14.581 MIT PhD International Trade
—Lecture 18: Trade and Growth (Empirics)—

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Spring 2011

Plan for Today's Lecture

- Brief introduction.
- Neoclassical growth models in open economies:
  - How large are the terms-of-trade effects that come with growth?
  - Does trade liberalization promote income convergence (as FPE theorem would suggest)?
  - Structural Transformation in open economies.
- Endogenous growth models in open economies:
  - What evidence is there for international knowledge spillovers?
  - Does technology embodied in physical goods (intermediate inputs or capital equipment) lead to important international technology transfer?
  - Brief discussion of other effects: market size, competition.
- Brief discussion of other 'trade and growth' channels.

Introduction: Trade and Growth Empirics

- "Trade and Growth" is a field that is of great importance:
  - Obviously growth is important so understanding whether there is anything that countries can do to promote it (eg trade policy) is clearly important.
  - Also, studies like Feyrer (2009) suggest that the empirical gains from trade/openness are quite a bit larger than those predicted in any static model of trade. Perhaps 'dynamic effects' of openness (ie where openness changes technology/endowments) can have a bearing on this puzzle.
- This is also a field that should be ripe for empirical work:
  - Theory is fundamentally ambiguous about how openness affects growth rates.
  - Additionally, theories often postulate concepts like 'technological spillovers' with some parameter governing the extent to which these spillovers can occur. It is up to empirical work to measure those (extremely important) parameters.

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Neoclassical Growth Models in Open Economies

- We'll cover 3 papers:
  - Acemoglu and Ventura (QJE 2002) empirics
  - Ben-David (QJE 1993) on convergence
  - Structural Transformation in open economies

Acemoglu and Ventura (2002)

- In the previous lecture we discussed the theory part of this paper.
- Recall the key insights:
  - AK model: in autarky countries would grow at different rates.
  - Add simple (Armington with no trade costs) trade model: countries grow at the same rate.
  - Why? As a country accumulates K and produces more of its good, it floods the world market with this good. This depresses the price of its export good, and hence its terms of trade. Lower terms of trade harms the country's GDP (ie the return on its K). Lower return means less incentive to accumulate.
- Here we briefly cover the empirical side of AV (2002).
  - The punchline is that the forces for convergence created by TOT appear to be large—too large in fact.

AV (2002): Question 1: Are growth rates similar around the world?

Yes (for growth over relatively long time gaps).

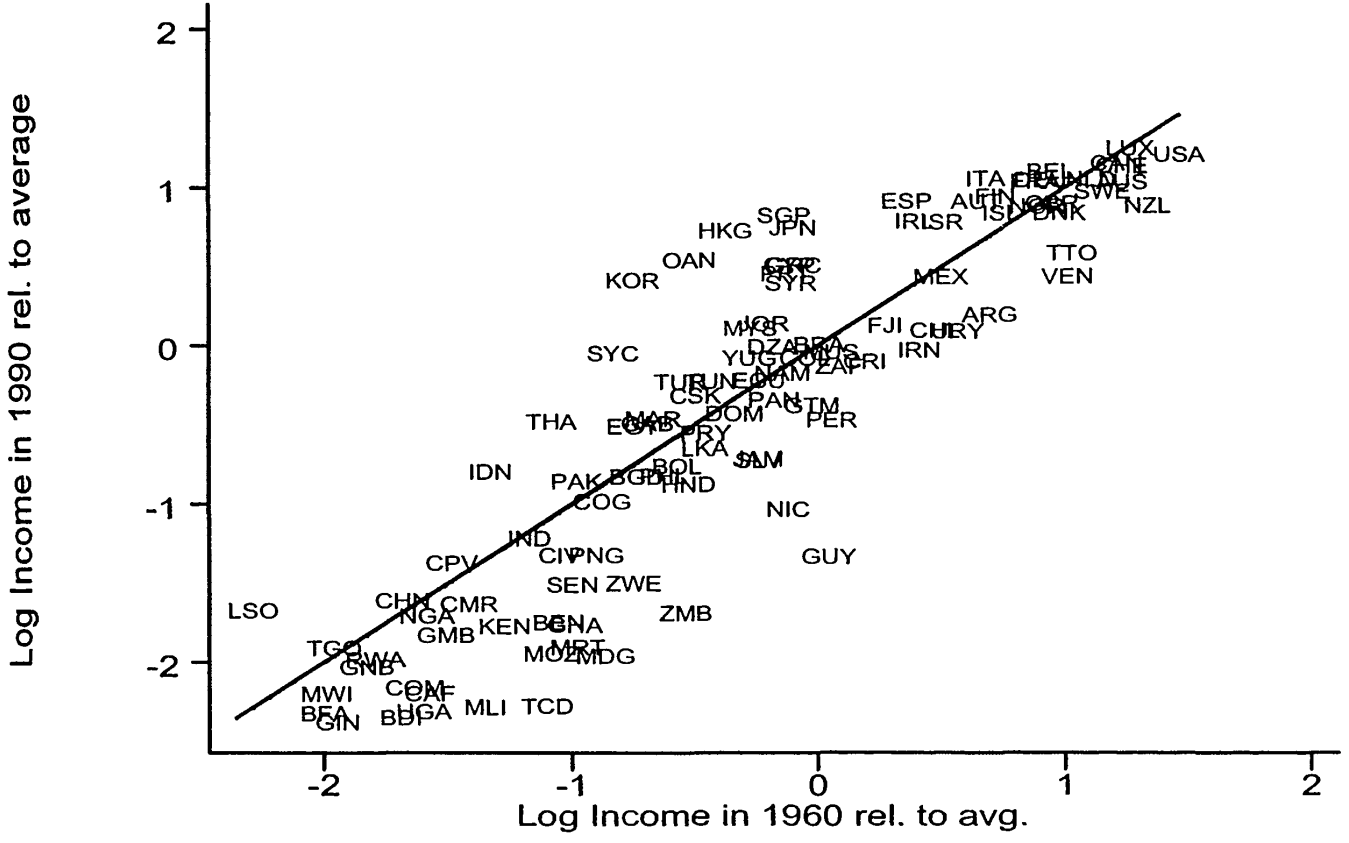

FIGURE I

Log of Income per Worker in 1990 and 1960 Relative to World Average from the Summers and Heston [1991] Data Set

The thick line is the 45 degree line.

AV (2002): Question 2: Do Terms of Trade Move Enough?

- Recall that country i's income level (y_i) is given by:

$$y_i = \mu_i p_i^{1-\sigma} Y \tag{1}$$

  - μ_i = index of country i's technology level.
  - Y = world GDP level ($Y = \sum_i y_i$).
  - σ = elasticity of substitution across world (Armington) varieties (with $\sigma > 1$).

- Taking logs this implies that TOT evolve over time (growth of TOT $\equiv \pi_{it}$) as:

$$\pi_{it} = \frac{g_{it} - x_t}{\sigma - 1} + \Delta \ln \mu_{it} \tag{2}$$

  - g_{it} = growth rate of country i's income.
  - x_t = growth rate of world income.
  - Recall that price of Y is taken as the numeraire.

AV (2002): Question 2: Do Terms of Trade Move Enough?

$$\pi_{it} = \frac{g_{it} - x_t}{\epsilon - 1} + \Delta \ln \mu_{it} \tag{3}$$

- AV (2002) want to take this equation to the data (and estimate the coefficient on g_{it}).
- One challenge is that $\Delta \ln \mu_{it}$ (the growth of technology) is not directly observable and that g_{it} is of course endogenous to technology growth.
- Indeed, if you look at this as a scatter plot (of π_{it} against g_{it}) the results are not encouraging at all (Figure II).

AV (2002): Question 2: Do Terms of Trade Move Enough?

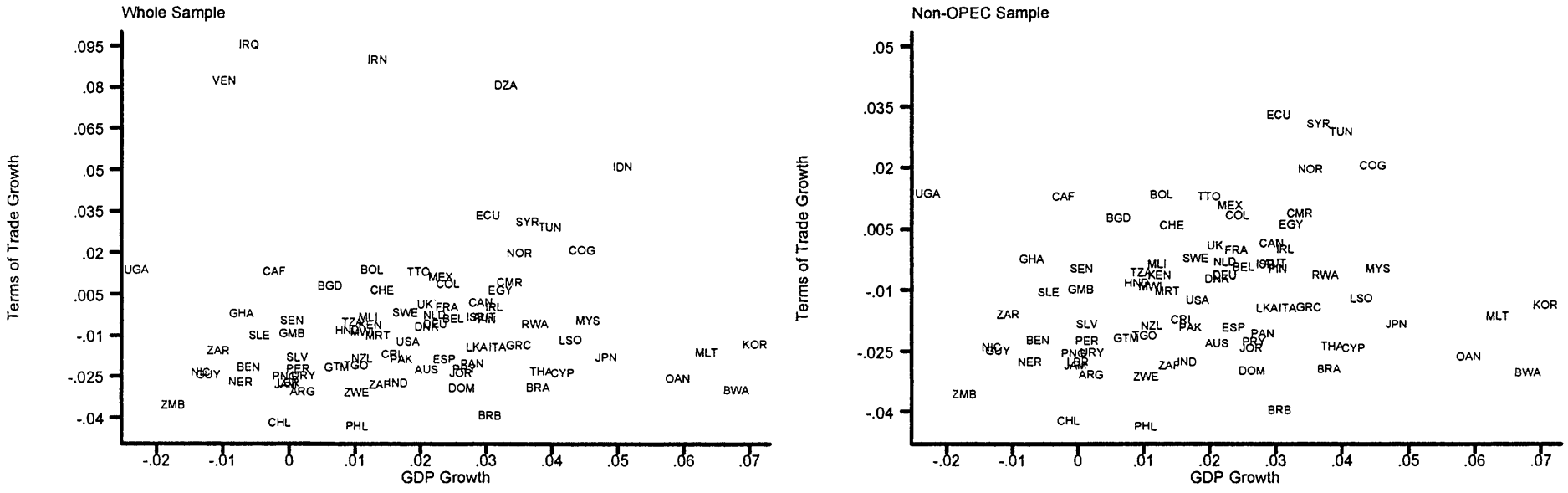

FIGURE II

Changes in Terms of Trade 1965–1985 versus GDP Growth 1965–1985

AV (2002): Question 2: Do Terms of Trade Move Enough?

$$\pi_{it} = \frac{g_{it} - x_t}{\epsilon - 1} + \Delta \ln \mu_{it} \tag{4}$$

- But the model suggests an IV: conditional convergence (if the country is out of steady-state):

$$g_{it} = -\beta \ln y_{i,t-1} + \theta Z_{it} + u_{it} \tag{5}$$

  - Here β is the (conditional) convergence coefficient.
  - And Z_{it} is a vector of variables that characterize where a country's steady-state level is.

- AV (2002) use $\ln y_{t-1}$ as the excluded IV, and of course therefore remember to include Z_t in both the first and second stages.

AV (2002): Question 2: Do Terms of Trade Move Enough?

Once AV instrument for g_t the results are more encouraging

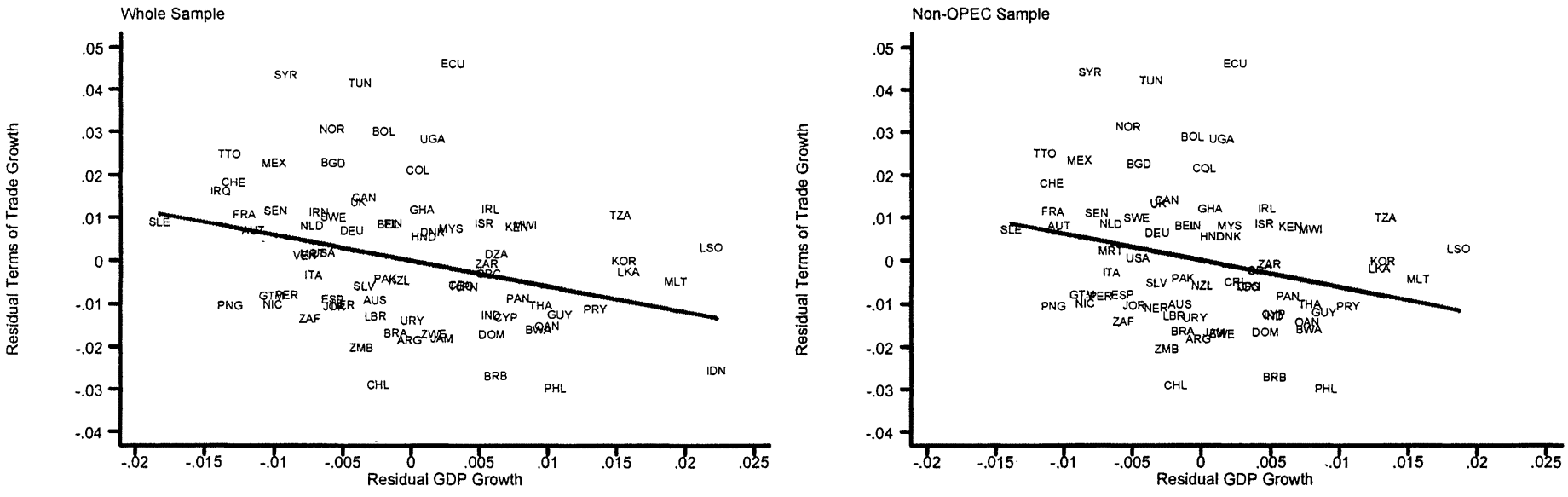

FIGURE III

The Instrumental-Variables Relationship between Changes in Terms of Trade 1965–1985 and GDP Growth 1965–1985 (Instrumented by log GDP 1965)

AV (2002): Question 2: Do Terms of Trade Move Enough?

TABLE I

IV Regressions of Growth Rate of Terms of Trade

	Main regression (1)	Detailing schooling (2)	Adding political indicat (3)	Adding change in Sch (4)	Adding change in Sch (5)	Nonoil sample (6)
Panel A: Two-stage least squares						
GDP Growth 1965–1985	−0.595	−0.578	−0.458	−0.561	−0.455	−0.620
	(0.265)	(0.261)	(0.221)	(0.248)	(0.187)	(0.354)
Years of schooling 1965	−0.001		−0.002	−0.000		−0.001
	(0.002)		(0.002)	(0.002)		(0.002)
Years of primary schooling 1965		−0.002				
		(0.003)				
Years of secondary schooling 1965		−0.002				
		(0.006)				
Years of higher schooling 1965		0.019				
		(0.034)				
Log of life expectancy 1965	0.043	0.045	0.034	0.020		0.046
	(0.024)	(0.024)	(0.021)	(0.027)		(0.030)
OPEC dummy	0.091	0.090	0.092	0.086	0.087	
	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	
War dummy			−0.013			
			(0.005)			
Political instability			0.007			
			(0.023)			
Log black market premium			−0.005			
			(0.012)			
Change in years of schooling 1965–1985				0.008	0.009	
				(0.004)	(0.003)	
Change in log of life expectancy 1965–1985				−0.000	−0.042	
				(0.078)	(0.045)	
Panel B: First-stage for GDP growth						
Log of GDP 1965	−0.019	−0.020	−0.024	−0.020	−0.020	−0.016
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
R^2	0.35	0.36	0.54	0.47	0.47	0.34
Panel C: Ordinary least squares						
GDP Growth 1965–1985	0.037	0.037	0.038	0.041	−0.005	0.116
	(0.106)	(0.107)	(0.107)	(0.112)	(0.103)	(0.114)
N. of obs	79	79	70	79	79	74

AV (2002): Question 3: Are the Results Sensible?

- Effect of growth on TOT:
  - Coefficient (from 2SLS) in column 1 is -0.6. Structural interpretation of regression says that this is $\frac{1}{\sigma-1}$, or σ=2.6.
  - This is reasonable compared to outside estimates of the Armington elasticity.
- Convergence coefficient near steady-state:
  - This is $\beta = \frac{\tau(\rho+x^*)}{\sigma}$, where τ is the share of tradables in GDP (eg, generously, around 0.3) and x^* is the steady-state world growth rate.
  - All of this implies $\beta = 0.011$, which is smaller than the $\beta = 0.02$ that Barro (1991) finds.
  - But we are not allowing for any other source of diminishing returns, or for any technological catch-up.
- The steady-state level of each country's GDP:
  - This is $y^* = \mu\phi^{(\sigma-1)/\tau}\left(\frac{s}{x^*}\right)^{(\sigma-1)/\tau}$.
  - Mankiw, Romer and Weil (QJE 1992) estimate this (in logs) and find a coefficient on (log) s of around 2.
  - With $\sigma = 2.6$ and $\tau = 0.3$, the coefficient on s is too low.

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Ben-David (QJE, 1993)

- Ben-David (1993) asks whether we see faster convergence among countries that trade more.

- He focuses on countries within free trade areas (FTAs) to proxy for 'countries that trade more'.
  - Paper starts with the European Economic Community (EEC).
  - And then moves on to wider FTAs (EFTA and Canada-USA).

Ben-David (1993): Intra-EEC Convergence

The drop in intra-EEC tariffs and NTBs

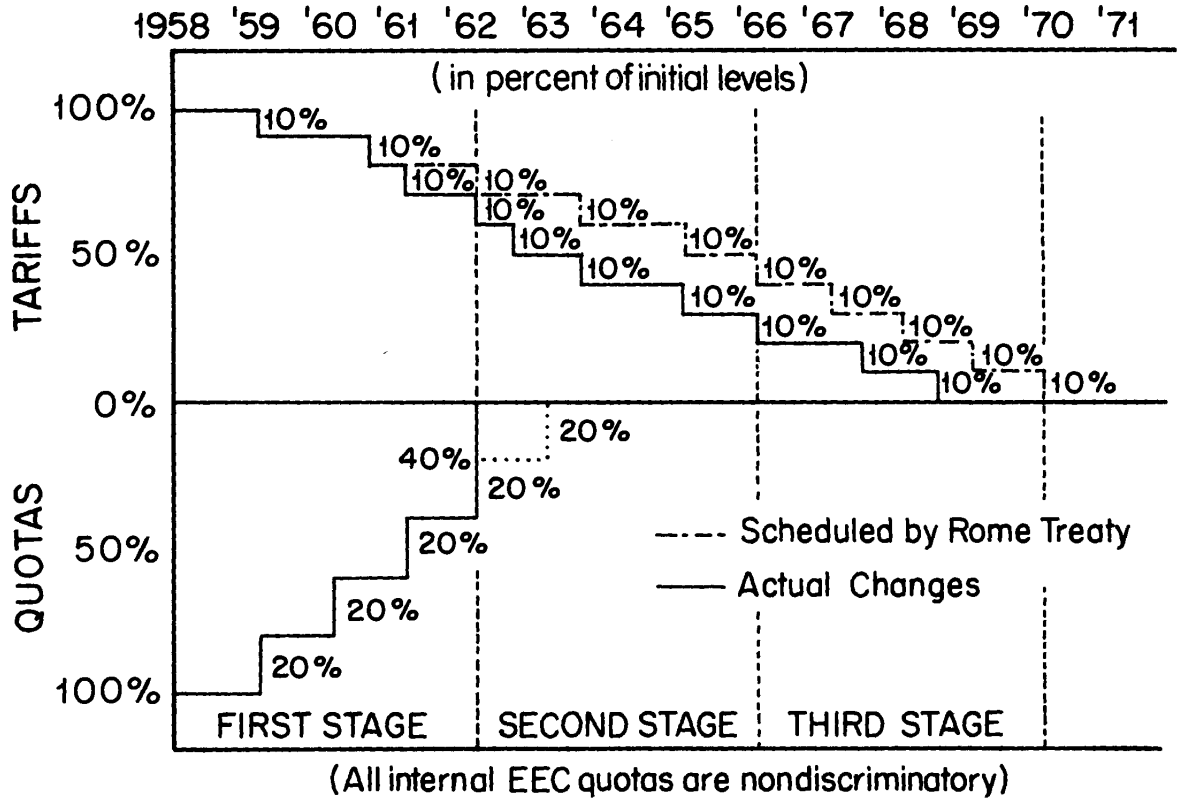

FIGURE II

Reduction of Internal EEC Trade Barriers

This graph was first used by Jensen and Walter [1965]. It was slightly altered here to include information from Bourdot [1988]. The first tariff reduction was 10 percent on *all* goods. The remaining reductions were 10 percent *on average*, and as little as 5 percent on any *one* good. Quotas were increased in steps of 20 percent *on average*, with a minimum of 10 percent on any *one* good.

Ben-David (1993): Intra-EEC Convergence

Tariff change did affect trade flows

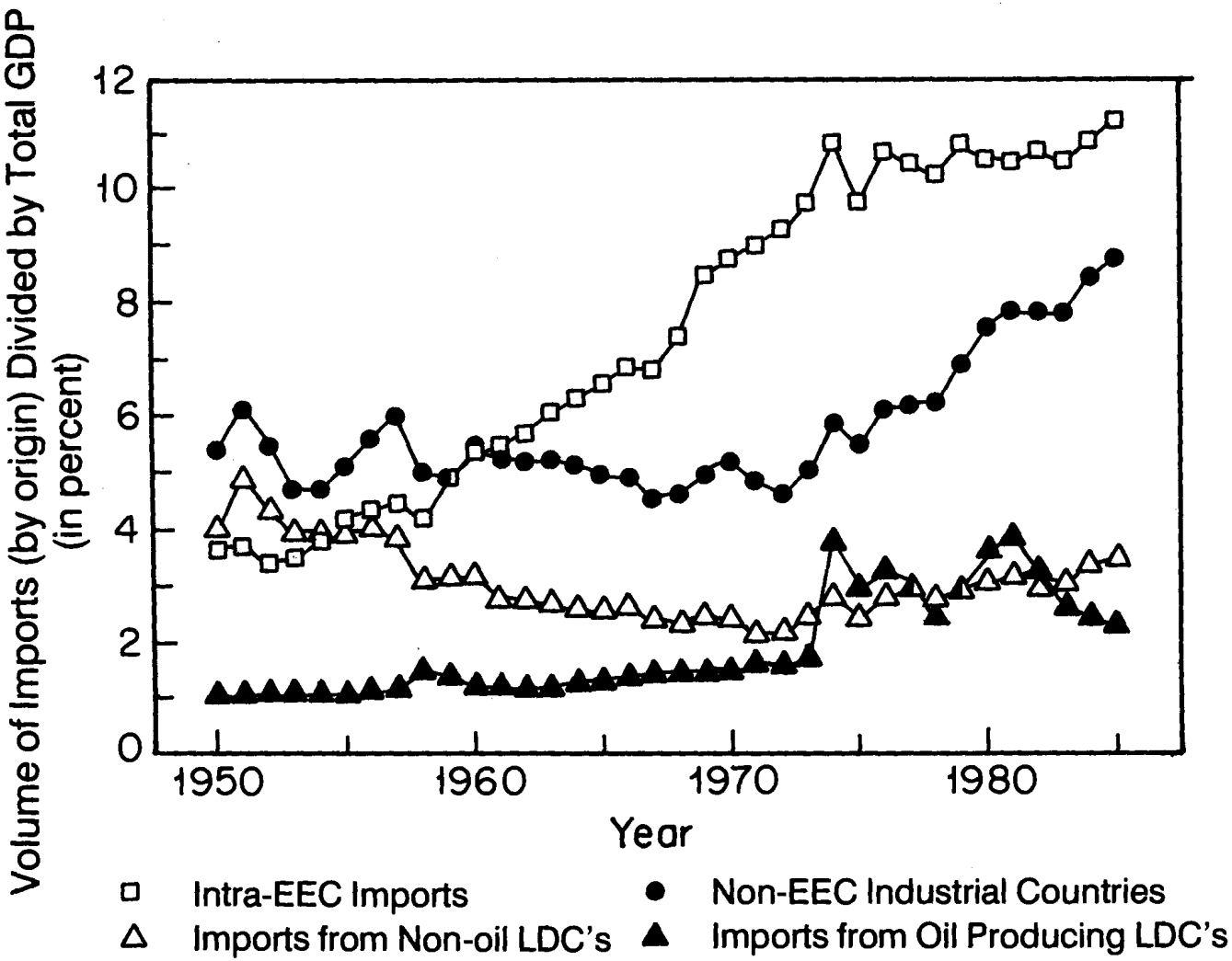

FIGURE IV
Origin of Imports, as a Percent of GDP

Ben-David (1993): Intra-EEC Convergence

Dramatic reduction in intra-EEC income disparities. But was this phenomenon already underway prior to WWII?

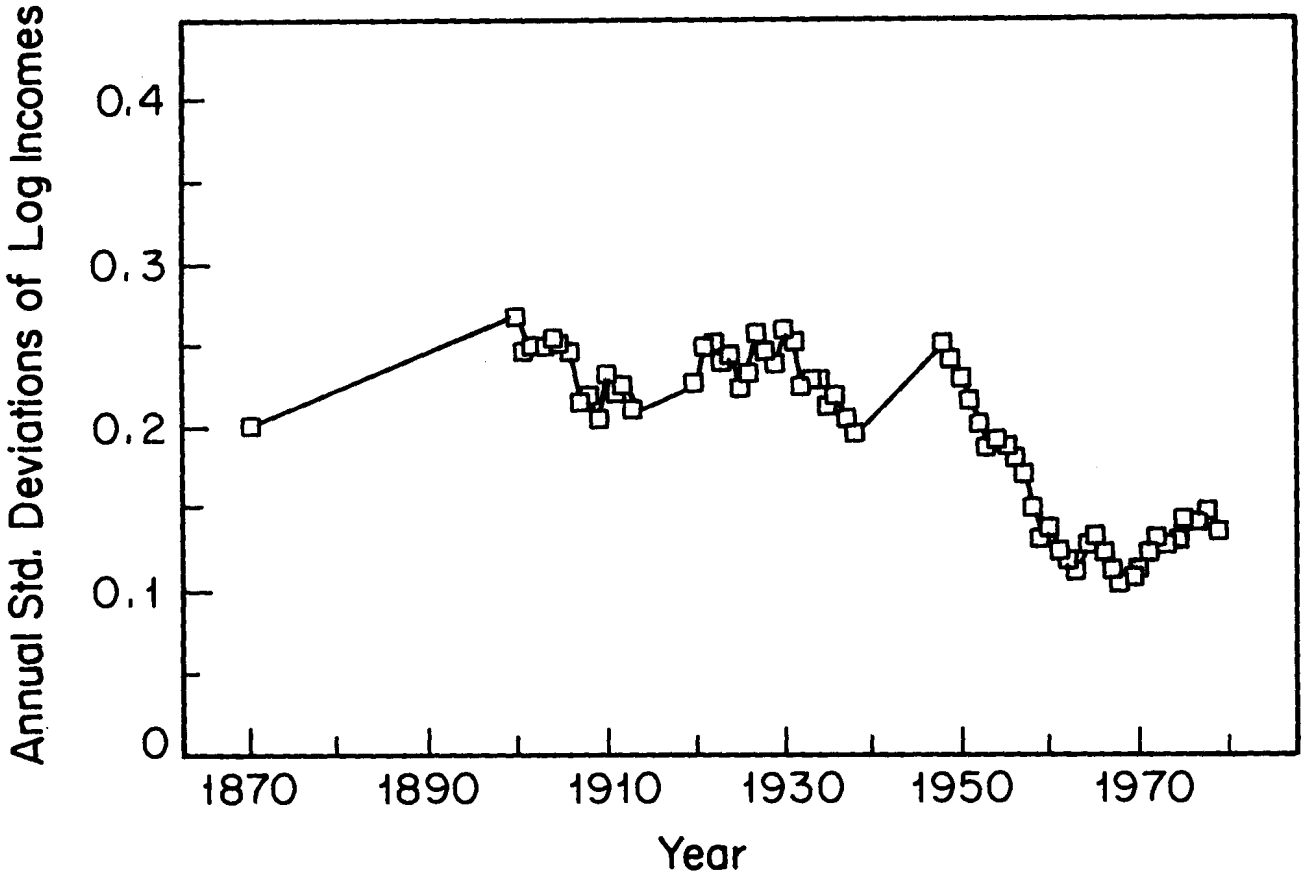

FIGURE VII

Per Capita Income Dispersion: Between Belgium, France, the Netherlands, and Italy, 1870–1979

Ben-David (1993): Intra-EEC Convergence

3 countries joined the EEC late. They converged too.

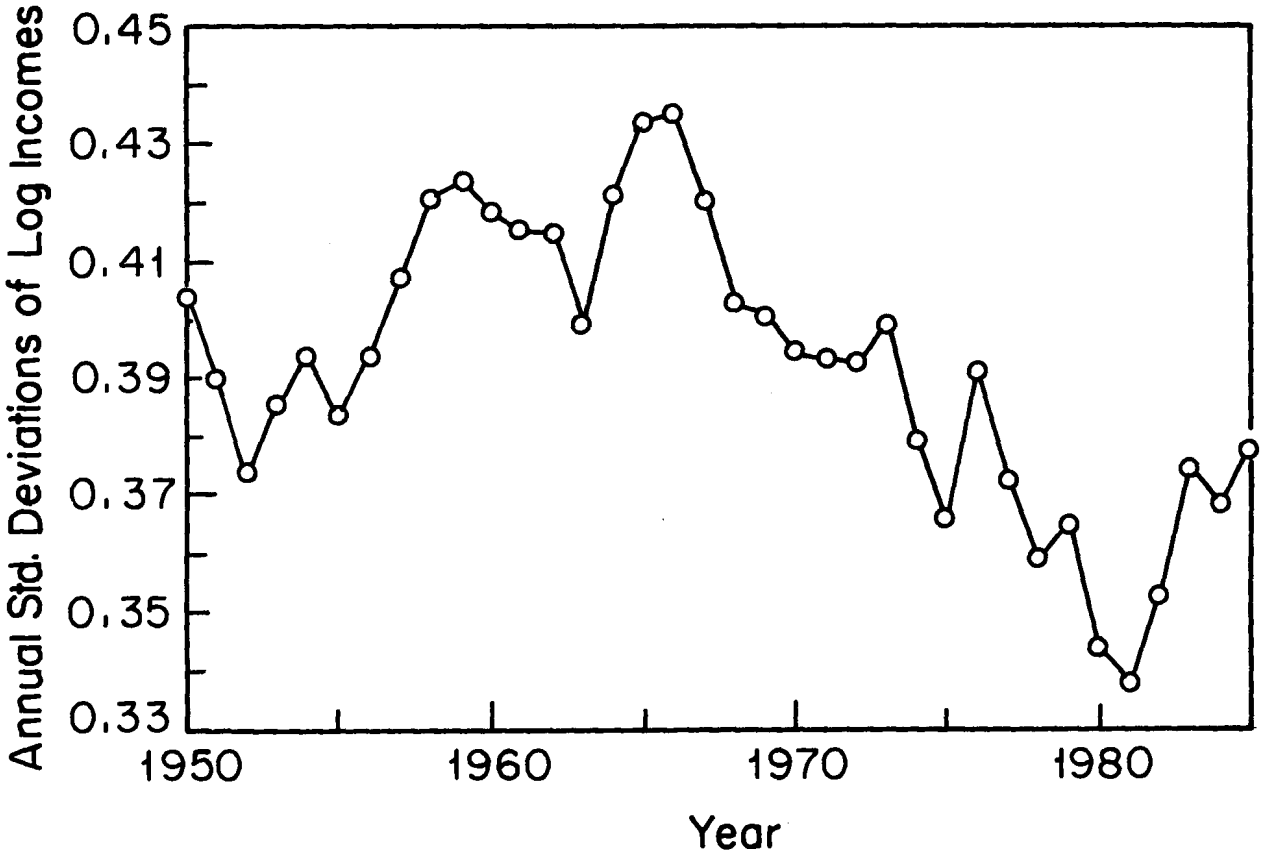

FIGURE VIII

Per Capita Income Dispersion: Between the United Kingdom, Denmark, and Ireland, 1950–1985

Ben-David (1993): Intra-EEC Convergence

Rest of world was diverging (unconditionally) at this time

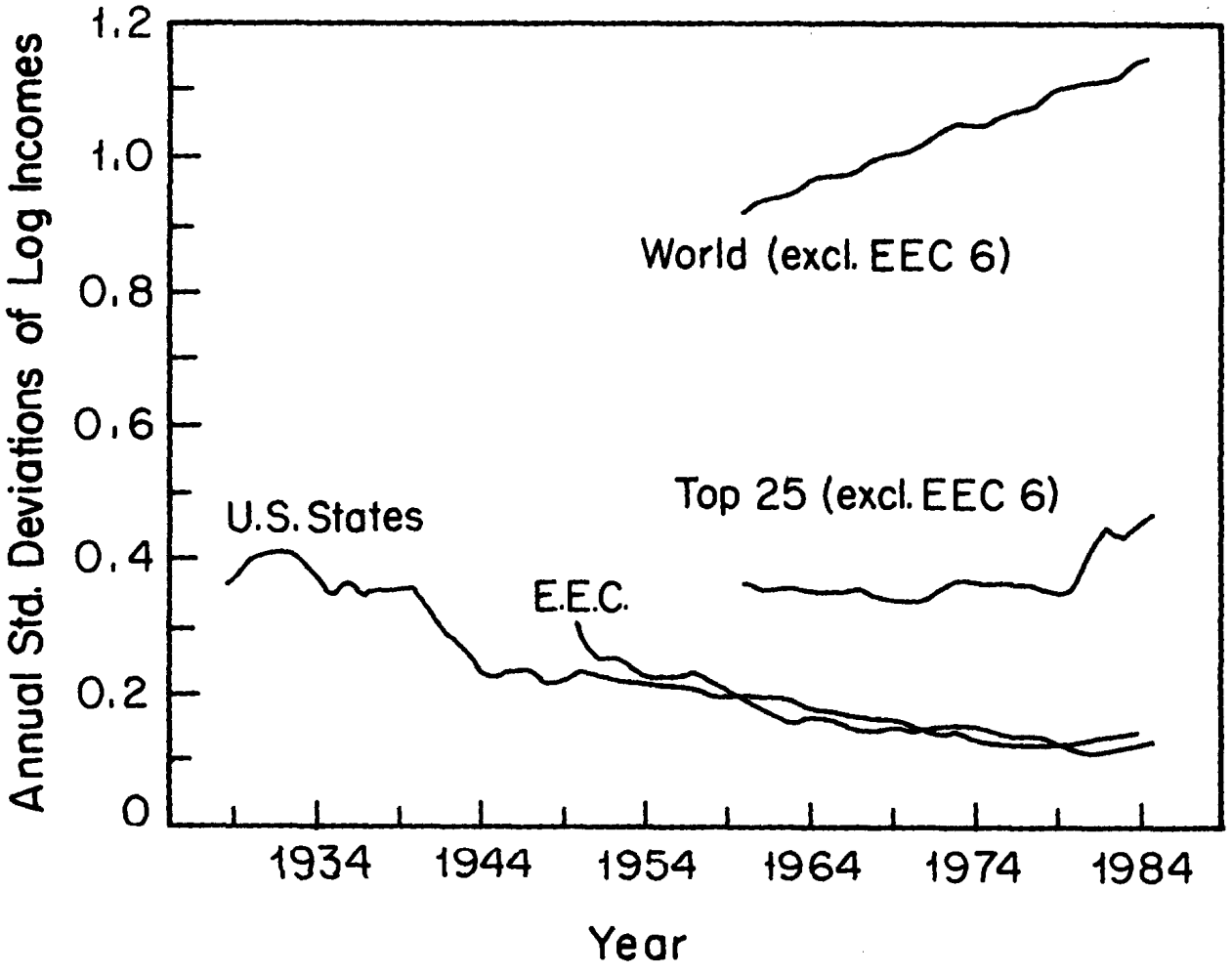

FIGURE IX
Comparison of Income Dispersions, 1929–1985

Ben-David (1993): Convergence within other FTAs

Kennedy Round (affected US-Canada), and EFTA (European countries not in EEC)

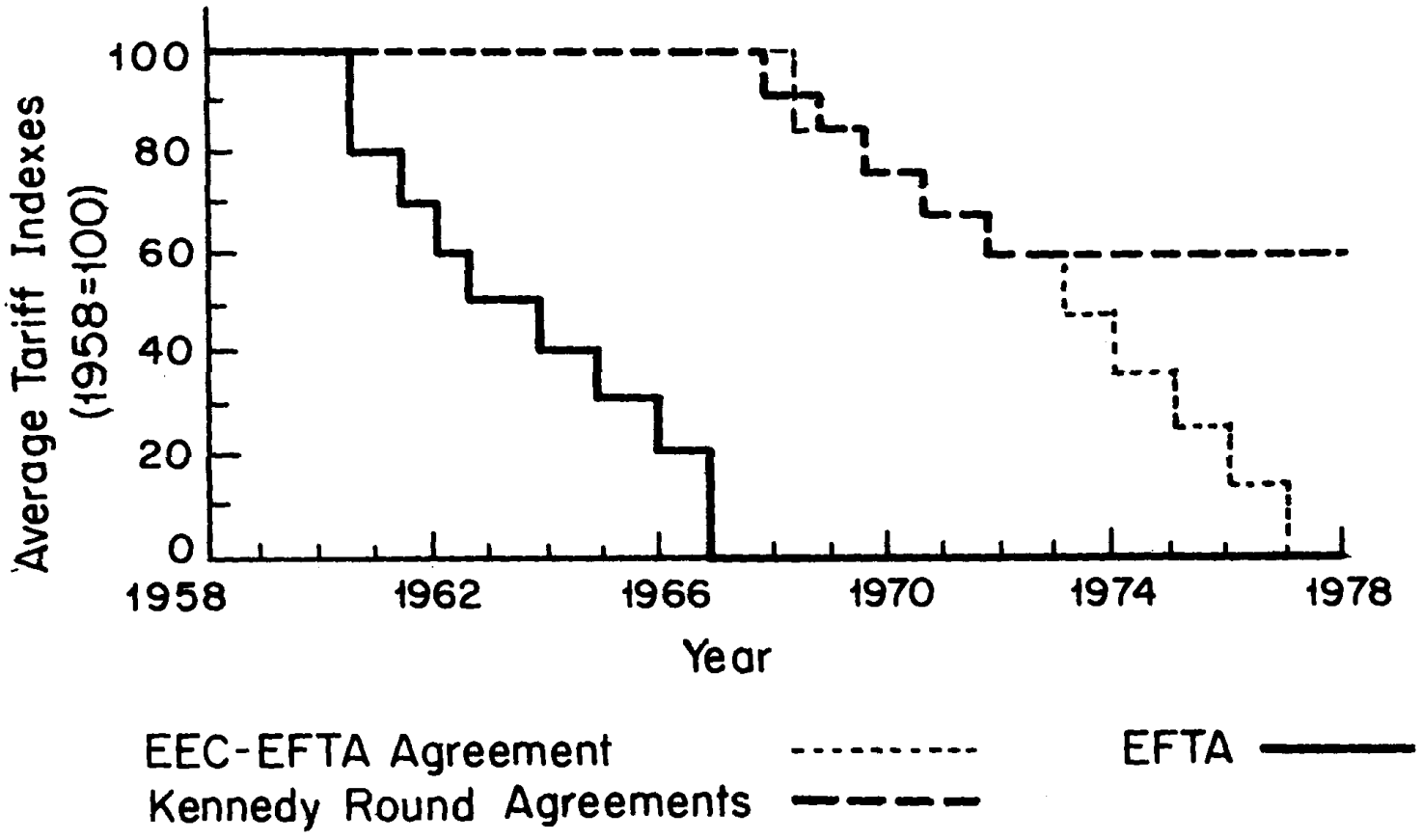

FIGURE XI
Tariff Elimination Schedules: 1958–1978

Ben-David (1993): Convergence within other FTAs

Convergence between US and Canada

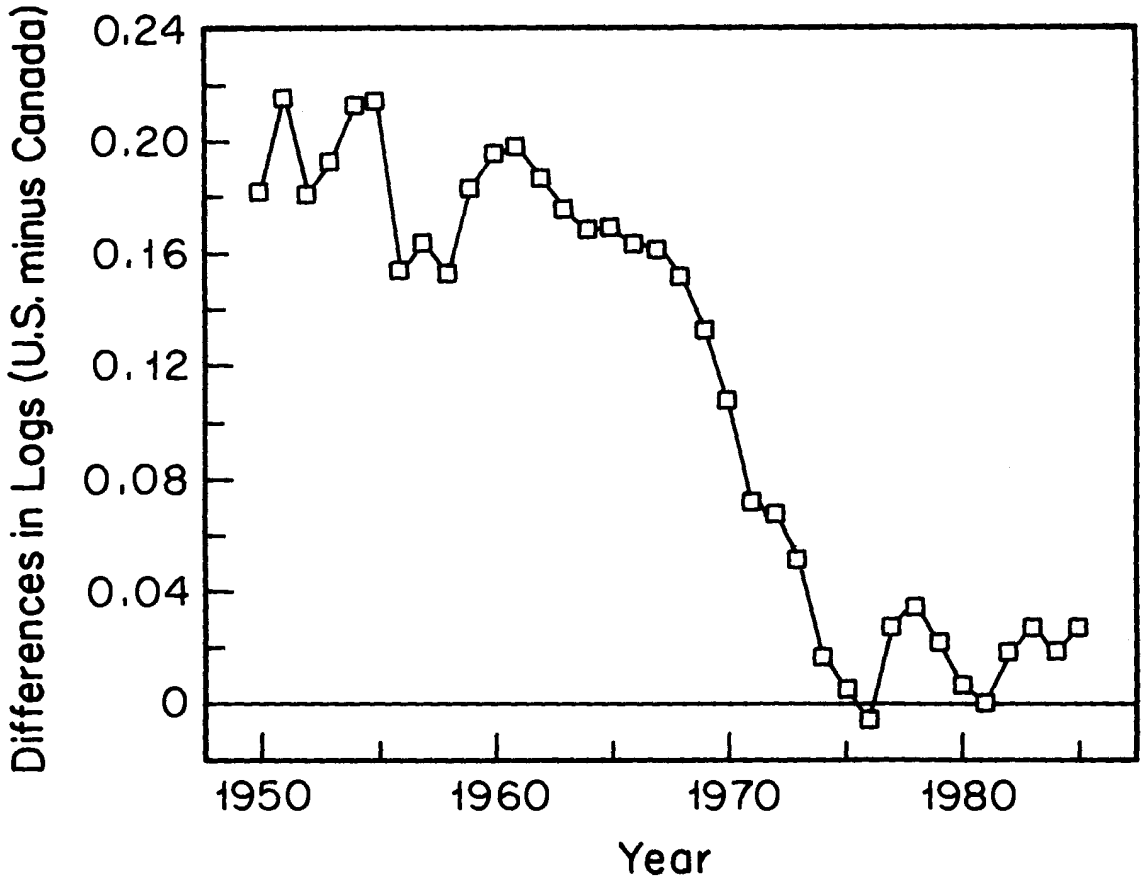

FIGURE XIII

Gap in Per Capita Incomes: Between the United States and Canada, 1950–1985

Ben-David (1993): Convergence within other FTAs

Convergence within EFTA 6

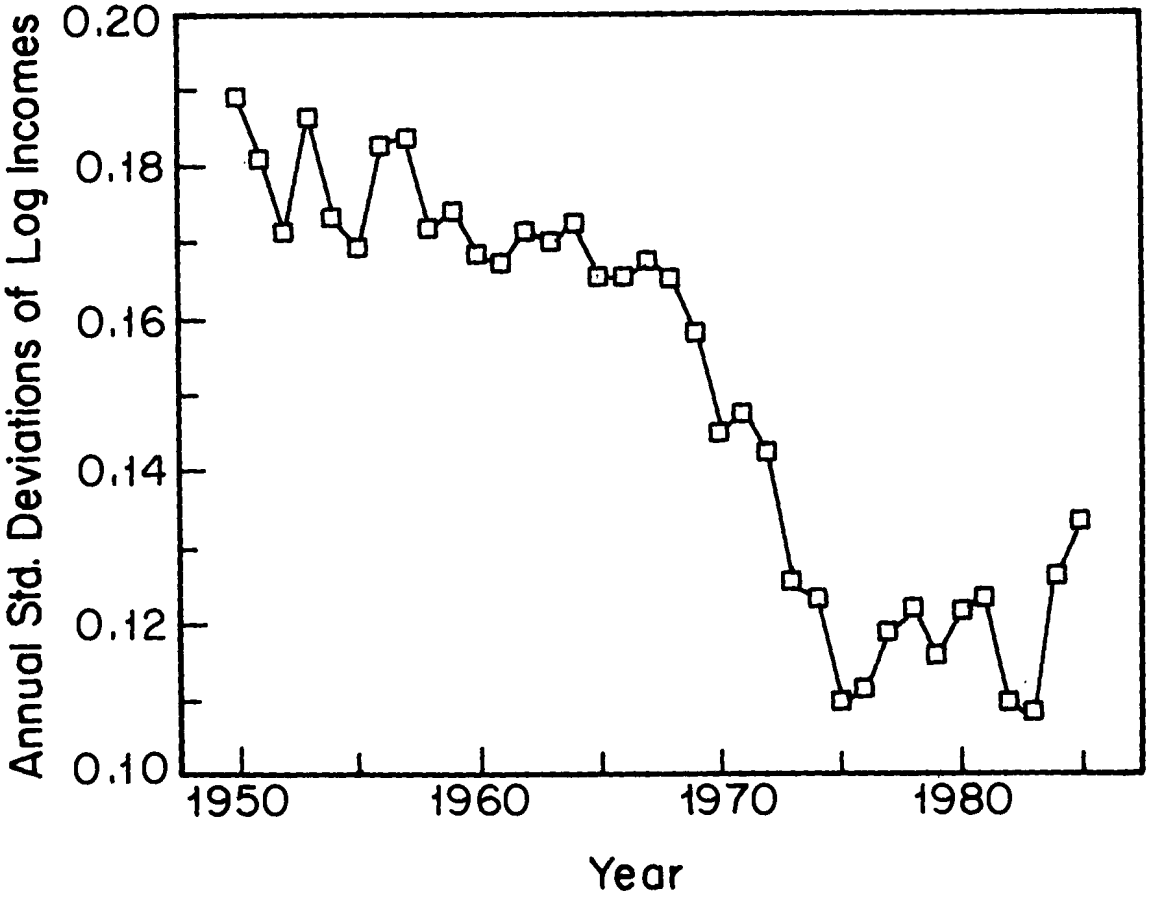

FIGURE XIV

Per Capita Income Dispersion Among EFTA 6: Switzerland, Sweden, Denmark, Norway, Finland, and the United Kingdom

Ben-David (1993)

- These are striking findings. But we need to remember some caveats:
  1. Other aspects of economic policy were liberalized as well in this time period.
  2. Mankiw, Romer and Weil (1992) find evidence for *conditional* convergence throughout the world, but not for unconditional convergence. Unfortunately, Ben-David (1993) presents plots (and regressions) related to unconditional convergence. There is a serious risk that FTA countries have similar Solovian fundamentals and all we are seeing is conditional convergence. (But the timing of the convergence is impressive, and a pure Solow story would require FTA members' fundamentals to become more similar as they sign up to the FTA.)

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Openness and the Structural Transformation

- The 'structural transformation' (shifts in sectoral output shares as GDP grows) has received a lot of recent attention.
  - Ngai and Pissarides (AER, 2007)
  - Acemoglu and Guerrieri (JPE, 2008)
  - Buera and Kaboski (2006, 2007).
  - And others—"Baumol's curse" being the foundation.

- Most of this work (along with most of the work in the 'growth' literature) works with an autarkic country model and then takes it to the data.
  - This is probably misleading for thinking about growth (as, eg, Acemoglu and Ventura (2002) demonstrated).
  - But it might be even worse for thinking about inter-sectoral issues, because trade means that countries' inter-sectoral allocations are interdependent. Matsuyama (JEEA, 2009) makes this point very nicely.
  - Yi and Zhang (2010) and Teignier-Baque (2009, JMP) attempt to remedy this.

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Openness and Endogenous Growth

- Recall from previous (theory) lecture that the effect of openness on growth in endogenous growth models depends on:
  1. The scope for technological spillovers. This should really be sub-divided further into:
     - 'Knowledge spillovers': transfer of technology that is not embodied in physical inputs. Eaton and Kortum (IER, 1999) formalize this, but the 'model' of knowledge spillover is just an exogenous diffusion process.
     - 'Input trade': transfer of technology that is embodied in physical inputs (intermediate inputs or 'capital'). This is the mechanism in open economy versions of Romer-style engogenous growth (eg Grossman and Helpman book).
  2. The 'market size effect'. Openness creates larger markets, which enlarges the gains from innovation and therefore makes firms want to innovate more.
  3. The 'competition effect'. Larger markets have the down-side that a firm faces higher competition and therefore gains less from any innovation.
- We discuss empirical work motivated by these 3 phenomena.

Technological Spillovers and Openness

- An enormous literature (surveyed by Keller (JEL, 2004)) has attempted to measure technological spillover across countries (and another huge literature looks at spillovers within countries).
- I will draw a distinction between:
  - 'Knowledge spillovers': these leave no direct empirical trace, so they're harder to pin down.
  - 'Input (intermediates and K) trade': here we can actually track the flow of goods, and use prices, quantities and theories of input demand to quantify the effects of trade in 'inputs'.

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Knowledge Spillovers and Openness

- A number of papers have looked at 'knowledge spillovers' across and within countries.
- What do we mean by 'knowledge spillovers'? A famous quote from Marshall (1890):
  - "When an industry has thus chosen a locality...it is likely to stay there...so great are the advantages...The mysteries of the trade become no mysteries; but are as it were in the air...inventions and improvements in machinery, in processes and the general organization of the business have the merits promptly discussed; if one man starts a new idea, it is taken up by others and combined with suggestions of their own..."

Knowledge Spillovers and Openness

- A central challenge is to measure 'knowledge'. Three approaches prevail in the literature:
  1. Proxy for knowledge via inputs to knowledge: R&D expenditure.
  2. Proxy for knowledge via outputs of knowledge: patents.
  3. Proxy for knowledge via the effects of knowledge: TFP.
- An ensuing challenge is how to regress one country's 'knowledge' on another country's 'knowledge' and interpret the coefficient in a causal manner.
  - The 'peer effects' literature in labor economics (eg Manski (ReStud, 1993)) should give us cause for caution when doing this.

Jaffe, Trajtenberg and Henderson (QJE 1993)

- This was the first paper to use US patent data *citations* to systematicaly document the geographic concentration of citations.
  - This is an extremely influential and highly-cited article (over 3000 on Google Scholar!)
- The logic here:
  - An inventor (usually) "builds on the shoulders of giants" when coming up with a new product.
  - He/she is legally obliged (when filing a patent) to cite prior inventions that the present invention builds on.
  - The patent inspector also adds citations to the final published citation.

Jaffe, Trajtenberg and Henderson (QJE 1993): Results

- Their finding is that citations (excluding self-cites) are more likely to occur within the same US city, US state, and country then a 'control group' would predict.
  - The 'control group' basically just adjusts for clustering of industries by geography.
  - Eg, does Silicon Valley cite Silicon Valley because of knowledge spillovers or because everyone there is in the same industry?
- We can easily control for industries because 'industry' is observed. But what about unobserved spatially correlated variables that affect everyone in Silicon Valley?
  - This is one of the challenges of doing work on peer effects highlighted by Manski (1993).

Jaffe, Trajtenberg and Henderson (1993): Results

TABLE III
GEOGRAPHIC MATCHING FRACTIONS

	1975 Originating cohort			1980 Originating cohort		
	University	Top corporate	Other corporate	University	Top corporate	Other corporate
Number of citations	1759	1235	1050	2046	1614	1210
Matching by country						
Overall citation matching percentage	68.3	68.7	71.7	71.4	74.6	73.0
Citations excluding self-cites	66.5	62.9	69.5	69.3	68.9	70.4
Controls	62.8	63.1	66.3	58.5	60.0	59.6
t-statistic	2.28	−0.1	1.61	7.24	5.31	5.59
Matching by state						
Overall citation matching percentage	10.4	18.9	15.4	16.3	27.3	18.4
Citations excluding self-cites	6.0	6.8	10.7	10.5	13.6	11.3
Controls	2.9	6.8	6.4	4.1	7.0	5.2
t-statistic	4.55	0.09	3.50	7.90	6.28	5.51
Matching by SMSA						
Overall citation matching percentage	8.6	16.9	13.3	12.6	21.9	14.3
Citations excluding self-cites	4.3	4.5	8.7	6.9	8.8	7.0
Controls	1.0	1.3	1.2	1.1	3.6	2.3
t-statistic	6.43	4.80	8.24	9.57	6.28	5.52

Number of citations is less than in Table I because of missing geographic data for some patents. The *t*-statistic tests equality of the citation proportion excluding self-cites and the control proportion. See text for details.

Coe and Helpman (EER, 1995)

- Coe and Helpman (1995) look at international spillovers of RD expenditure, and attempt to further restrict attention to spillovers occurring through trading relationships.
  - Again, this is an enormously influential paper (with almost 3200 Google Scholar cites, Helpman's highest article.)

- They estimate the following regression:

$$\ln TFP_{ct} = \alpha_c + \beta^D S^D_{ct} + \beta^F S^F_{ct} + \varepsilon_{ct} \tag{6}$$

  - Here S^D_{ct} is domestic R&D stocks. Stock data is from Grilliches.
  - And S^F_{ct} is import-weighted foreign R&D stocks: $S^F_{ct} \equiv \sum_{c' \neq c} m_{cc'} S_{c'}$.

Coe and Helpman (1995)

Table 3
Total factor productivity estimation results (pooled data 1971–90 for 22 countries, 440 observations) [a]

	(i)	(ii)	(iii)
log S^d	0.097	0.089	0.078
$G7 \cdot \log S^d$		0.134	0.156
log S^f	0.092	0.060	
$m \cdot \log S^f$			0.294
Standard error	0.049	0.046	0.044
R^2	0.558	0.621	0.651
R^2 adjusted	0.534	0.600	0.630
Cointegration tests:			
Levin and Lin (1992)	−4.533	−9.356	−5.082
Levin and Lin (1993)	0.570	2.201	2.266
t-statistic on the lagged residual in the EC model	−5.451	−6.293	−6.974

[a] The dependent variable is log (total factor productivity). All equations include unreported, country-specific constants. The critical value at the 10 percent confidence level is −6.78 for Levin and Lin (1992), and −1.64 for the other two cointegration tests; test statistics that are negative and greater in absolute value than the critical values indicate that the equations are cointegrated. The EC (error correction) model is the first difference of each equation augmented to include the lagged residual from the equations reported above. S^d = domestic R and D capital stock, beginning of year; S^f = foreign R and D capital stock, beginning of year; $G7$ = dummy variable equal to 1.0 for the seven major countries and equal to 0 for the other 15 countries; m = ratio of imports of goods and services to GDP, both in the previous year.

The Coe and Helpman Approach

- Keller (1998) criticized the extent to which these results spoke to *trade flows* as the channel through which international R&D efforts spill over across countries.
  - He showed that randomly-weighted (rather than import-weighted) international R&D stocks matter too.

- Coe and Helpman have extended this work in a number of directions:
  - Coe, Helpman and Hoffmaister (EJ, 1997): North-South spillovers.
  - Bayoumi, Coe and Helpman (JIE 1999): how important are spillovers for global growth?
  - Coe, Helpman and Hoffmaister (EER, 2009): Do good institutions promote the incorporation of a country's neighbors' RD efforts?

Keller (AER, 2002)

- Keller (2002) extended the Coe and Helpman (1995) approach by:
  - Looking at *distance*-weighted rather than *import*-weighted foreign R&D stocks. Clearly this will then capture a more all-encompassing notion of 'geographical spillovers', but will also be more 'reduced form' in that the emphasis is not on *why* we see spillovers.
  - Conducting the analysis at the industry-level, rather than the national level.
- The specific regression that Keller (2002) runs is:

$$\ln TFP_{cit} = \alpha_{ci} + \alpha_t + \beta \ln[S_{cit} + \gamma(\sum_g S_{git} e^{-\delta D_{cg}})] + \varepsilon_{cit} \quad (7)$$

  - Here g is countries in the G5 (the big R&D producers), and the sample countries c are not in the G5.
  - D_{cg} is the distance between c and g.

Keller (2002)

TABLE 2—GEOGRAPHIC LOCALIZATION:
BENCHMARK RESULTS

	(2.1)	(2.2)	(2.3)	(2.4)
β	0.078	0.077	0.078	0.069
	(0.013)	(0.013)	(0.016)	(0.023)
δ	1.005	0.981	1.037	
	(0.239)	(0.196)	(0.262)	
χ				0.090
				(0.012)
γ	0.843			
	(0.059)			
γ_J		1.0		
		(set)		
γ_{US}		1.081		
		(0.059)		
γ_{UK}		0.616		
		(0.060)		
γ_G		1.188		
		(0.060)		
γ_F		0.944		
		(0.060)		
n	2808	2808	2808	2808
R^2	0.702	0.702	0.702	0.696
AIC	−4.233	−4.232	−4.234	−4.214

Notes: Standard errors are in parentheses; β measures the effect of domestic R&D; γ (and γ_g) measure the relative effect from G-5 country R&D; δ as well as χ determine the distance effects ($\delta > 0$ and $\chi > 0$, respectively, are consistent with localization); AIC = Akaike's Information Criterion, as defined in the text.

Knowledge Spillovers: Subsequent Work

- Eaton and Kortum (EER, 1999):
  - A structural model of RD and diffusion. One sensible feature is that domestic knowledge and inwardly-diffused foreign knowledge don't just mix naively. Firms only use the best 'idea' available today, regardless of where it came from. Mathematics of characterizing 'best' idea come from Kortum (Ecta, 1997).
- Griffith, Lee and van Reenen (2007):
  - Consider the *speed* with which a patent gets cited. Use duration models to do this. Distance affects citation speed, but the effect of distance is falling over time.
- Bloom, Schankerman and van Reenen (2008):
  - Look for spillovers between US firms. Create separate measures of 'technological proximity' and 'product market proximity' to separately identify each. Instrument for RD expenditure using RD subsidies.
- Branstetter, Fisman and Foley (QJE, 2006):
  - A study of technology transfer between US multinational firms and their foreign affiliates (and then how these transfers change as IPRs in foreign countries improve).

Plan for Today's Lecture

- Brief introduction.
- Neoclassical growth models in open economies:
  - How large are the terms-of-trade effects that come with growth?
  - Does trade liberalization promote income convergence (as FPE theorem would suggest)?
  - Structural Transformation in open economies.
- **Endogenous growth models in open economies:**
  - What evidence is there for international knowledge spillovers?
  - **Does technology embodied in physical goods (intermediate inputs or capital equipment) lead to important international technology? transfer?**
  - Brief discussion of other effects: market size, competition.
- Brief discussion of other 'trade and growth' channels.

Input Trade

- New technology is often embodied in inputs that can (and do) move across countries.

- We review here a literature that has described this effect theoretically and empirically.
  - One theoretical distinction is whether the embodied technology comes in the form of intermediate inputs or capital.
  - Empirically, however, these are hard to distinguish (since they are often misclassified).

Eaton and Kortum (EER 2001): Capital Goods Trade

- EK (2001) start out by noting that for most countries (even most OECD countries), most equipment (ie a big part of capital) used is equipment imported from abroad.
  - This suggests that a key channel from trade to 'growth' is that if a country is to grow by capital accumulation it has to accumulate by purchasing capital from abroad.
  - So trade barriers will have a big effect here on GDP levels because it is durable inputs to production that are needed to be imported from abroad (not final goods or non-durable intermediate goods that make final goods).
- They develop an EK (2002)-style Ricardian model of capital production and capital trade in GE.
  - This allows them to use a gravity equation (in capital goods flows) to predict how costly it is to get equipment in every country in the world. They call this the "trade predicted price of equipment".
  - Using this 'trade predicted' price of equipment they ask how much of world Y/L variation can be accounted for by trade in equipment. The answer is nearly 25 %.

EK (2001): Most countries import equipment

Table 2
Trade in manufactures and equipment[a]

No.	Country	Imports in absorption		Imports from 'Big 7'	
		Manufactures (%)	Equipment (%)	Manufactures (%)	Equipment (%)
1	Australia	25.8	58.0	72.1	81.1
2	Austria	41.5	62.3	76.5	80.6
3	Bangladesh	50.8	80.9	36.6	49.0
4	Canada	31.7	62.6	88.8	91.9
5	Denmark	57.2	92.0	67.0	78.7
6	Egypt	33.7	64.6	59.7	79.7
7	Finland	28.0	57.2	69.4	78.1
8	France	25.3	40.3	60.4	75.0
9	Germany	26.1	34.1	49.3	62.5
10	Greece	35.4	67.7	66.4	76.0
11	Hungary	29.1	53.0	33.0	38.1
12	India	12.2	24.3	53.6	73.9
13	Iran	26.6	45.7	55.7	74.3
14	Italy	29.0	54.9	59.7	73.1
15	Japan	5.3	4.7	45.8	73.8
16	Kenya	18.7	60.0	66.1	74.4
17	Korea	23.1	47.9	80.0	90.0
18	Malawi	42.4	99.3	44.1	64.4
19	Mauritius	35.3	87.6	46.3	61.4
20	Morocco	32.8	66.0	67.3	82.0
21	New Zealand	30.3	57.1	66.7	75.1
22	Nigeria	29.1	73.0	66.1	72.7
23	Norway	41.5	49.9	67.0	77.4
24	Pakistan	33.3	66.4	64.6	74.4
25	Philippines	23.5	72.3	57.2	75.8
26	Portugal	31.1	74.1	64.0	76.8
27	Spain	16.4	46.0	74.4	84.1
28	Sri Lanka	48.9	94.0	48.4	72.6
29	Sweden	41.5	80.5	57.4	70.0
30	Turkey	22.4	53.2	64.9	75.1
31	United Kingdom	28.7	46.1	57.2	70.0
32	United States	11.9	16.6	44.4	58.8
33	Yugoslavia	15.6	31.4	55.5	63.8
34	Zimbabwe	18.8	64.7	54.7	72.2

EK (2001): Most countries import equipment

Table 3
Sources of equipment purchases[a]

Importing country	Source of equipment purchases (% of absorption)							
	Home	US	Japan	Germany	UK	France	Italy	Sweden
Europe:								
Austria	37.7	3.2	3.6	33.0	2.7	2.4	3.9	1.5
Denmark	8.0	7.9	6.8	28.0	10.3	4.6	4.7	10.2
Finland	42.8	4.7	5.7	13.8	5.1	2.7	2.8	10.0
France	59.7	7.0	3.2	10.7	3.9	—	4.6	0.9
Germany	65.9	5.2	5.1	—	3.6	3.5	3.0	0.9
Greece	32.3	3.8	3.8	18.7	5.3	5.2	13.4	1.3
Hungary	47.0	1.6	2.1	10.9	1.4	1.6	1.6	1.1
Italy	45.1	6.6	3.7	16.6	5.6	6.2	—	1.4
Norway	50.1	6.1	3.7	9.9	6.1	2.0	2.3	8.5
Portugal	25.9	5.0	5.9	18.8	8.5	7.3	9.3	2.1
Spain	54.0	6.5	5.2	10.9	4.2	5.4	5.4	1.2
Sweden	19.5	10.3	8.0	20.7	9.4	4.7	3.3	—
Turkey	46.8	7.1	6.7	14.0	4.5	2.0	4.9	0.8
UK	53.9	11.0	5.3	8.5	—	3.4	2.8	1.3
Yugoslavia	68.6	2.9	0.6	8.2	1.6	1.5	4.0	1.2
Pacific:								
Australia	42.0	15.9	16.3	5.5	4.5	1.2	2.1	1.5
Canada	37.4	45.7	5.8	2.1	1.8	0.8	0.7	0.6
Japan	95.3	2.7	—	0.4	0.2	0.1	0.1	0.1
Korea	52.1	12.9	23.9	2.5	1.0	1.5	0.4	0.8
New Zealand	42.9	11.6	15.6	4.8	6.7	1.5	1.7	1.0
Philippines	27.7	26.0	18.1	5.3	2.2	1.7	0.9	0.5
US	83.4	—	6.4	1.3	0.9	0.5	0.4	0.2
South Asia:								
Bangladesh	19.1	5.7	14.9	6.6	6.7	4.0	1.6	0.3
India	75.7	3.7	4.0	4.5	2.9	1.9	0.8	0.3
Iran	54.3	0.9	7.2	13.4	4.9	0.9	5.6	1.1
Pakistan	33.6	11.5	12.2	9.7	8.5	2.5	3.9	1.2
Sri Lanka	6.0	8.9	27.8	10.0	12.9	3.9	2.5	2.2
Africa:								
Egypt	35.4	10.0	8.0	10.7	5.3	6.3	10.2	0.9
Kenya	40.0	4.0	7.4	7.4	17.4	3.3	3.7	1.4
Malawi	0.7	8.0	5.6	7.0	26.9	8.7	6.3	1.3
Mauritius	12.4	1.2	12.0	5.3	8.4	23.3	3.2	0.3
Morocco	34.0	3.2	2.7	7.5	3.7	27.7	7.0	2.4
Nigeria	27.0	8.1	8.0	8.8	16.7	5.5	5.5	0.5
Zimbabwe	35.3	9.1	2.3	7.0	14.7	4.9	6.7	2.1

EK (2001) meets Hseih and Klenow (AER, 2007)

- HK (2007) cast doubt on the details of the EK (2001) mechanism.
- They argue that if EK (2001) were right, then the price of equipment would be much higher in poor countries.
  - EK (2001)'s Figure 6 plots just this: the *observed* price of equipment (from the International Comparison of Prices (ICP) project).
  - EK's reply would (presumably) be: We don't really believe this ICP data. Such data is very hard to collect (as it's hard to compare 'equipment' well). Our 'trade predicted' equipment price (which is derived from the choices that firms in poor countries make about whether to buy capital from home or from Germany) is what we believe.

EK (2001): ICP Equipment Price Data

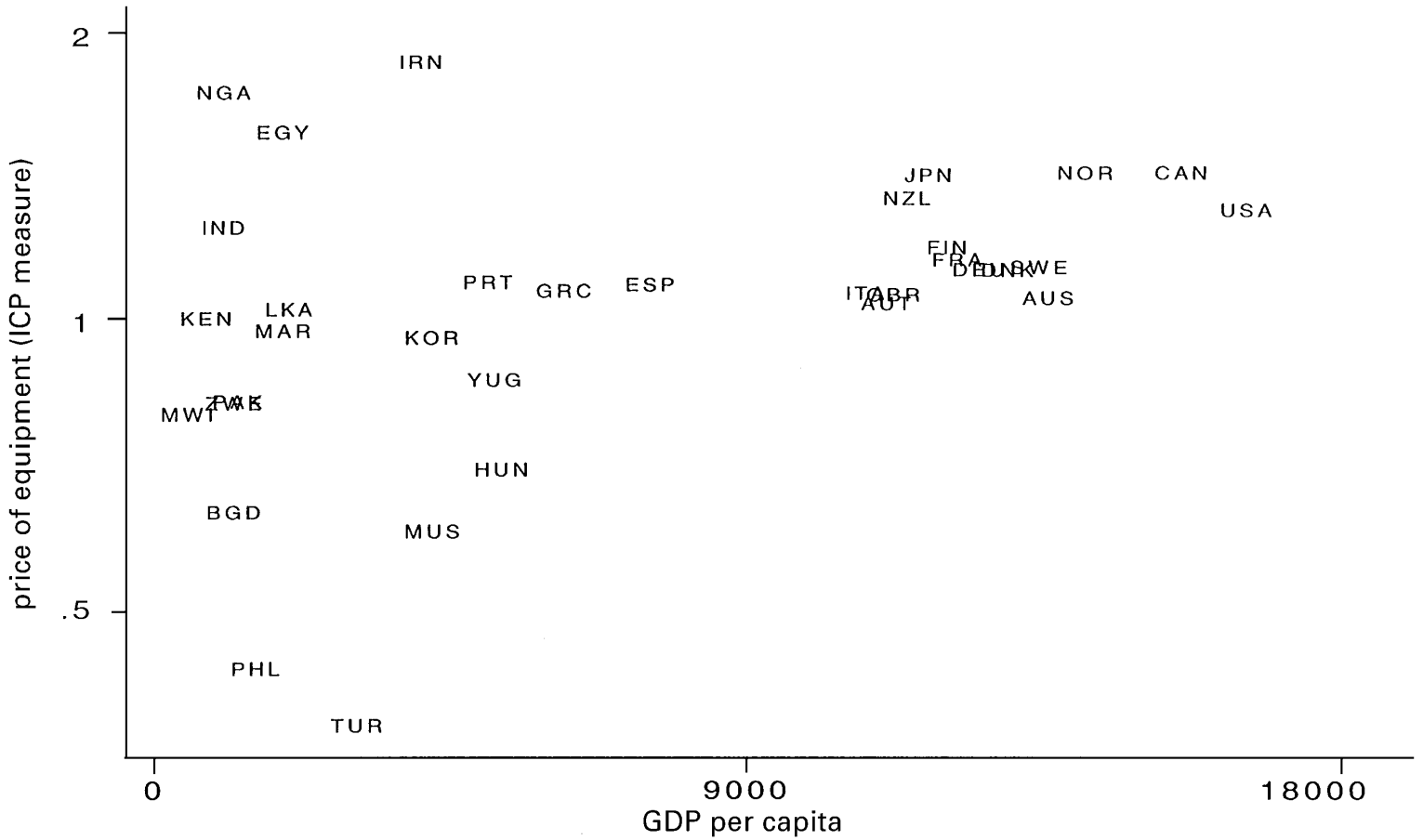

Fig. 6. Development and the price of equipment.

Intermediate Input Trade

- There has been a lot of recent work on this. One source of confusion is whether we want to include cheaper intermediate inputs as part of 'productivity' or simply as something that raises Y/L.
- Broad, Greenfield and Weinstein (2006):
  - Estimate the 'productivity' effects inherent in a Romer-style production function (which features 'love of variety', a la Dixit-Stiglitz).
  - They make the assumption that if the same 'good' (eg groundnuts) is available from country A and country B, then these are different varieties of the good.
  - They quantify the productivity benefits of all the new 'varieties' that LDCs have been importing around the world between 1994 and 2003.
  - Quantifying the gains from new varieties requires: CES assumption, estimate of the CES parameter, and the Sato-Vartia-Feenstra formula. (See Feenstra (AER, 1994)).
  - This accounts for 15 % of productivity growth over the period.

Intermediate Input Trade

- Amiti and Konings (AER, 2007):
  - Focus on the trade liberalization (lower tariffs) effects of cheaper *imported* intermediate goods for domestic firms. (Recall, most of these firm-level trade liberalization studies focus on how tariffs change the prices of the final goods in which firms compete.)
  - This takes seriously Corden's old idea of "effective protection" (that an import-competing firm enjoys protection on its output good but suffers from protection on its input goods, so the appropriate measure of a country's level of protection should take both of these forces into account).
  - The effects are large: about twice as large as those coming about through output goods tariffs.
- Other important recent work by Goldberg, Khandelwal, Pavcnik and Topalova (QJE 2010).

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  - **Brief discussion of other effects: market size, competition.**
- Brief discussion of other 'trade and growth' channels.

Endogenous Growth: Other Effects

- There is not much work on these in a specifically international setting.
- Market Size Effect:
  - But Acemoglu and Lin (QJE, 2003) does this domestically, using 'market size' for pharmaceuticals generated by demographic change.
  - Sokoloff (JEH, 1998) looks at innovation (patenting) around canals in the early 19th century United States.
  - Trefler and Lileeva (QJE 2010) and Bustos (AER 2010) are about exporters and potentially fit under this heading, though the meachanisms at work are different.
- Competition Effect:
  - Aghion, Bloom, Blundell, Griffith and van Reenen (QJE 2007) is a nice study of competition and innovation (patenting) in the UK. Some of their exogenous competition 'shock' variables relate to import competition.
  - Some work surveyed in Tybout (Handbook chapter, 2001) can be interpreted in this way.

Other Trade and Growth Channels

- Institutional Change:
  - Acemoglu, Johnson and Robinson (AER, 2005): Gains from "Atlantic Trade" around the industrial revolution are too big to be gains from trade. Likely that trade openness changed domestic institutions for the better.
  - Levchenko (ReStud 2007) formalized this notion.

- Learning by Doing:
  - Very little work on this in general.
  - Irwin and Klenow (JPE 1994) looks at LBD in the semiconductor industry. Finds some evidence of learning both from both domestic production and foreign (other firms') production.
  - Irwin (JEH, 2000) is study of the US tinplate industry.
  - Benkard (AER 2000) is purely domestic study of US airline industry.
  - Thornton and Thompson (AER 2001) is purely domestic LBD study of 'liberty ship' building in US.