Which Sectors Make the Poor Countries so Unproductive?

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I. Motivation

- **Facts**
  - **There are large cross–country differences in labor productivity**
  - **The main cause is cross–country differences in TFP**
    Standard growth accounting (e.g. Prescott IER '98 and Hall and Jones QJE '99)

- **Research agenda**
  - **What accounts for these TFP differences?**
  - **Our questions**
    - **Are specific sectors driving the aggregate TFP differences?**
    - **And, if "Yes", which are these problem sectors?**

What data?

- **We do NOT have**
  - **comparable international data on sector inputs and outputs**
  - **access to the McKinsey's firm level data**
- **We DO have data on expenditure and relative purchase prices**
  - **Very detailed data available for 1996 benchmark of Penn World Tables**
  - **Tricky to use though because it does not contain information on**
    - sector outputs and sector inputs
    - producer prices
- **We need to build a model to use this data set**
  - To what extent relative purchase price differences reflect relative TFP differences?
  - What wedges between purchase and producer prices?

Our contributions

- **We argue that it is important to consider four sectors**
  - **Growth theory distinguishes between consumption and investment**
  - **Trade theory distinguishes between tradables and nontradables**
  - **We document that both consumption and investment**
    - have large tradable and nontradable components
    - show systematic variations in the relative prices of these two components
  - **We therefore consider**
    - **nontradable and tradable consumption**
      services and consumption goods
    - **nontradable and tradable investment**
      construction and equipment investment

- **We provide evidence that our four sectors show very different patterns**
  - the largest international TFP disparity is in tradable investment
  - the second–largest TFP disparity is in tradable consumption
  - **in other words, the tradable sectors are the problem sectors**

- **We suggest that the key question is**

  Why do the poor countries have so much lower TFPs in the tradable sectors?

What is the relation of our results to the existing literature?

- **Using two–sector models, the literature finds problem sectors everywhere**
  - **tradables** (Balassa and Samuelson)
  - **agriculture** (Kuznets, Rogerson, Restuccia etal.)
  - **investment** (Hsieh and Klenow)
- **Using firm level–data, the literature finds yet another problem sector**
  - **nontradables** (McKinsey Global Institute, Lewis)

If we aggregate to two sectors, we can explain the reason for the findings of the two–sector studies

- larger labor productivity variation in tradables than in nontradables
- larger labor productivity variation in consumption goods than in "rest"
- larger TFP variation in total investment than in total consumption

We do not, however, confirm the McKinsey results

- We find that TRADABLES, not nontradables are the problem sectors
- Possible explanations: McKinsey
  - has firm–level data on just 10 countries
  - does not have firm–level data on developing countries other than India, Brazil

II. Environment

What do we want from our environment?

- **Four sectors**
  - tradable and nontradable consumption goods
  - tradable and nontradable capital stocks
- **Distinguish between purchase price and competitive producer prices**
  - we observe purchase prices
  - we need competitive producer prices to measure sector TFPs

Illustrative example

- Technologies of producing tradables and nontradables

$$x_T = A_T l_T \quad \text{and} \quad x_N = A_N l_N$$

- p_N: producer price of nontradables relative to tradables
- Competition and wage equalization $\implies$ $p_N = A_T / A_N$
- E.g. how does a value–added tax drive a wedge between the producer price p and the purchase price P?

$$\frac{P_T}{P_N} = \frac{(1+\tau_T)p_T}{(1+\tau_N)p_N} = \frac{(1+\tau_T)A_N}{(1+\tau_N)A_T}$$

What wedges between purchase and producer prices?

- **"Taxes" on all final goods**
  - **broad notion of taxes: any distortion that**
    - increases the purchase price above the competitive producer price
    - gets lump–sum rebated to consumers
  - **examples of "taxes"**
    - value added tax
    - tariffs
    - monopoly power
    - bribes

- **Distribution services**
  - retail, wholesale and transport services
  - prices vary systematically across countries

Small open economies

People

- **Representative household in each country**
- **Preferences**

$$\sum_{t=0}^{\infty} \beta^t u(x_{st}, x_{gt})$$

- **Endowments**
  - one unit of labor in each period
  - positive initial stocks of buildings and equipment in first period

Technology

$$y_i = F_i(k_{bi}, k_{ei}, l_i) \qquad i \in \{s, b, g, e\}$$
$$x_i = G_i(y_i^*, y_{si}) \qquad i \in \{g, e\}$$

- distribution services required to deliver tradable goods to the domestic consumers
- distribution services are retail, wholesale, and transport services

III. Competitive Equilibrium

Sequence of markets

- **Balanced trade in each country**
  (since economies are small and open, no world–market–clearing condition)

$$p_g^*(y_g^* - y_g) + (y_e^* - y_e) = 0$$

  Implicit restriction: tradable production sold in world market

- **Domestic goods markets**

$$x_s + y_{sg} + y_{se} = y_s, \qquad x_b = y_b,$$

- **Domestic factor markets**

Definition of Competitive Equilibrium

Given "taxes" and rebates, a competitive equilibrium is
sequences of relative prices, household allocations, and firm allocations such that

- $p_g = p_g^*$ and $p_e = 1$
- the household allocations solve the household problem in each country

$$\max \sum_{t=0}^{\infty} \beta^t u(x_{st}, x_{gt}) \quad \text{s.t.} \quad P_t \cdot x_t = r_t \cdot k_t + w_t + \mathcal{T}_t$$

$$k_{it+1} = (1 - \delta_i) k_{it} + x_{it} \qquad i \in \{b, e\}$$

- the firm allocations solve the firm problems in each sector and each country (maximize profits s.t. production function)
- world markets and domestic markets clear

IV. Data and Measurement

Expenditure data of the 1996 Benchmark Study of the PWTs

- data actually collected within the International Comparisons Program
- cross section for 1996 about expenditures, purchased quantities, and consumer prices
- 31 goods categories in 98 countries with more than 1 million inhabitants

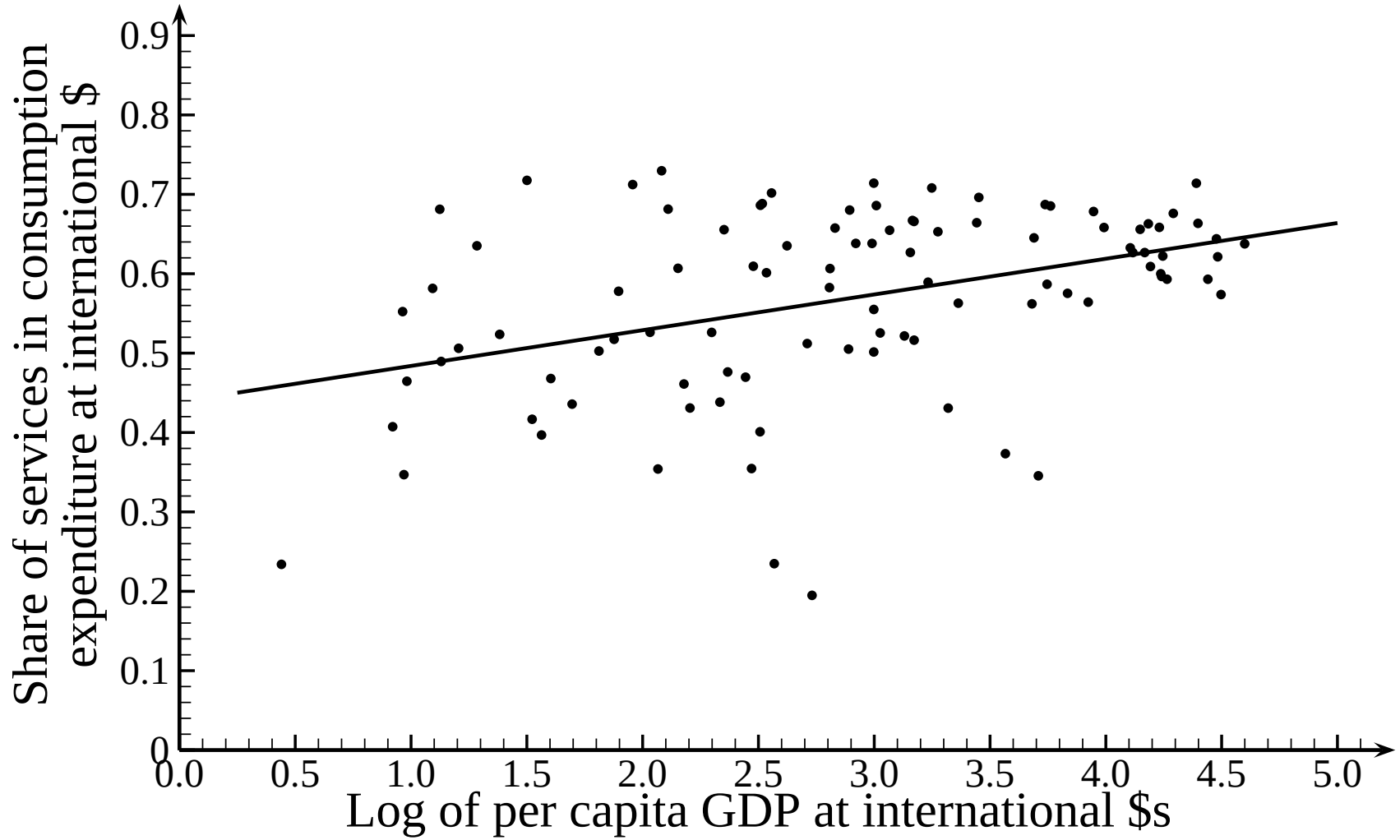
How to take our model to the PWTs?

Definitions

- **Countries**
  - **US**: U.S.
  - **LA**: Latin America
  - **PC:** 20 poorest countries in our sample

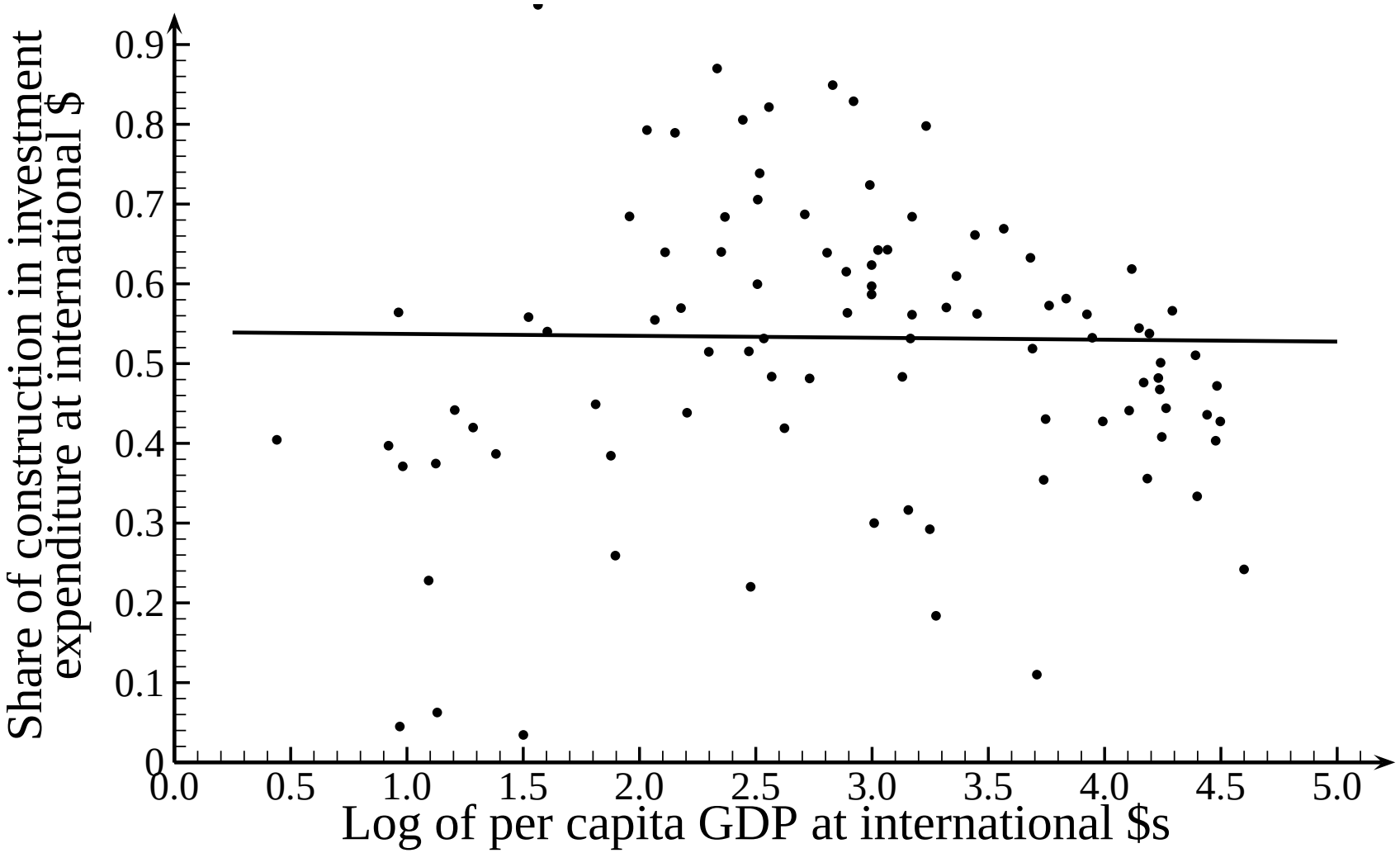
- **Nontradable versus tradable**
  - **call a category (non)tradable if most items are (non)tradable**
  - **For example investment**
    - nontradable: construction
    - tradable: personal transportation equipment, machinery & equipment
    - changes in stocks: split between the previous two

Figure 1: Share of nontradable in total consumption expenditures against income



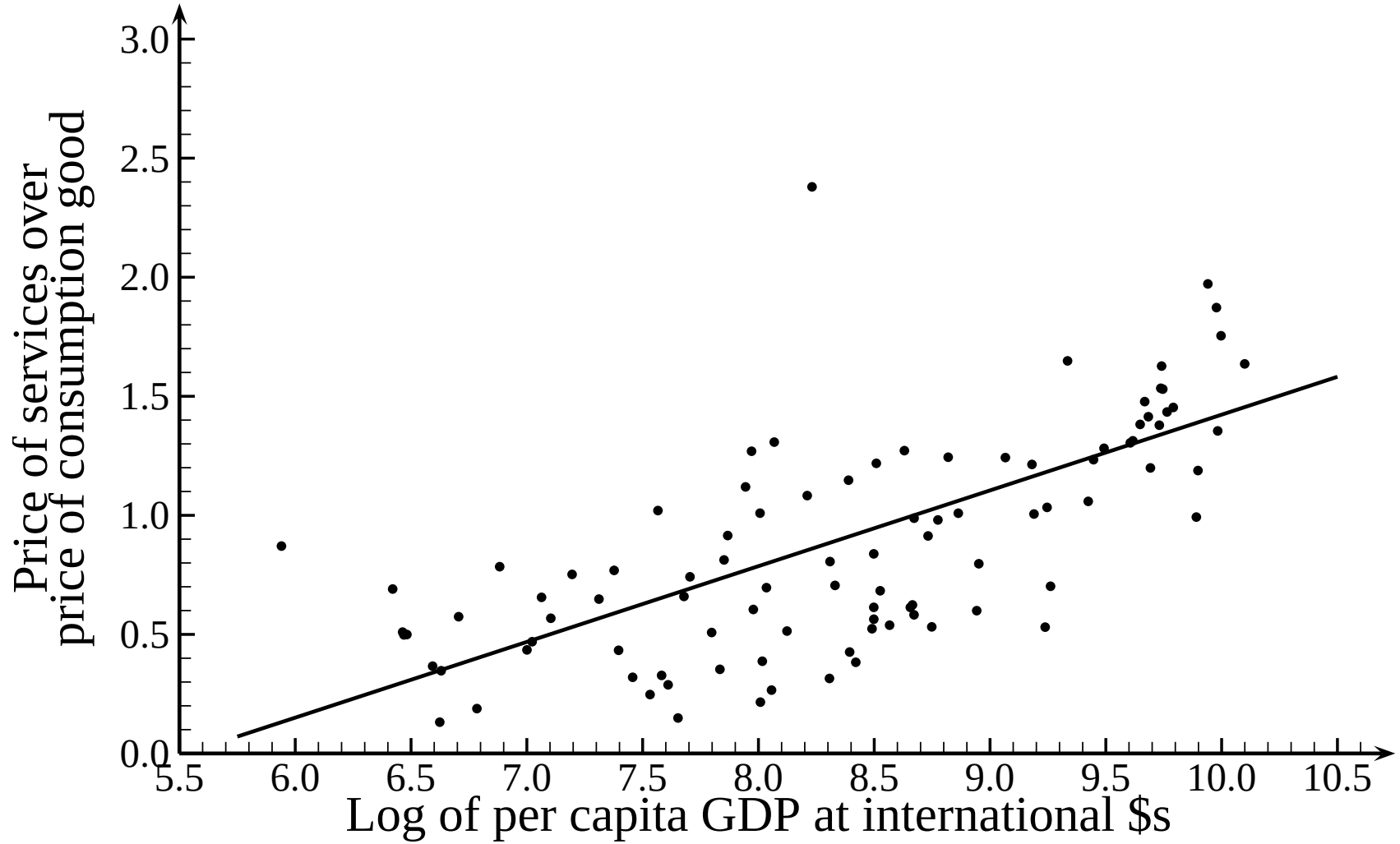
Source: Penn World Tables 1996

Figure 2: Share of nontradable in total investment expenditures against income



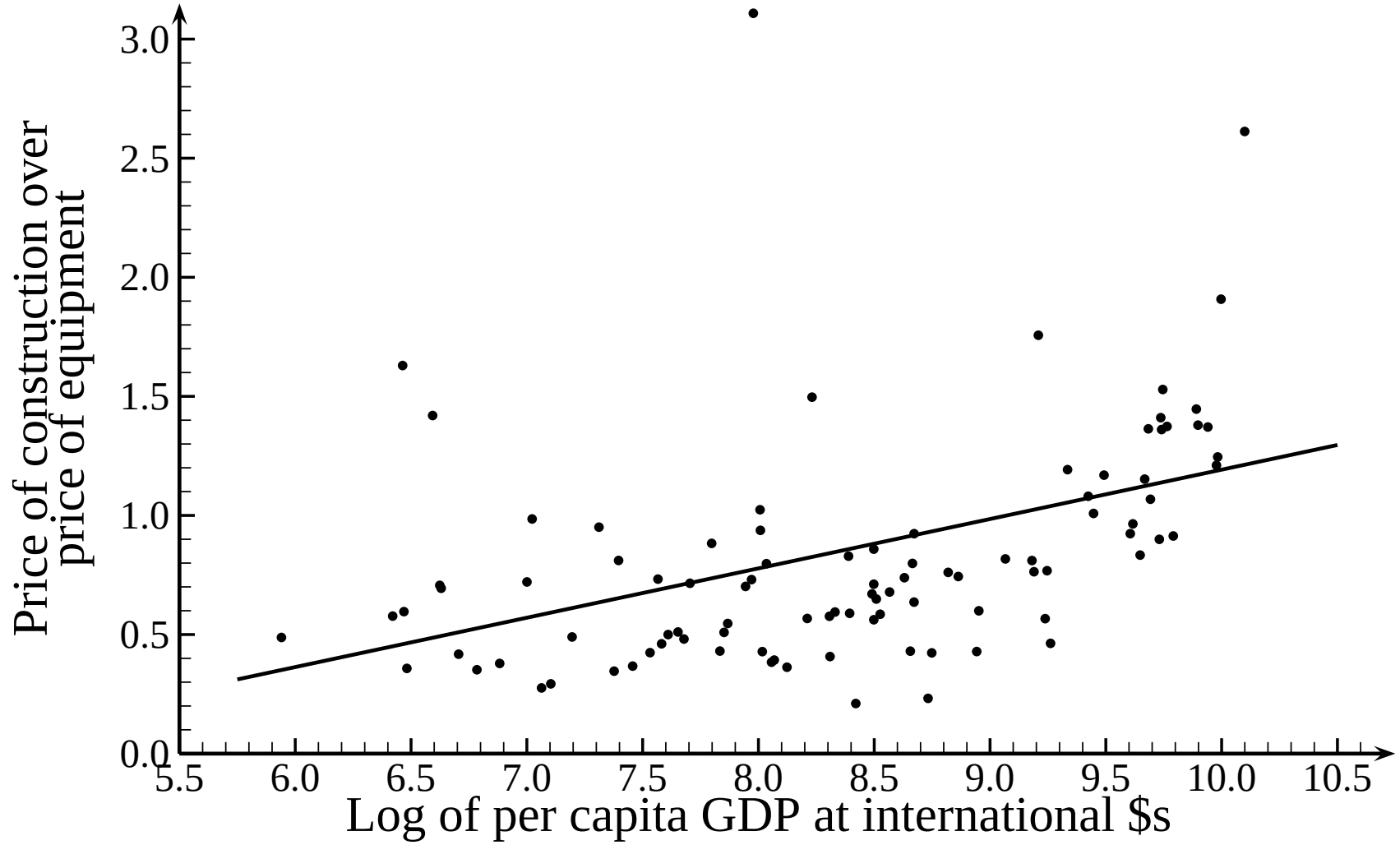
Source: Penn World Tables 1996

Figure 3: Price of nontradable relative to tradable consumption against income



Source: Penn World Tables 1996

Figure 4: Price of nontradable relative to tradable investment against income



Source: Penn World Tables 1996

Specialization

- **Countries may specialize and produce only one tradable good**

  If a country specializes, then
  - it replaces the domestic technology by the world–market technology
  - we cannot infer what tradable TFPs would be under autarky

- **We avoid dealing with different specialization patterns by**
  - endowing each country with the world–market technology $MRT_{e,g} = p^*_g$
  - analyzing the equilibrium without specialization

- **This is not restrictive for our purpose, because**
  - only the tradable quantities *produced* in each country may differ with different specialization patters
  - our data gives us no information about these anyways

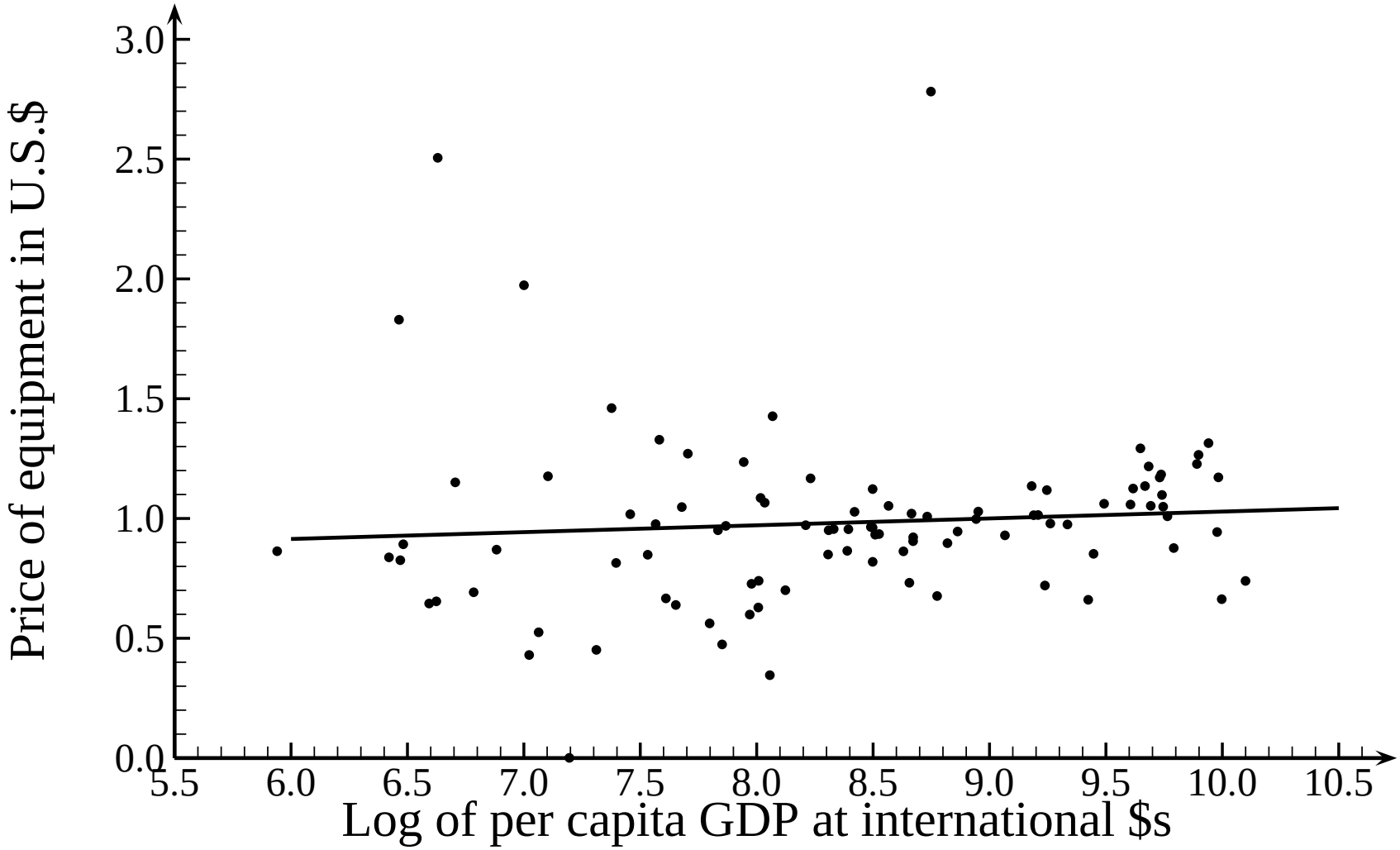
Functional forms

$$
\begin{aligned}
u(x_s, x_g) &\equiv \log\left(x_s^{\alpha}(x_g - \bar{x}_g)^{1-\alpha}\right) \\
F_i^j(k_{bi}, k_{ei}, l_i) &\equiv A_i^j k_i^{\theta_i} l_i^{1-\theta_i} \\
k_i &\equiv \left[\mu^{\frac{1}{\sigma}}(k_{bi})^{\frac{\sigma-1}{\sigma}} + (1-\mu)^{\frac{1}{\sigma}}(k_{ei})^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \\
G_i(y_i^*, y_{si}) &\equiv \min\{y_i^*, \psi_i y_{si}\}
\end{aligned}
$$

Parameters and targets

- **We normalize $A_e^{US} = 1$ and we assume $\tau_i^{US} = 0$ for $i \in \{s, b, g, e\}$**
- **We have 32 parameters**
  (including the remaining 11 sector TFPs we want to measure)
- **We use 36 statistics**
  - **8 from U.S. sources**
    - 4 U.S. sector capital shares from I.O.–tables 1997
      (we find that the tradable sectors are much more capital intensive)
    - 2 U.S. distribution margins from I.O.–tables 1997
    - 2 U.S. depreciation rates from capital stock and investment data 1950–2001
  - **28 from the PWTs**
    - 2 income ratios
    - 9 relative prices
    - $p_e^{US} = p_e^{LA} = p_e^{PC}$
    - 3 expenditure shares of services
    - 12 investment shares

Figure 5: Purchase Prices of Equipment in U.S. $s



- **We match all targets fairly closely. The required parameters are**

Table 1: Parameter values

$\theta_s = 0.32$	$\theta_b = 0.20$	$\theta_g = 0.39$	$\theta_e = 0.31$	$\delta_b = 0.02$	$\delta_e = 0.14$
$\psi_g = 36.30$	$\psi_e = 4.07$	$\sigma = 1.55$	$\mu = 0.46$		
$\beta = 0.98$	$\alpha = 0.79$	$\bar{x}_g = 0.02$			

- **However, $(\tau_s^j, \tau_b^j, A_s^j, A_b^j)$ for j numerically indeterminate**
  - for each $j \in \{LA, PC\}$,
    a one–dimensional ray of linear combinations matches data equally well
  - we are going to vary τ_s^j and see what happens

V. Findings

Table 2: Relative aggregate TPFs, tradable TFPs, and nontradable TFPs for different service taxes

τ_s^{LA}	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18
A^{US}/A^{LA}	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30	2.30
A_T^{US}/A_T^{LA}	3.57	3.54	3.52	3.50	3.48	3.46	3.44	3.43	3.41
A_N^{US}/A_N^{LA}	1.67	1.68	1.68	1.69	1.69	1.70	1.71	1.71	1.71

τ_s^{PC}	0.02	0.04	0.06	0.08	0.10	0.12
A^{US}/A^{PC}	6.00	6.02	6.04	6.06	6.08	6.10
A_T^{US}/A_T^{PC}	13.14	13.08	13.04	13.00	12.95	12.90
A_N^{US}/A_N^{PC}	3.23	3.28	3.32	3.36	3.40	3.44

Understanding the Findings of the Literature

- **Balassa and Samuelson's conjecture**

  the problem is in the tradable sectors

- **McKinsey Global Institute, Lewis**

  the problem is in the nontradable sectors

- **Kuznets**

  the problem is in agriculture

- **Hsieh and Klenow**

  the problem is in investment

- **Note**

  the first three talk about labor productivity, the forth about sector TFPs

Table 3: Relative labor productivities in tradables and nontradables

τ_s^{LA}	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18
LP_N^{LA}/LP_N^{LA}	2.73	2.75	2.76	2.77	2.78	2.80	2.81	2.82	2.83
LP_T^{LA}/LP_T^{LA}	6.43	6.35	6.29	6.23	6.18	6.12	6.07	6.02	5.97
τ_s^{PC}	0.02	0.04	0.06	0.08	0.10	0.12			
LP_N^{PC}/LP_N^{PC}	9.91	10.01	10.07	10.15	10.23	10.31			
LP_T^{PC}/LP_g^{T}	49.72	49.38	49.14	48.84	48.57	48.30			

Table 4: Relative labor productivities in consumption goods and the rest

τ_s^{LA}	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18
LP_g^{US}/LP_g^{LA}	6.92	6.83	6.77	6.70	6.64	6.58	6.53	6.48	6.43
LP_R^{US}/LP_R^{LA}	3.20	3.22	3.23	3.24	3.26	3.27	3.28	3.29	3.30

τ_s^{PC}	0.02	0.04	0.06	0.08	0.10	0.12
LP_g^{US}/LP_g^{PC}	57.09	56.70	56.42	56.09	55.77	55.46
LP_R^{US}/LP_R^{PC}	19.60	21.38	22.90	24.52	26.09	27.62

Table 5: Relative TFPs in consumption and investment

τ_s^{LA}	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18
A_C^{US}/A_C^{LA}	2.11	2.05	2.00	1.96	1.91	1.87	1.83	1.80	1.76
A_I^{US}/A_I^{LA}	1.91	2.32	2.66	3.00	3.32	3.62	3.90	4.17	4.43

τ_s^{PC}	0.02	0.04	0.06	0.08	0.10	0.12
A_C^{US}/A_C^{PC}	18.87	18.58	18.33	18.08	17.83	17.60
A_I^{US}/A_I^{PC}	20.90	23.33	25.37	27.51	29.55	31.50

VI. Conclusion

- **The tradable sectors are the problem sectors of poor counties**
- **The largest cross–country differences in TFP are in the tradable sectors**

A criterion for a successful theory of aggregate TFP

- **Existing theories of aggregate TFP difference include differences in**
  - institutions
  - policies
  - human capital

- **Unclear why such differences should do most damage in the tradables**

- **Example: human capital**
  - **If sectors use the same human capital, then $\widetilde{A}_i(K_i)^{\theta_i}(hL_i)^{1-\theta_i}$**
    - Since we abstract from human capital, $A_i = \widetilde{A}_i h^{1-\theta_i}$
    - Thus, the largest differences in A_i should be where the largest $1-\theta_i$ are
    - $1-\theta_T = 0.65$ and $1-\theta_{NT} = 0.70$, so this is the wrong way round
  - **If sectors use different human capital, then $\widetilde{A}_i(K_i)^{\theta_i}(h_iL_i)^{1-\theta_i}$**
    - In progress ...

Defensive Slides

Figure 6: Purchase Price of Non–tradables Relative to Tradables

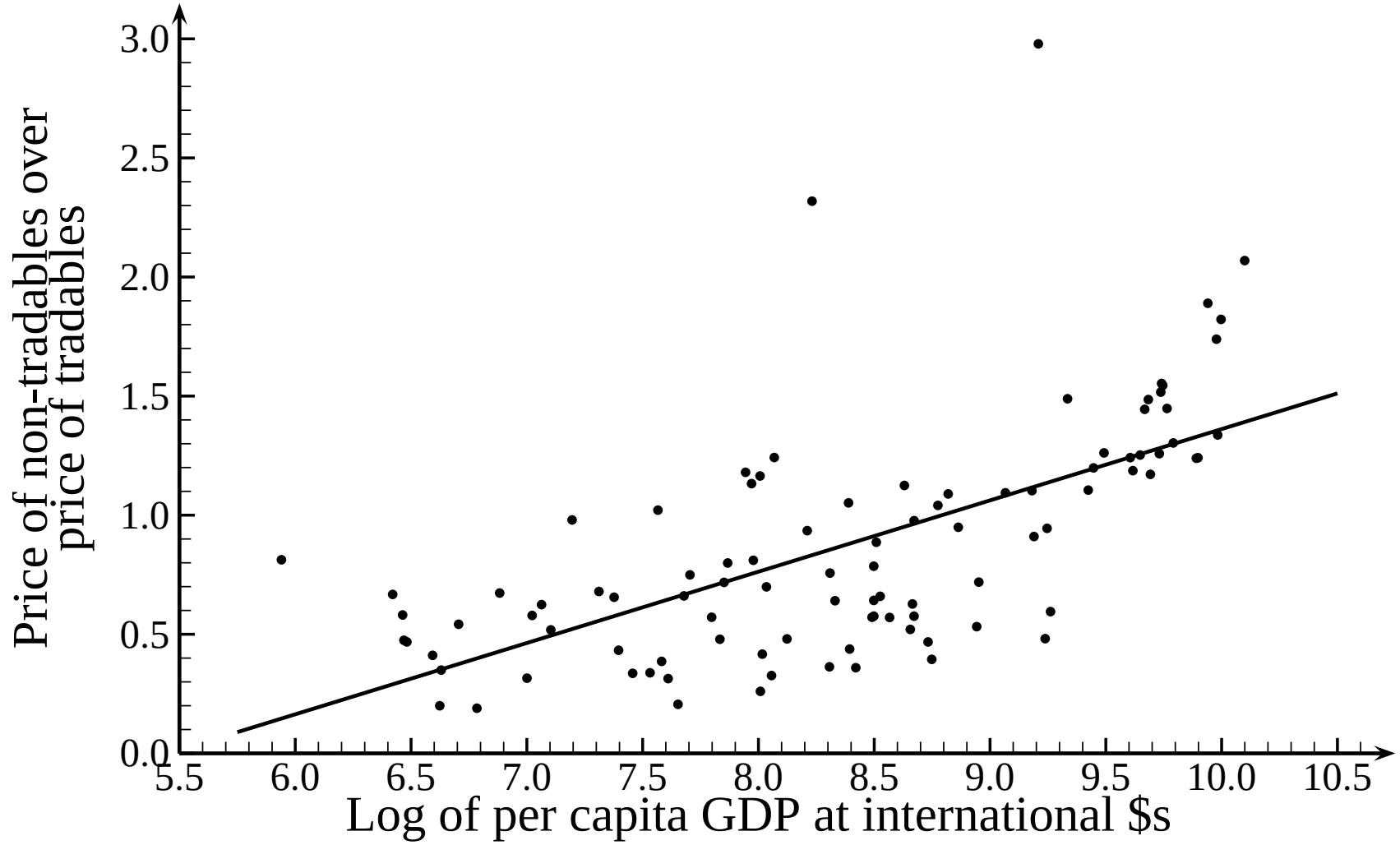


Figure 7: Purchase Price of Services Relative to Construction

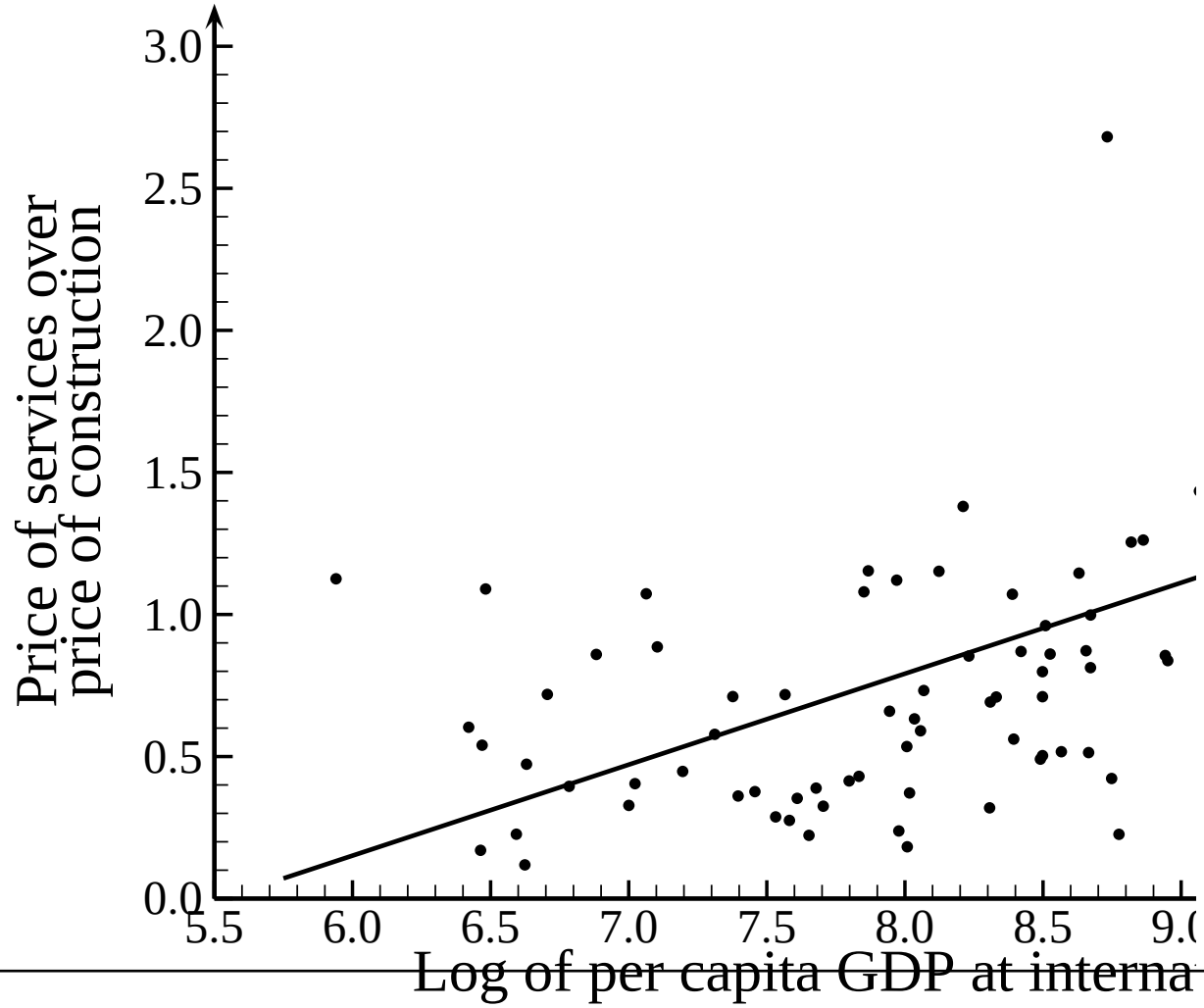
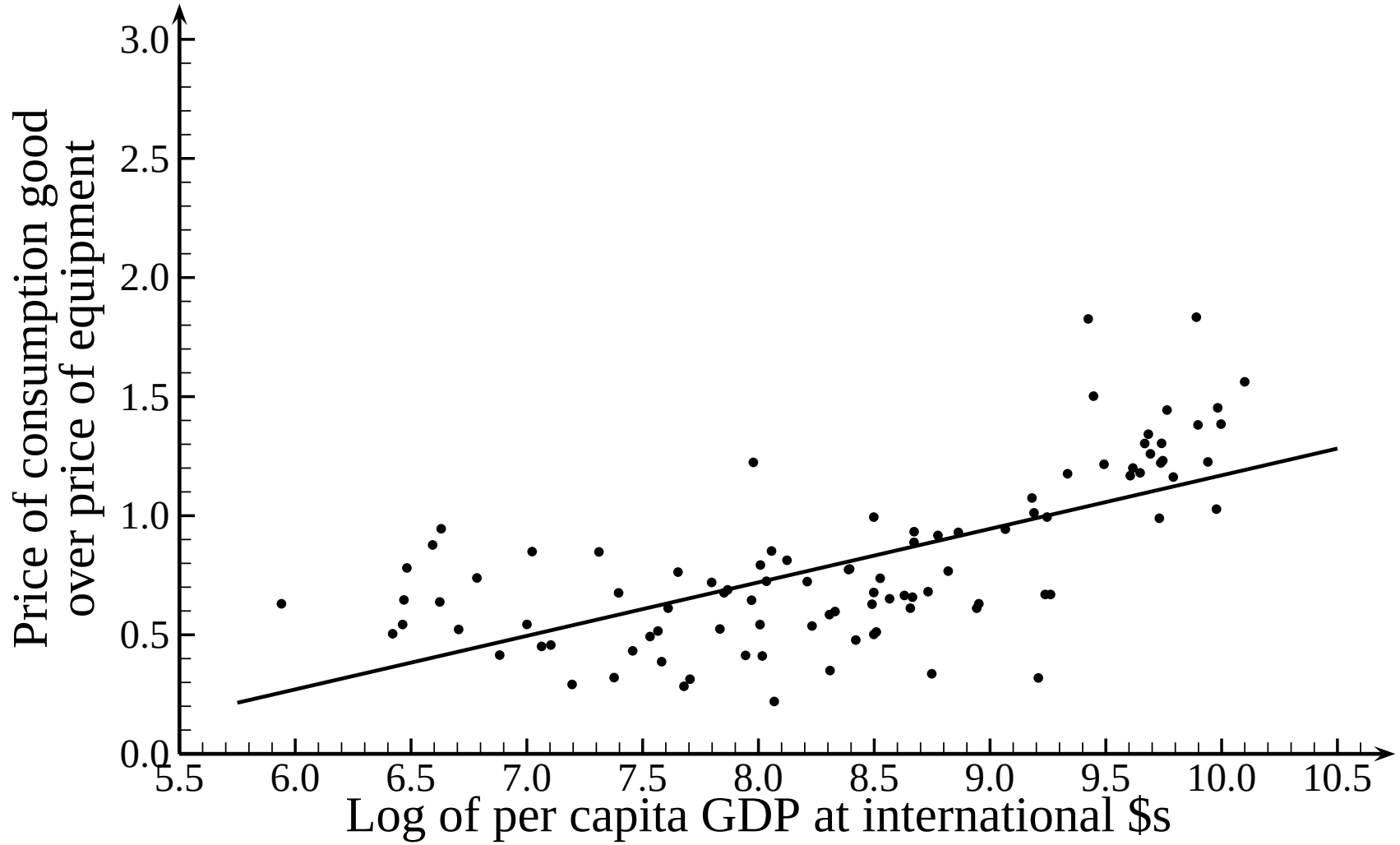


Figure 8: Purchase Price of Consumption Goods Relative to Equipment



In sum, richer countries tend to have higher prices of

- nontradables relative to tradables
- services relative to construction
- manufactured consumption relative to equipment

Figure 9: Equipment–investment share at domestic prices

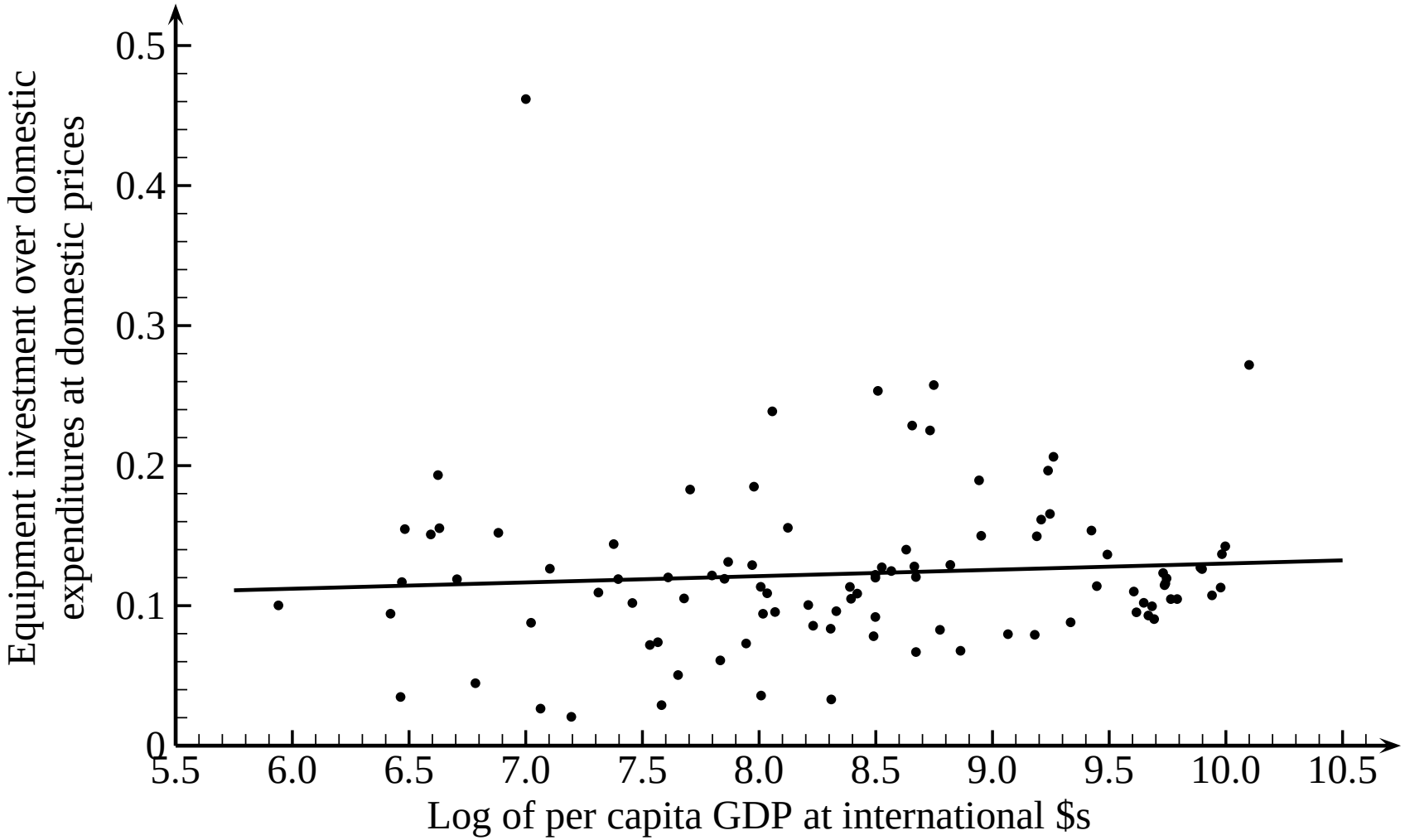


Figure 10: Equipment–investment share at international $s

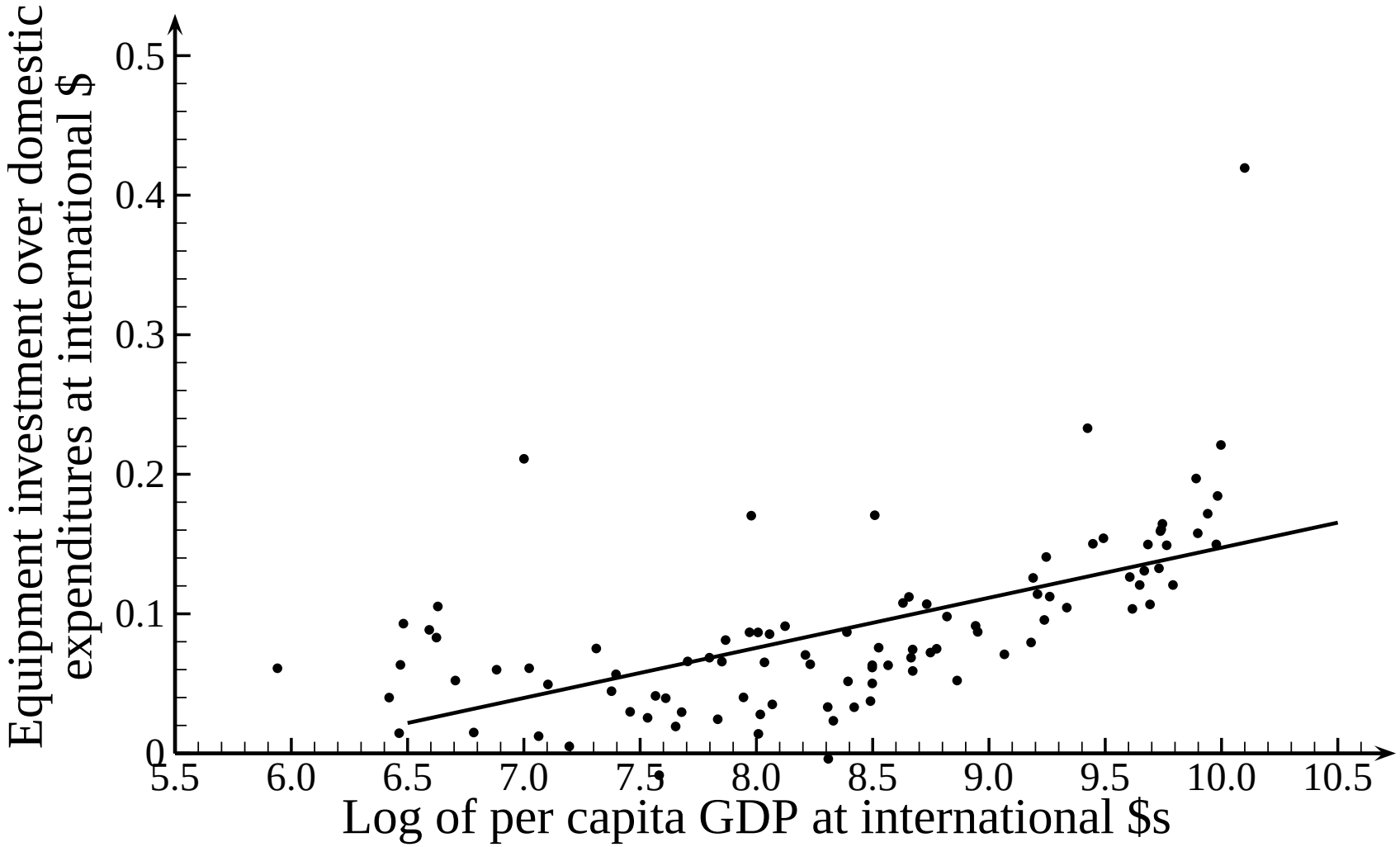


Figure 11: Construction–investment share at domestic prices

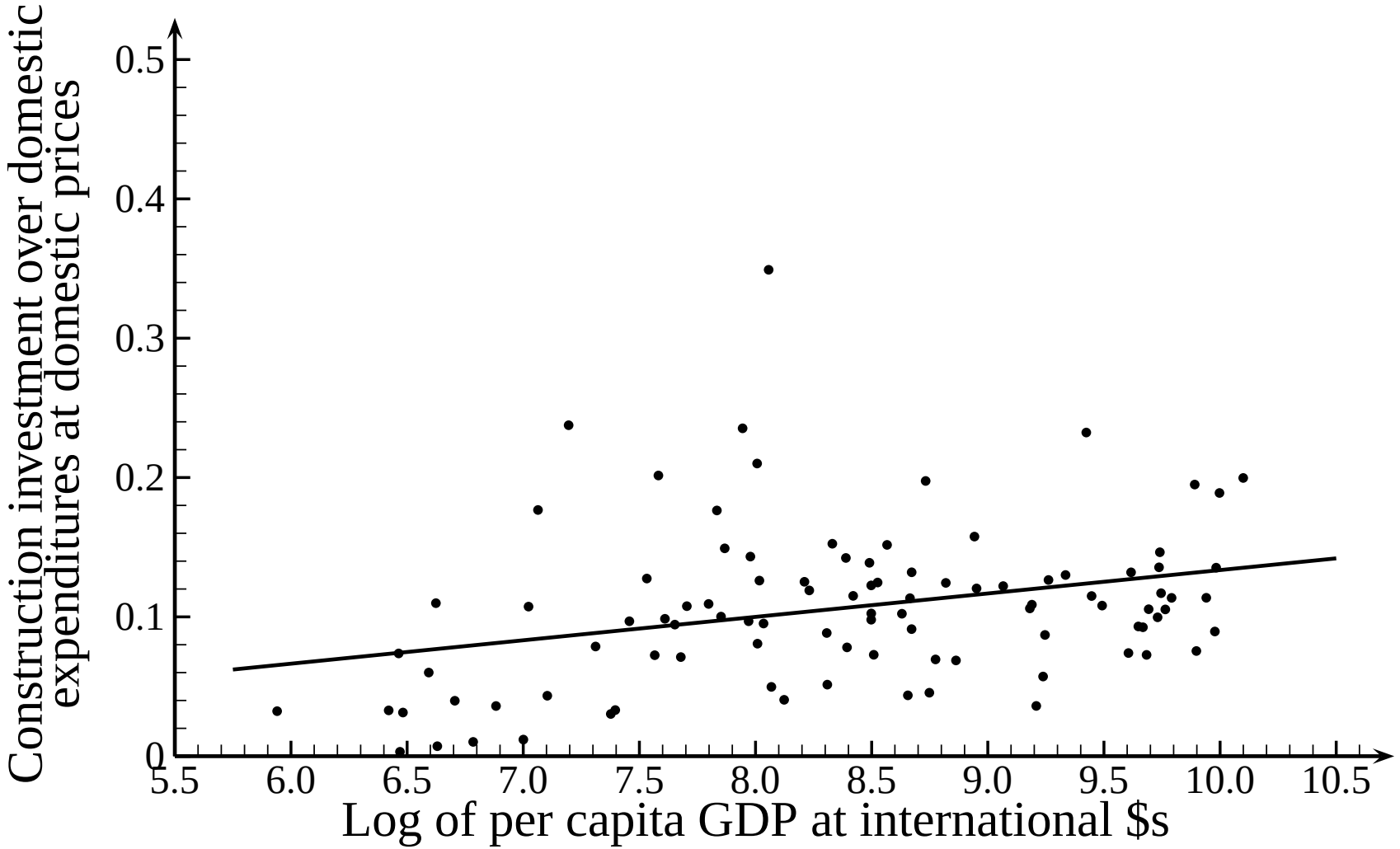


Figure 12: Construction–investment share at international $s

Figure 13: Expenditure shares of services in consumption at domestic prices

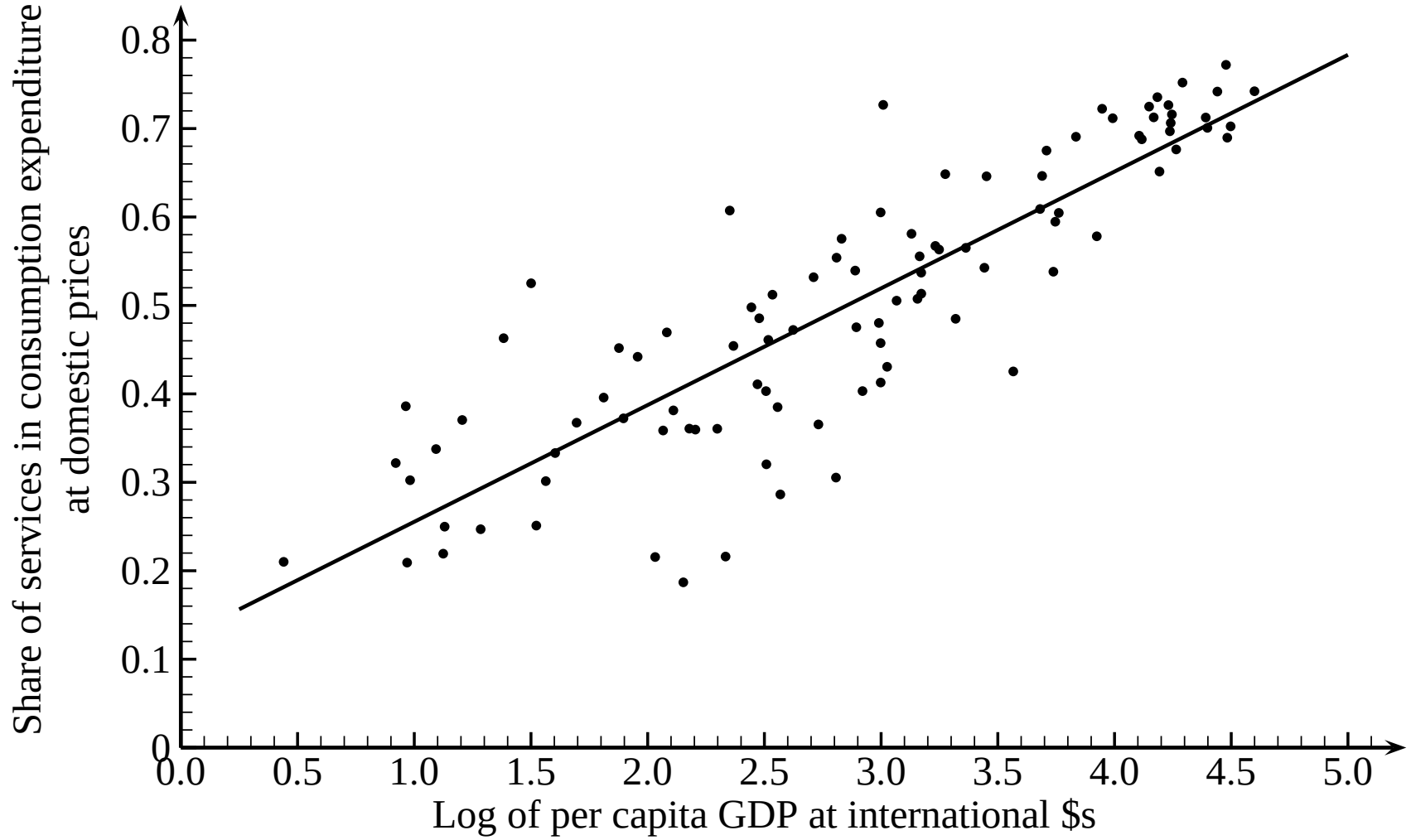


Figure 14: Purchase Prices of Nontradables Relative to Tradables

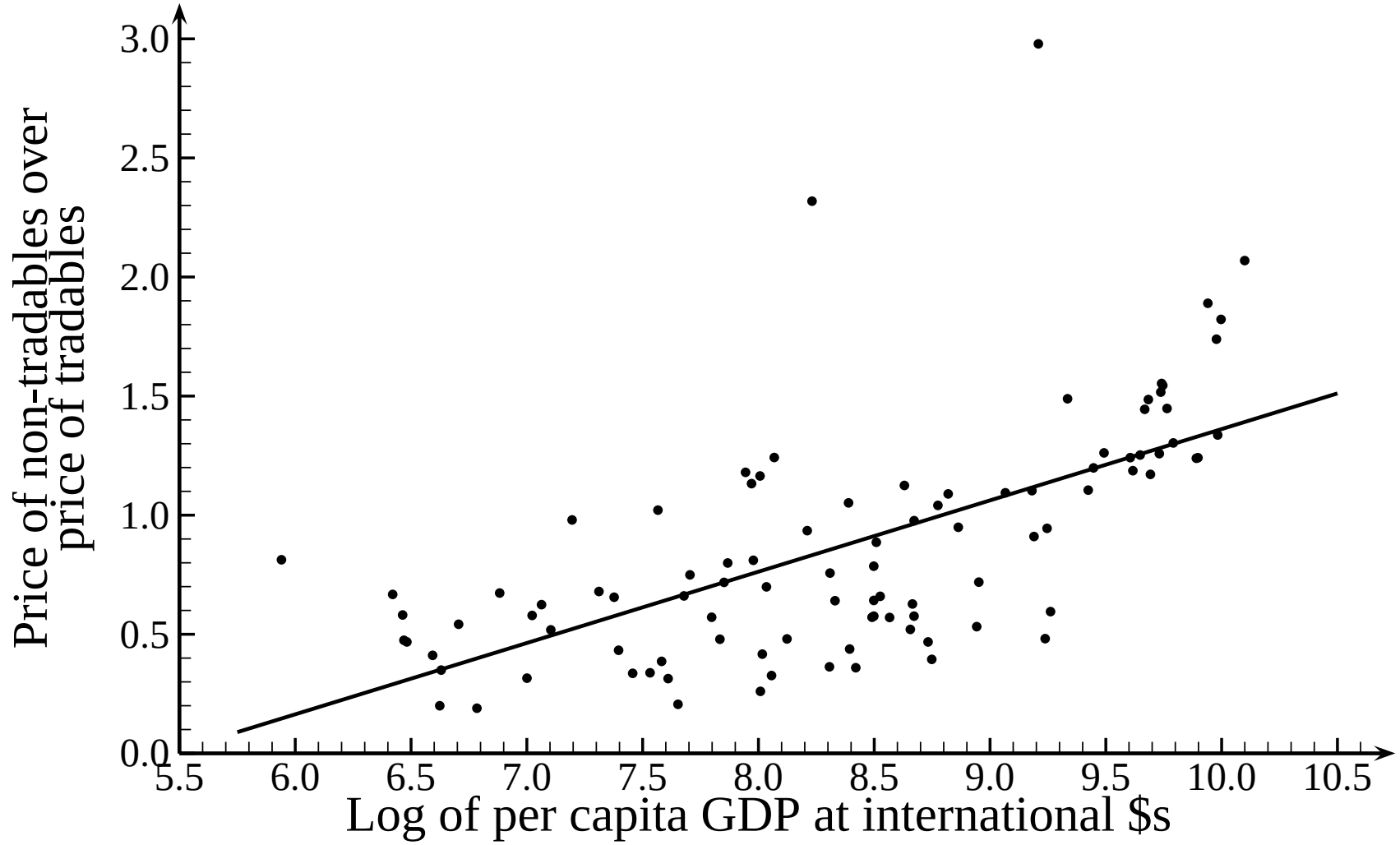


Figure 15: Purchase Prices of Consumption Relative to Investment

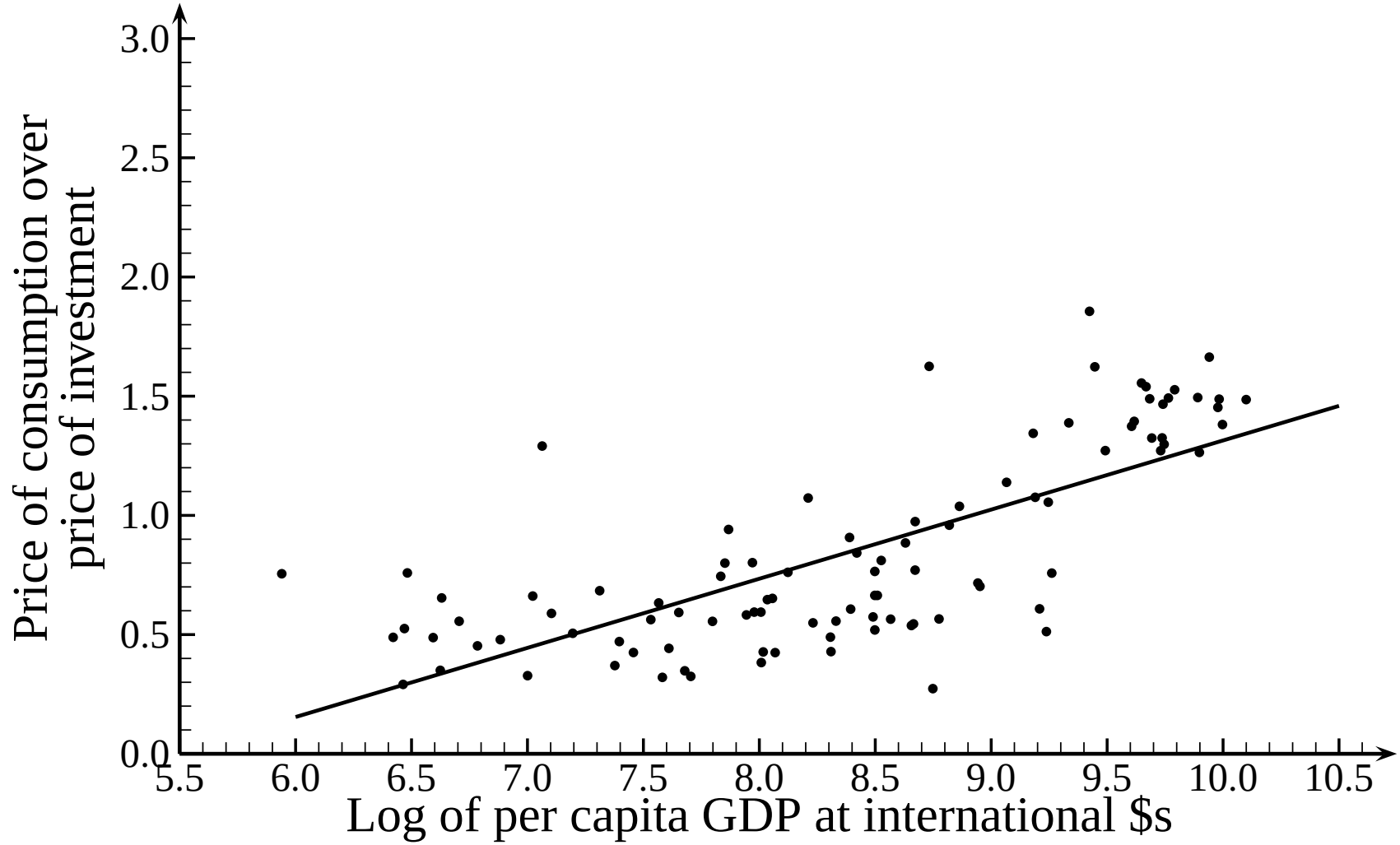


Table 6: Statistics in the Data and the Model

	US		LA		PC	
	Data	Model	Data	Model	Data	Model
Income relative to the US	1.00	1.00	3.77	3.82	19.76	19.54
Equip invest share (dom prices)	0.11	0.11	0.09	0.09	0.10	0.09
Constr invest share (dom prices)	0.09	0.09	0.12	0.09	0.10	0.10
Equip invest share (int $s)	0.15	0.14	0.12	0.07	0.06	0.05
Constr invest share (int $s)	0.10	0.11	0.12	0.10	0.07	0.08
Services expenditure share	0.77	0.62	0.51	0.58	0.34	0.25
Relative price services	1.92	1.92	0.90	0.90	0.36	0.36
Relative price construction	1.21	1.21	0.90	0.90	0.70	0.70
Relative price consumption goods	1.03	1.03	0.82	0.82	0.64	0.64
Distribution margin cons goods	0.46	0.46	–	–	–	–
Distribution margin equipment	0.05	0.05	–	–	–	–

Table 7: Relative taxes and sector TFPs for different values of τ_s

τ_s^{LA}	0.02	0.04	0.06	0.08	0.10	0.12	0.14	0.16	0.18
τ_b^{LA}	7.51	3.63	2.21	1.48	1.04	0.74	0.52	0.36	0.23
A_s^{US}/A_s^{LA}	1.86	1.81	1.76	1.72	1.68	1.64	1.60	1.56	1.53
A_b^{US}/A_b^{LA}	0.37	1.01	1.56	2.09	2.59	3.07	3.53	3.97	4.38
A_g^{US}/A_g^{LA}	3.58	3.55	3.53	3.51	3.49	3.47	3.45	3.43	3.42
A_e^{US}/A_e^{LA}	4.14	4.11	4.08	4.05	4.03	4.00	3.98	3.96	3.94

τ_s^{PC}	0.02	0.04	0.06	0.08	0.10	0.12
τ_b^{PC}	10.09	2.68	1.24	0.63	0.29	0.07
A_s^{US}/A_s^{PC}	3.22	3.15	3.08	3.01	2.94	2.88
A_b^{US}/A_b^{PC}	2.06	3.64	4.96	6.35	7.69	8.96
A_g^{US}/A_g^{PC}	13.41	13.36	13.32	13.27	13.22	13.18
A_e^{US}/A_e^{PC}	18.52	18.44	18.37	18.30	18.23	18.16