Discussion of "Capital Goods Trade and Economic Development"

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Big Picture

Experiment	N	$V[\alpha k]$	$V[(1-\alpha)l]$	$V[\alpha k + (1-\alpha)l]$	$V[y]$	Ratio
King-Levine	142	0.26			1.31	0.20
Hall-Jones	141	0.26	0.028	0.43	1.30	0.33
Weil	141	0.26	0.043	0.48	1.30	0.37
Test sample	75	0.11	0.017	0.18	0.53	0.34
Test correction	75	0.11	0.028	0.22	0.53	0.41
Imp. Sub. School.	141	0.26	0.150	0.72	1.30	0.55

Source: Caselli (2010)

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Trade

- Does trade in capital goods help to eliminate gaps in capital(+TFP)

- Eaton Kortum (2001)

    - Make observations that a handful of advanced countries export capital goods
    - North-South growth model with capital as the key tradable sector (with EK structure)
    - Trade improves relative price of capital, thus real investment rate and output per worker

Challenge: (1) the inferred "trade-based price" - Hsieh and Klenow (2007) makes a related observation that domestic price of capital does not vary strongly across countries of different income levels. (2) No intermediate good sector. Fill in the quantitative implications?
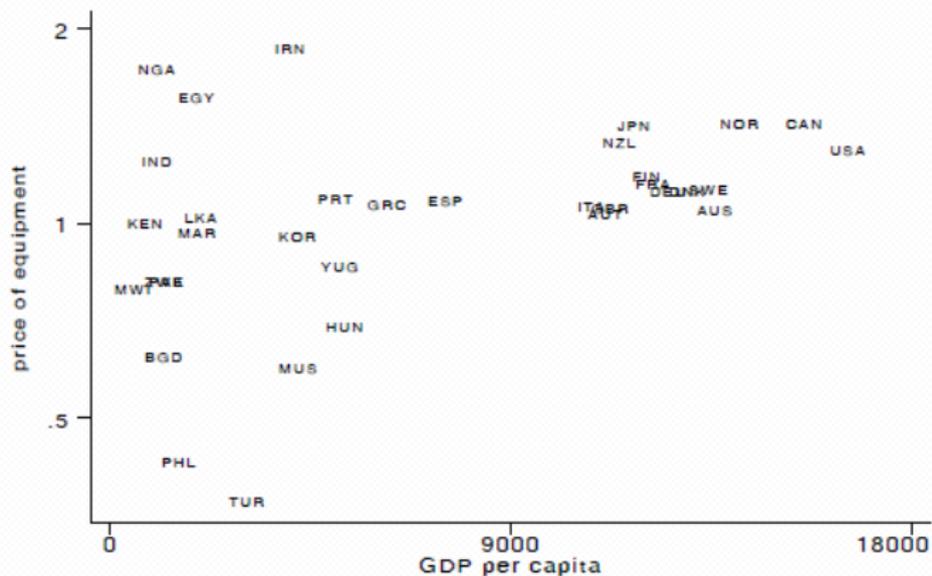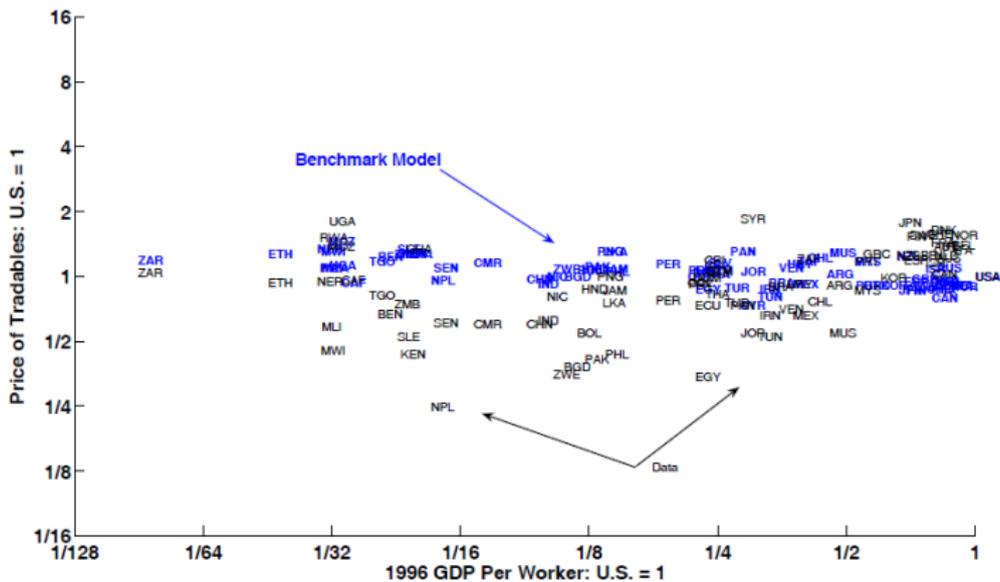
Figure 6: Development and the Price of Equipment

Source: Eaton and Kortum (2001), downward sloping

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Waugh 2010

Source: Waugh (2010), fits tradable price (with asym. trade costs)

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This Paper

- Eaton and Kortum (2001)+ Waugh (2010)
- Trade in capital goods $\rightarrow$ (1) improves capital formation (2) increases aggregate TFP
- Quantitatively important

Ambitious and carefully implemented paper !

Model: Technology

- Two tradable sectors: K capital, M intermediates

- For a continuum of K goods, $v \in [0,1]$, and M goods, $u \in [0,1]$.

$$e(v) = v^{-\theta}[k_e(v)^\alpha l_e(v)^{1-\alpha}]^\nu m_e(v)^{1-\nu}$$
$$m(u) = u^{-\theta}[k_m(u)^\alpha l_m(u)^{1-\alpha}]^\nu m_m(u)^{1-\nu}$$

- $v \sim \lambda_e, u \sim \lambda_m$, country specific, k and m are CES aggregate good of v and u respectively.

- Final consumption good producer

$$f = A_f[k_f^\alpha l_f^{1-\alpha}]^{\nu_f} m_f^{1-\nu_f}$$

- A_f exogenous to the model, country specific

Model: Consumer

- Neo-classical growth framework

- Consumer's invest/consumption decision is to maximize x_t and c_t
  $\sum_t \beta^t log(c_t)$, s.t.
  - $k_{t+1} = (1 - \delta)k_t + x_t$
  - $P_f^t c_t + P_k^t x_t = w_t + r_t k_t$

- Impose steady state such that $r = [1/\beta - (1 - \delta)]P_k$ and $x = \delta k$.

- Trade-off: purchase capital goods vs consumption goods.

Equilibrium Objects

For each country, in addition to consumer's save/consumption ($r \propto P_k$)

- Allocations of factors to each sector (Producer profit maximization)
- Prices P_f, P_k, P_m (CES aggregation)

$$P_{ki} = \gamma B_k \{\sum_j [(r_j^{\alpha\nu} w_j^{(1-\alpha)\nu} P_{mj}^{1-\nu})\tau_{kij}]^{-\frac{1}{\theta}} \lambda_{kj}\}^{-\theta}$$

$$P_{mi} = \gamma B_m \{\sum_j [(r_j^{\alpha\nu} w_j^{(1-\alpha)\nu} P_{mj}^{1-\nu})\tau_{mij}]^{-\frac{1}{\theta}} \lambda_{mj}\}^{-\theta}$$

$$P_{fi} = B_f \frac{[(r_i^{\alpha\nu_f} w_i^{(1-\alpha)\nu_f} P_{mi}^{1-\nu})]}{A_f}$$

- Trade shares (Gravity equation for both k, m)

$$\pi_{ij} = \frac{[(r_j^{\alpha\nu} w_j^{(1-\alpha)\nu} P_{mj}^{1-\nu})\tau_{ij}]^{-\frac{1}{\theta}} \lambda_j}{\sum_l [(r_l^{\alpha\nu} w_l^{(1-\alpha)\nu} P_{ml}^{1-\nu})\tau_{il}]^{-\frac{1}{\theta}} \lambda_l}$$

- Wages w (Balanced Trade)
- Can construct equilibrium objects similarly as in Waugh (2010)

Capital Deepening

The key insight from this paper is that

- Income per worker $y_i \propto A_{fi}(\frac{\lambda_{mi}}{\pi_{mii}})^{\frac{\theta(1-\nu_f)}{\nu}}k^{\alpha}$ (Waugh 2010)

- Trade endogenously affects TFP term $(\frac{\lambda_{mi}}{\pi_{mii}})^{\frac{\theta(1-\nu_f)}{\nu}}$

- New for this paper: capital per worker is endogenously determined too

$$k_i \propto (\frac{\lambda_{mi}}{\pi_{mii}})^{\frac{\theta(1-\nu)}{\nu(1-\alpha)}}(\frac{\lambda_{ki}}{\pi_{kii}})^{\frac{\theta}{(1-\alpha)}}$$

- Trade liberalization would accompany increase in capital investment and lower relative price of capital.
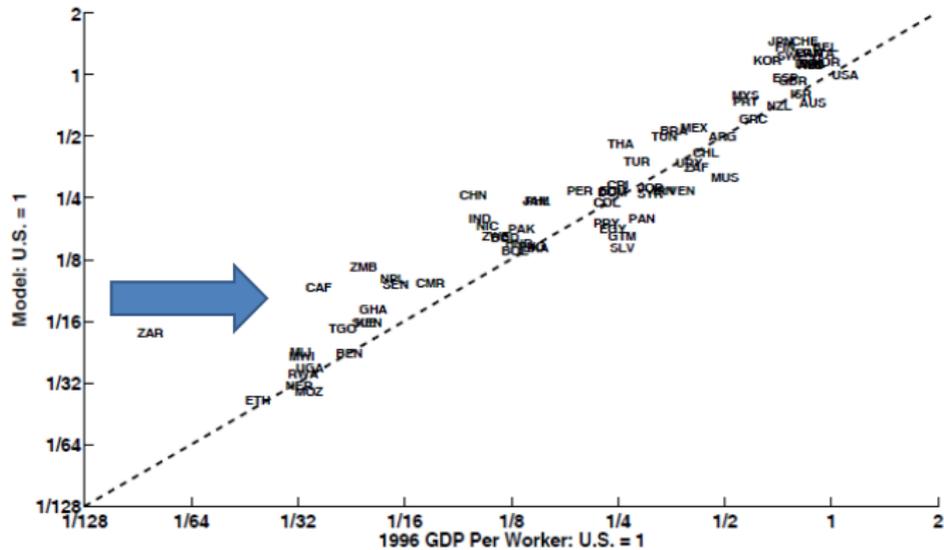
Identification Strategy

Bilateral trade flows play a central role in previous works (i.e. Waugh, EK)

- Parameters λ_i (N-1), τ_{ij} (N(N-1))

- Data π_{ij} (N(N-1))

- Under-identified by $N - 1$ data points

- Waugh (2010) shows that restricting parameter spaces $\tau_{ij} = \tau_{i'j} = \tau_j$ explains trade shares pretty well. Now over-identified.

Price data and Income per worker data are not directly targeted, instead used as external validations.

- As a result, fit is obviously not perfect.

Fit

Identification Strategy: This Paper

Bilateral trade flow + prices + income per worker

- Parameters $\lambda_{ki}, \lambda_{mi}, A_{fi}$ (3(N-1)), trade costs τ_{kij}, τ_{mij} (2N(N-1)).

- Trade flows π_{kij}, π_{mij} (2N(N-1)).

- No reduction of parameter space - instead target more data

- Prices $\frac{P_{ki}}{P_{fi}}, \frac{P_{mi}}{P_{fi}}$ (2(N-1)) relative to U.S.

- Income per worker (N-1) relative to U.S.

The above system is exactly identified. (1) Given observed price/trade flow: τ_{ij}. (2) Observed relative prices: λ_i. (3) Income per worker: A_{fi}.

- The paper further uses price levels, not clear what role it plays. But that restores over-identification.

- Might be useful to be explicit about estimation procedures.

Fit

Figure 2: Income per worker, US=1

- The way to estimate θ follows Simonovska and Waugh (2014), but is the background assumption consistent?

- The P_k and P_m directly targeted
  - How noisy is the data? Not an expert myself, but "quality" and "sample size" come to mind.

  - What if reduce parameter space (i.e. like Waugh 2010) and target only trade shares, can we still get reasonable cross-country pattern of P_k?

- Explains variations in cross-country capital formation quite well.

Discussion of Result

- No trade distortions: income per capita 90/10 goes from 22.5 to 10.2.
  - 80% is due to increase in capital per worker
- Total decline very close to Waugh (2010), which goes from 25.7 to 11.4
  - all TFP gains
- In other words, most of the import share response is captured now by capital sector, while limited action from intermediates. Supported by previous developing country liberalization episodes?
- Any deep reason why the fraction of change due to k is so uniformly 80% across countries? One would expect ex-ante country-sector-specific trade barriers, i.e. distortion to sectoral comparative advantage, could affect the relative importance.

Some Evidence: Average

FIGURE 3. Sample Means for Investment before and after Liberalization
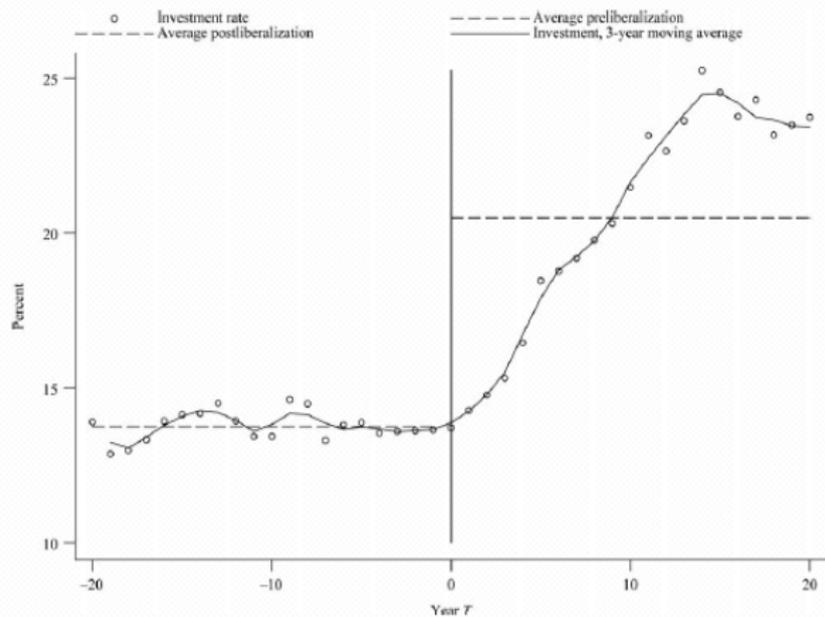
Source: Authors' analysis based on data described in the text.

Source: Wacziarg and Welch (2008)

Some Evidence: Heterogeneity

TABLE 7. Mean Growth, Investment, and Openness Changes in 24 Countries

Country	Growth difference	Investment difference	Openness difference	Year of liberalization	Sample period
Mauritius	3.62	0.34	35.90	1968	1951–98
Indonesia	3.32	9.80	25.96	1970	1961–98
Uruguay	3.08	−1.01	11.22	1990	1951–98
Korea, Rep. of	3.02	18.44	43.40	1968	1954–98
Chile	2.80	−1.12	26.33	1976	1952–98
Taiwan	2.29	9.91	55.77	1963	1952–98
Uganda	2.24	1.63	−6.60	1988	1951–98
Ghana	1.99	−3.91	9.13	1985	1956–98
Guinea	1.85	−2.74	7.28	1986	1960–98
Guyana	1.80	−7.49	84.49	1988	1951–98
Benin	1.74	1.64	8.72	1990	1960–98
Mali	1.19	0.86	15.68	1988	1961–98
Poland	0.83	−4.30	3.35	1990	1971–98
Paraguay	0.42	2.01	49.71	1989	1952–98
Cyprus	0.34	−4.05	29.13	1960	1951–96
Colombia	0.18	0.48	5.91	1986	1951–98
Tunisia	−0.30	−5.58	31.94	1989	1962–98
Philippines	−0.40	1.03	39.54	1988	1951–98
Israel	−0.96	−6.10	21.42	1985	1951–98
Botswana	−1.99	3.98	22.27	1979	1961–98
Mexico	−2.16	−4.59	17.56	1986	1951–98
Hungary	−2.41	−1.19	−4.17	1990	1971–98
Guinea-Bissau	−2.95	5.59	9.89	1987	1961–98
Jordan	−4.28	5.75	40.61	1965	1955–98

Source: Authors' analysis based on data described in the text.

Source: Wacziarg and Welch (2008)

Summary

- Great paper, learned a lot by reading it
- Capital back in picture for trade and growth.
  - Skill Capital Complementarity
  - Innovation