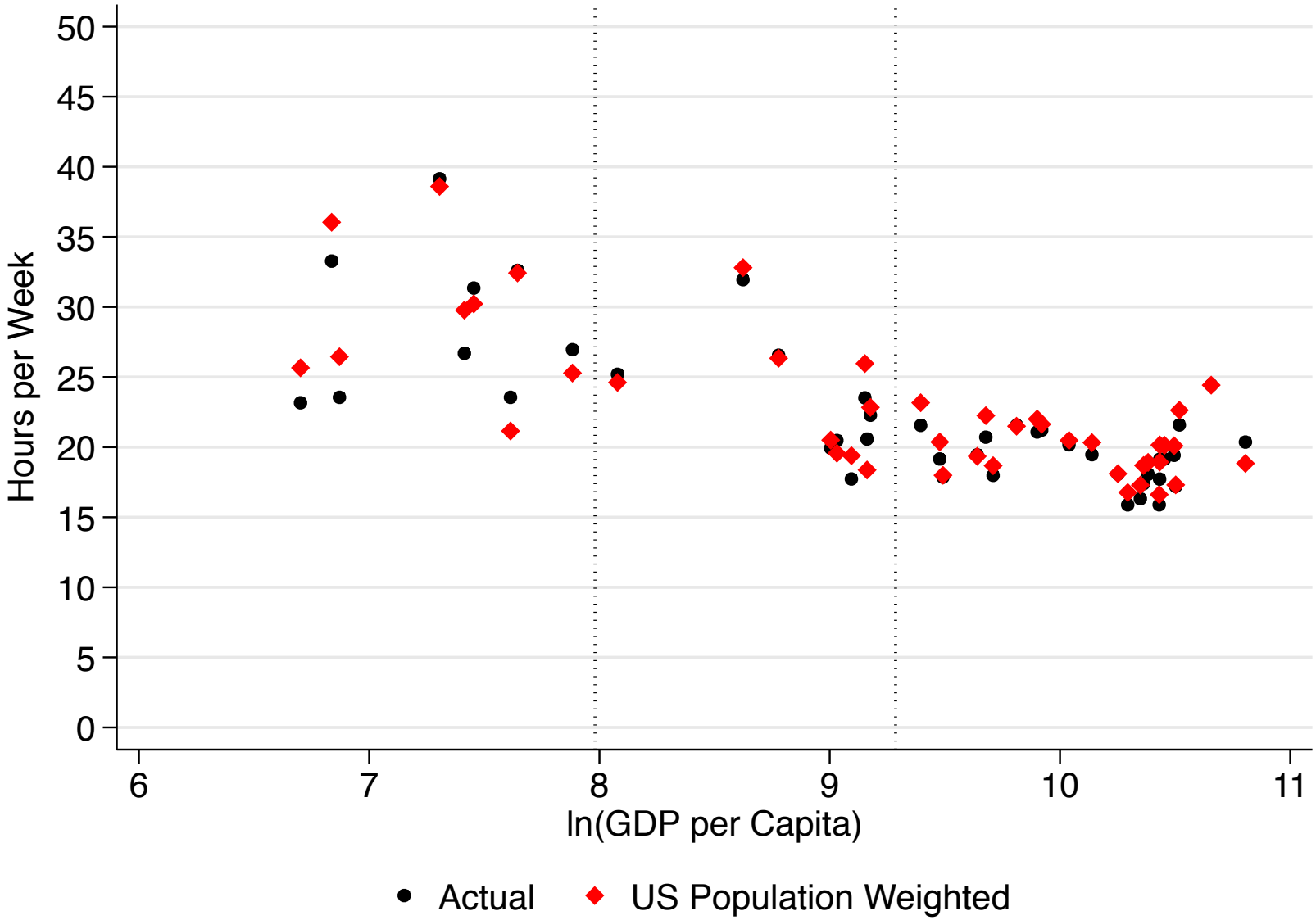
Average Weekly Hours per Adult: US Population Weights



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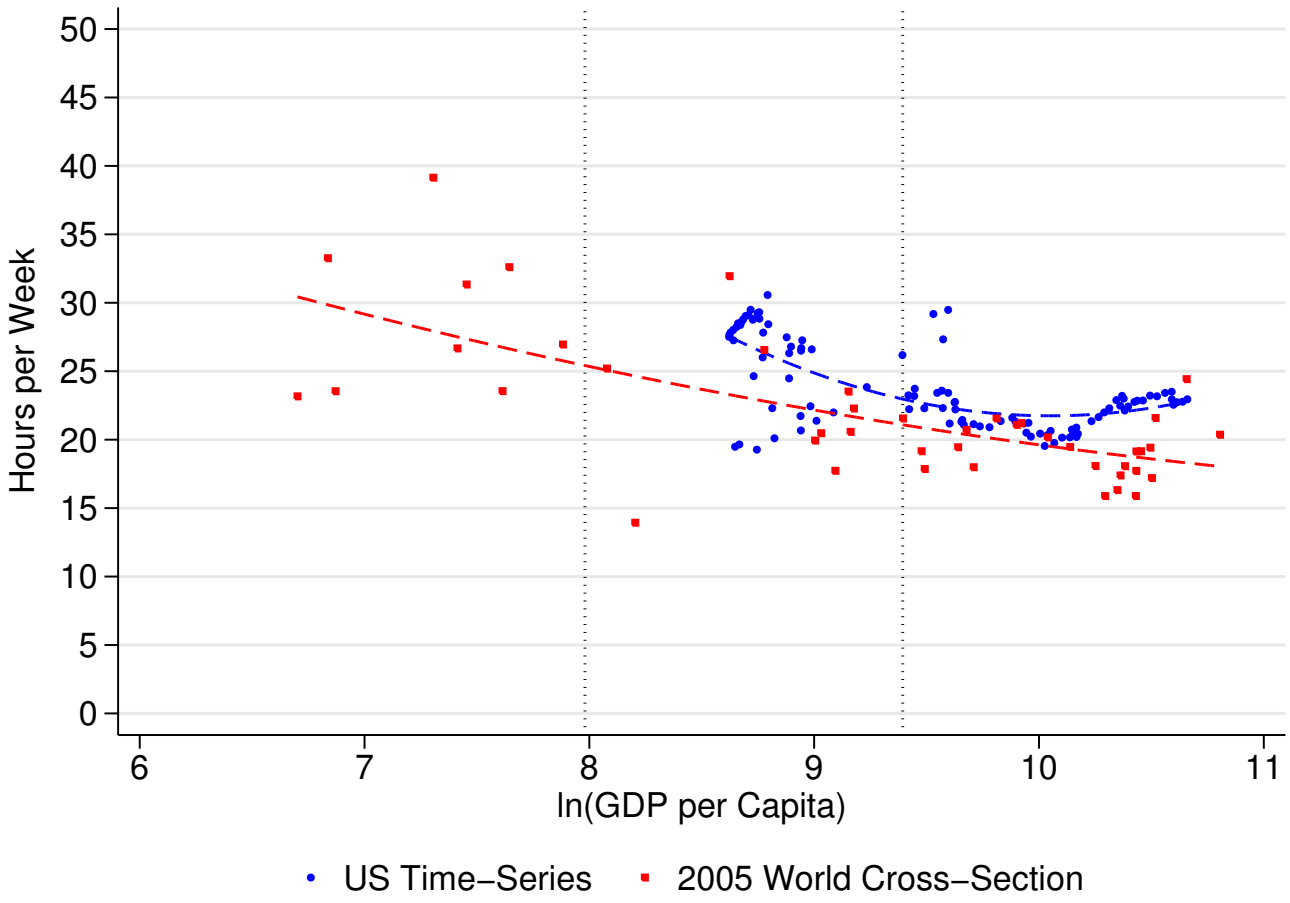
Average Weekly Hours per Adult: US Time-Series



	US Time-Series	2005 World Cross-Section
Mean Middle Inc. / Mean High Inc.	1.17	1.16

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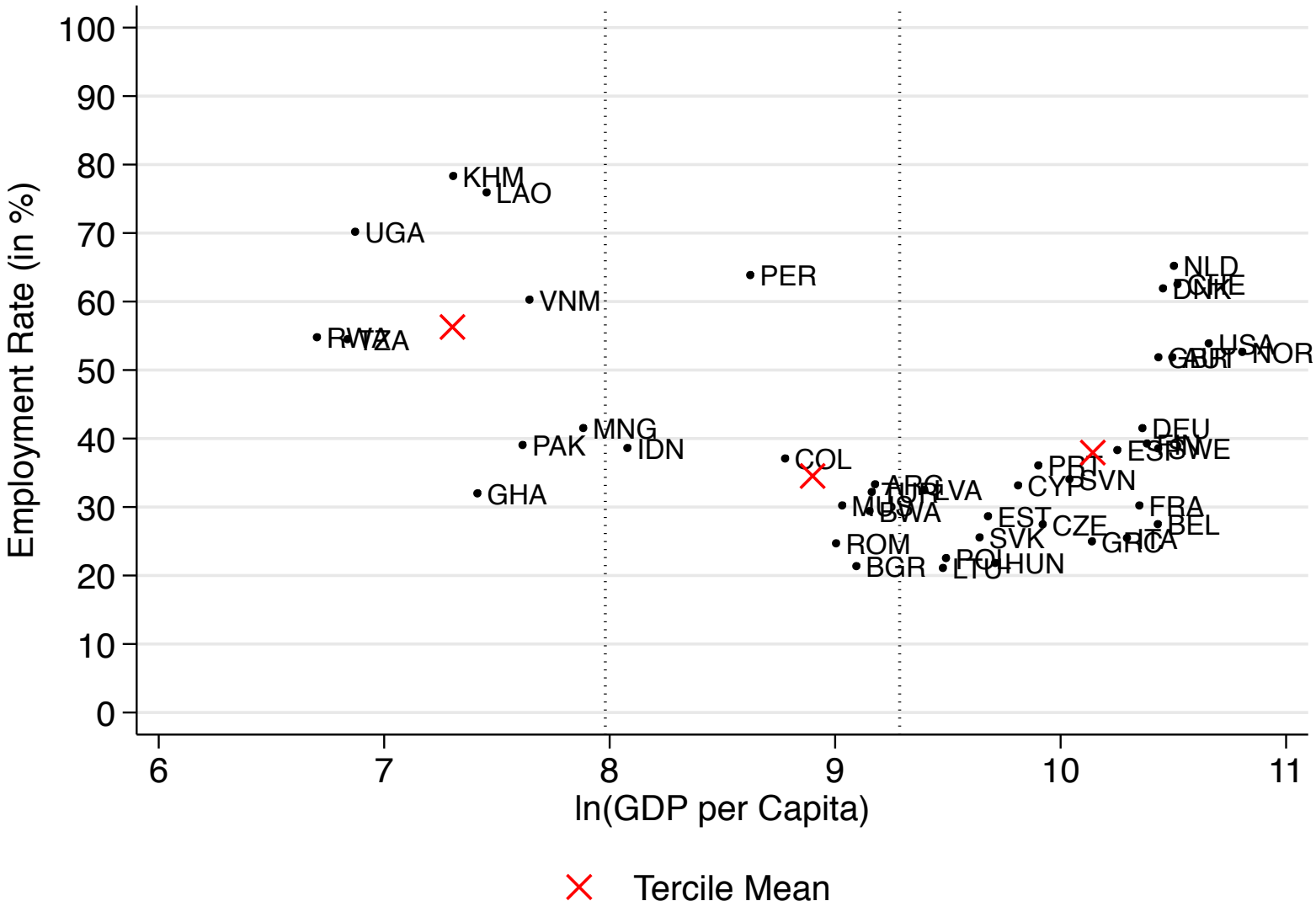
Employment Rates, Young



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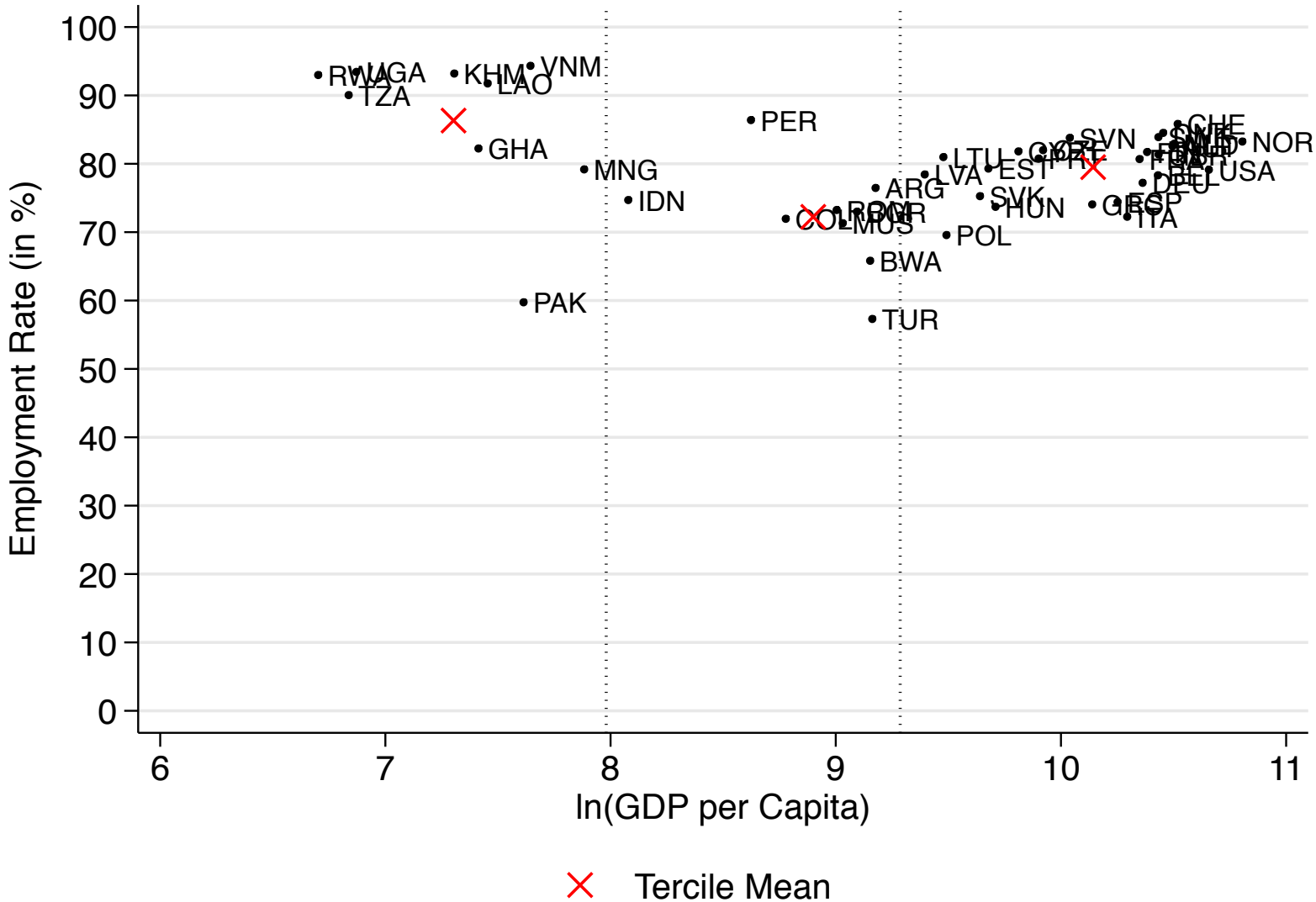
Employment Rates, Prime-Aged



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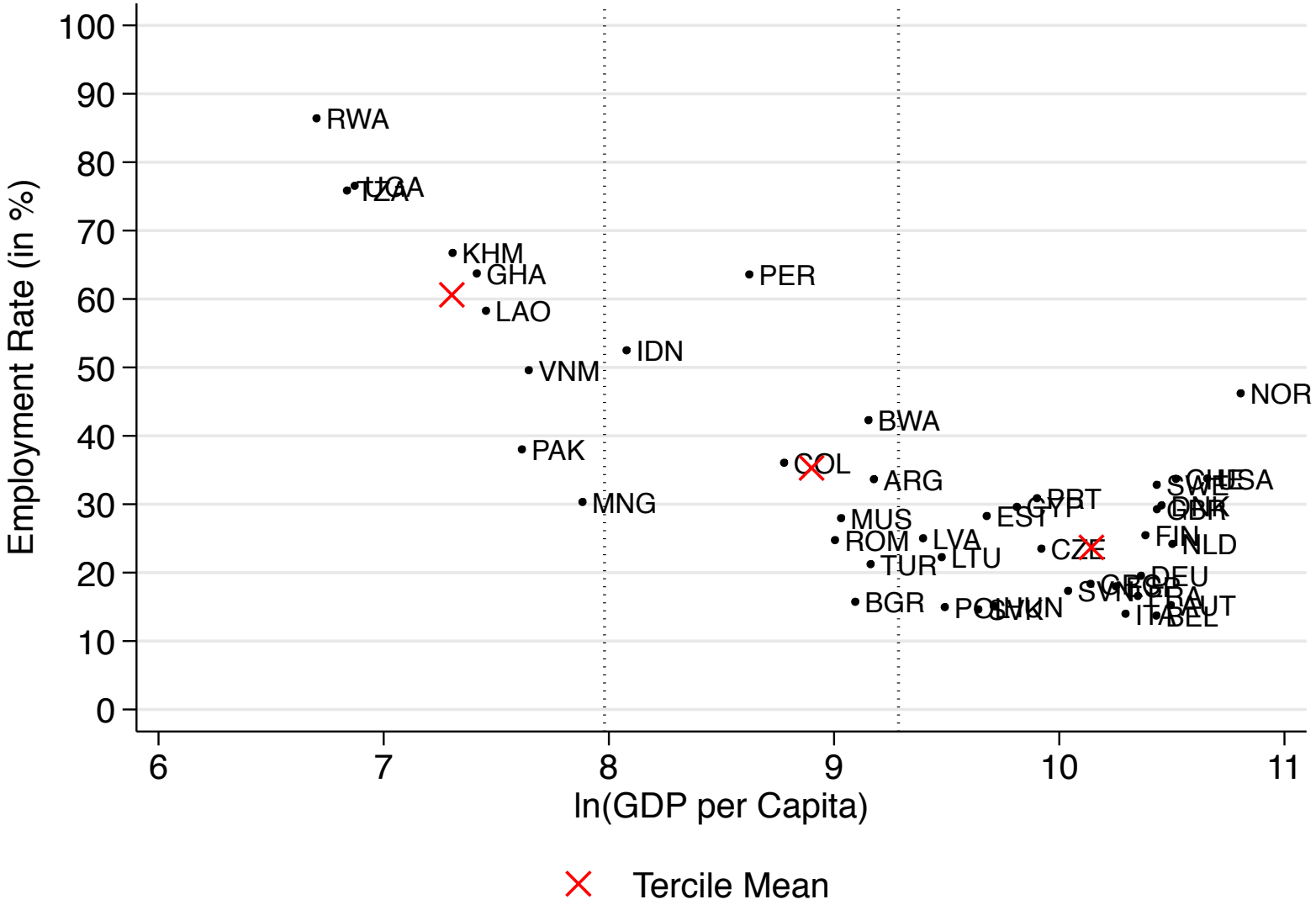
Employment Rates, Old



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Employment Rates by Age

Age Group	pp. Differences in Mean Employment Rates		
	Low - Middle	Middle - High	Low - High
All	20***	-2	18***
Young	23***	-4	18***
Prime	17***	-10	7***
Old	27***	10**	37***

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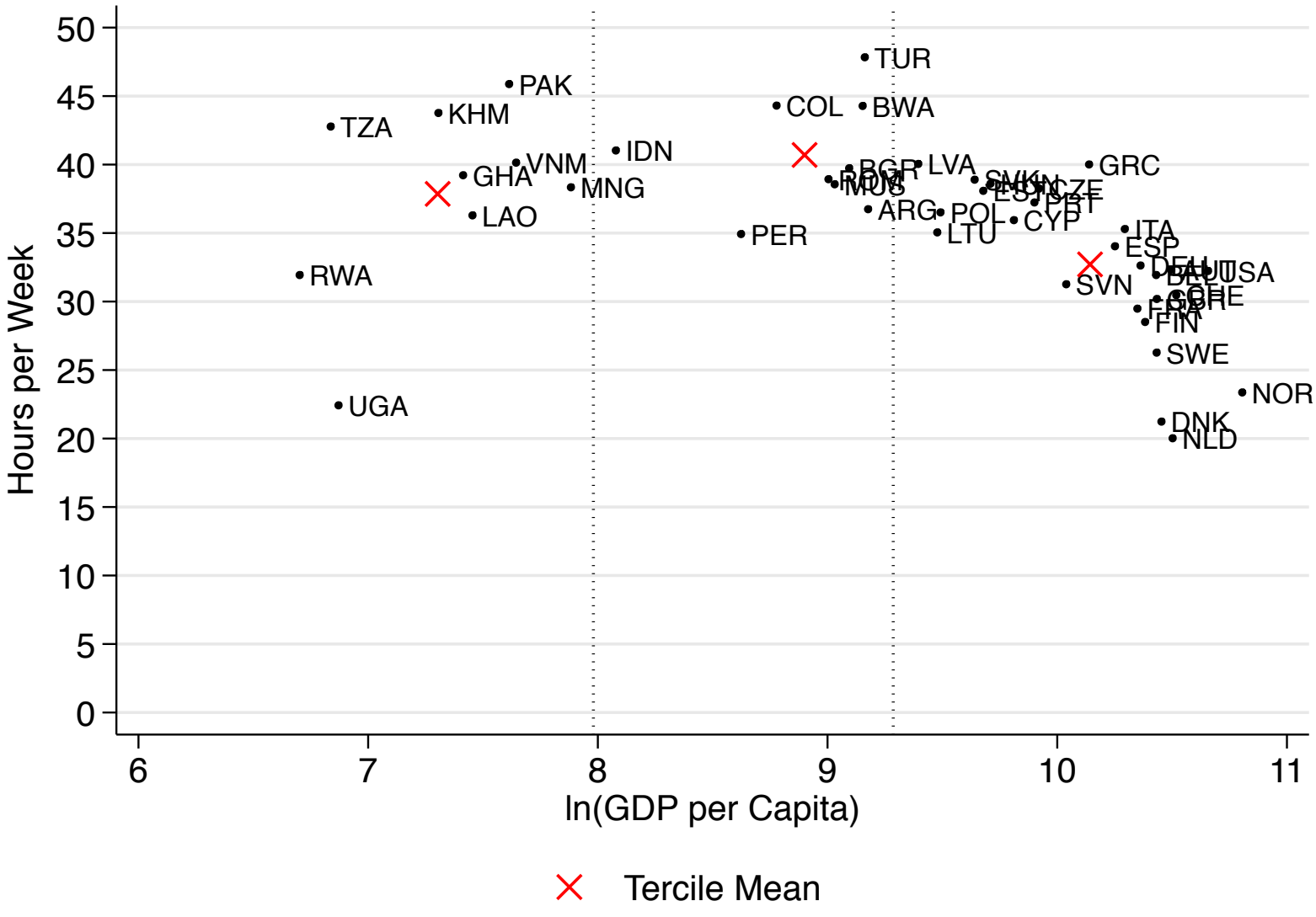
Hours Worked per Worker, Young



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Hours Per Worker by Age

Age Group	Differences in Mean Hours		
	Low - Middle	Middle - High	Low - High
All	-1.7	6.5***	4.8***
Young	-2.8	8.0***	5.2***
Prime	-0.6	6.6***	6.0***
Old	-4.5	4.8***	0.3

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Implications for Development Accounting

	Mean High Inc. / Mean Low Inc.	Mean High Inc. / Mean Medium Inc.
GDP per Capita	17.2	3.6
GDP per Hour	19.2	3.7
GDP per Worker	16.1	3.0

- Largest productivity differences for hourly measure
- Per capita & per hour do not differ that drastically because hours per capita more similar across countries than hours per adult
  - 11% higher in low income countries
  - 5% higher in middle income countries

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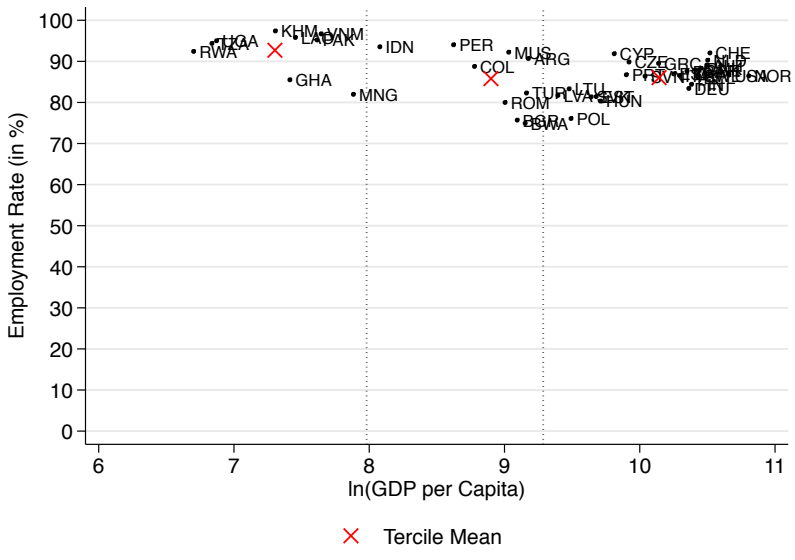
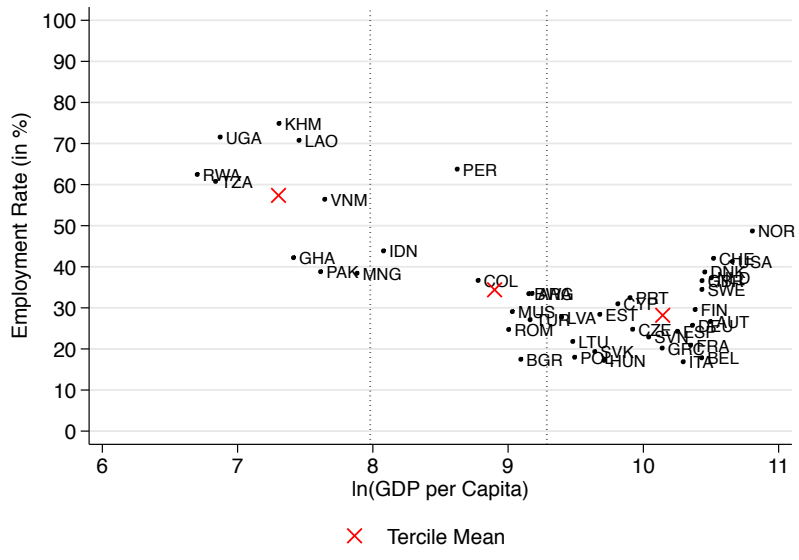
Employment Rate

Prime Males



Other



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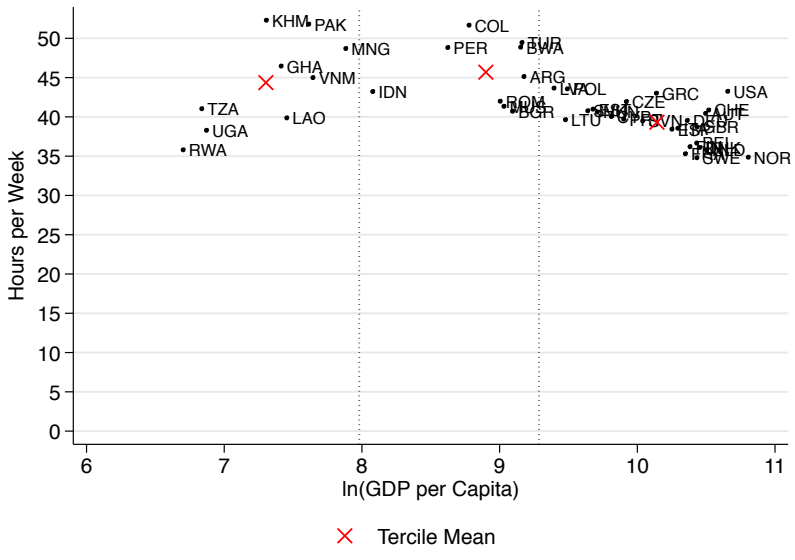
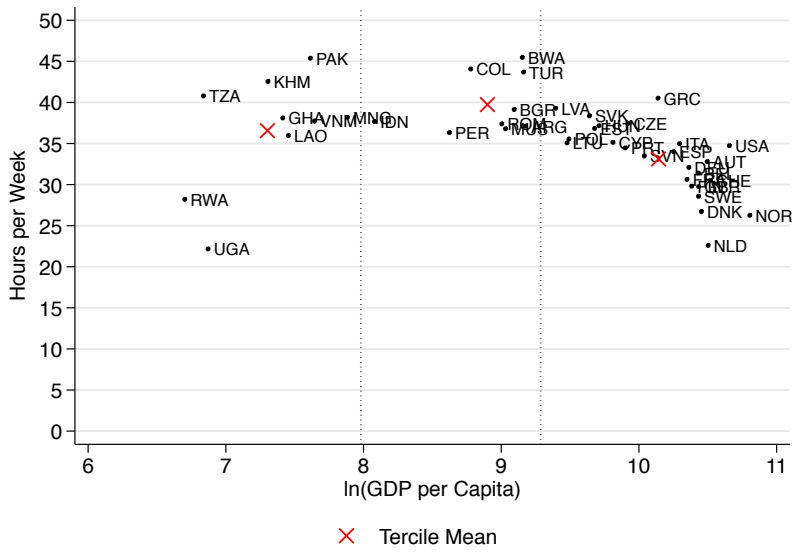
Hours per Workers

Prime Males



Other



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Moments to Match (Low-Income Group)

1. Subsistence consumption is 50% percent of total consumption
   - consistent with estimates of Rozenzweig & Wolpin (1993), Atkeson & Ogaki (1996) and food expenditure shares.

Prime:

2. Employment rate: 93%
3. Hours per worker: 44.4
4. Std deviation of hours per worker: 24.0

Others:

5. Employment rate: 57%
6. Hours per worker: 36.6
7. Std deviation of hours per worker: 24.5

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Parameters to Calibrate

1. $\bar{c}$=0.003
2. α=11
3. k_p=1.9
4. θ_p=1.9
5. ϕ=0.61
6. k_o=14.5
7. θ_o=2

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