Reaping the Gains: Specialization and Capital Flows

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Motivation

Old Question: Trade and Capital Flows - Complements or Substitutes?

- Standard textbook theory would rather suggest that both are substitutes
- Empirical Evidence: Factor endowment driven trade is relevant – along lines of high skill and low skill labor (Romalis, 2004; Morrow, 2010)
- More and more offshoring taking place, to make use of labor cost differences (e.g. Grossman & Rossi-Hansberg, 2006; Feenstra & Hanson, 1997)

- We show in this paper that factor endowment driven trade and increasing specialization for production on world markets has an effect of supporting capital inflows
- Develop simple formal theory capturing this intuitive argument
- Test its prediction empirically

This Talk

1. Introduction
2. Model Setup and Autarky Equilibrium
3. Small Open Economy
4. Primer on Two-Country Setting
5. Empirical Test
6. Conclusion

Overview Theoretical Relationship

- Factor Endowment Trade – M goods, N factors
  - Heckscher-Ohlin ($M = N$): Perfect Substitutes because of FPE (e.g. Mundell, 1957)
  - $M > N$: Full Specialization & FPE (Dornbusch, Fischer, Samuelson, 1980)
  - $N > M$: No FPE, but also no statement on complementarity/substitutability (e.g. Ruffin, 1981; Jones & Easton, 1983)
  - Full specialization: No FPE, but also no statement on complementarity/substitutability (Jones, 1956)
- Firm Level: Substitutability for serving foreign markets (e.g. Helpman, Melitz & Yeaple, 2004)
- Friction Perspective: (More or less) Endogenous sector-specifity of capital may lead to complementarity (e.g. Antras & Caballero, 2009; Jin, 2012; Neary, 1995)

Idea here

- In a Heckscher-Ohlin-setting, trade allows for efficient use of abundant factors
- Composite, mobile factor involved in production (capital) reaps part of gains
- If the marginal product increases due to trade, capital will move where specialization takes place
- Result: (Skill-)HOS-Trade and capital flows are actually complementary

Production

- Two sectors, 1 & 2, three factors of production K, H & L, respective factor rewards r, s & w
- Factor markets, good markets perfectly competetive
- CRS Production Functions:

$$Y_1 = K_1^{\alpha} H_1^{\beta} L_1^{1-\alpha-\beta}$$
$$Y_2 = K_2^{\alpha} H_2^{\gamma} L_2^{1-\alpha-\gamma}$$

  where w.l.o.g. $\beta > \gamma$ – Sector 1 is skill-intensive
- Capital receives constant share α of production

Production cont'd

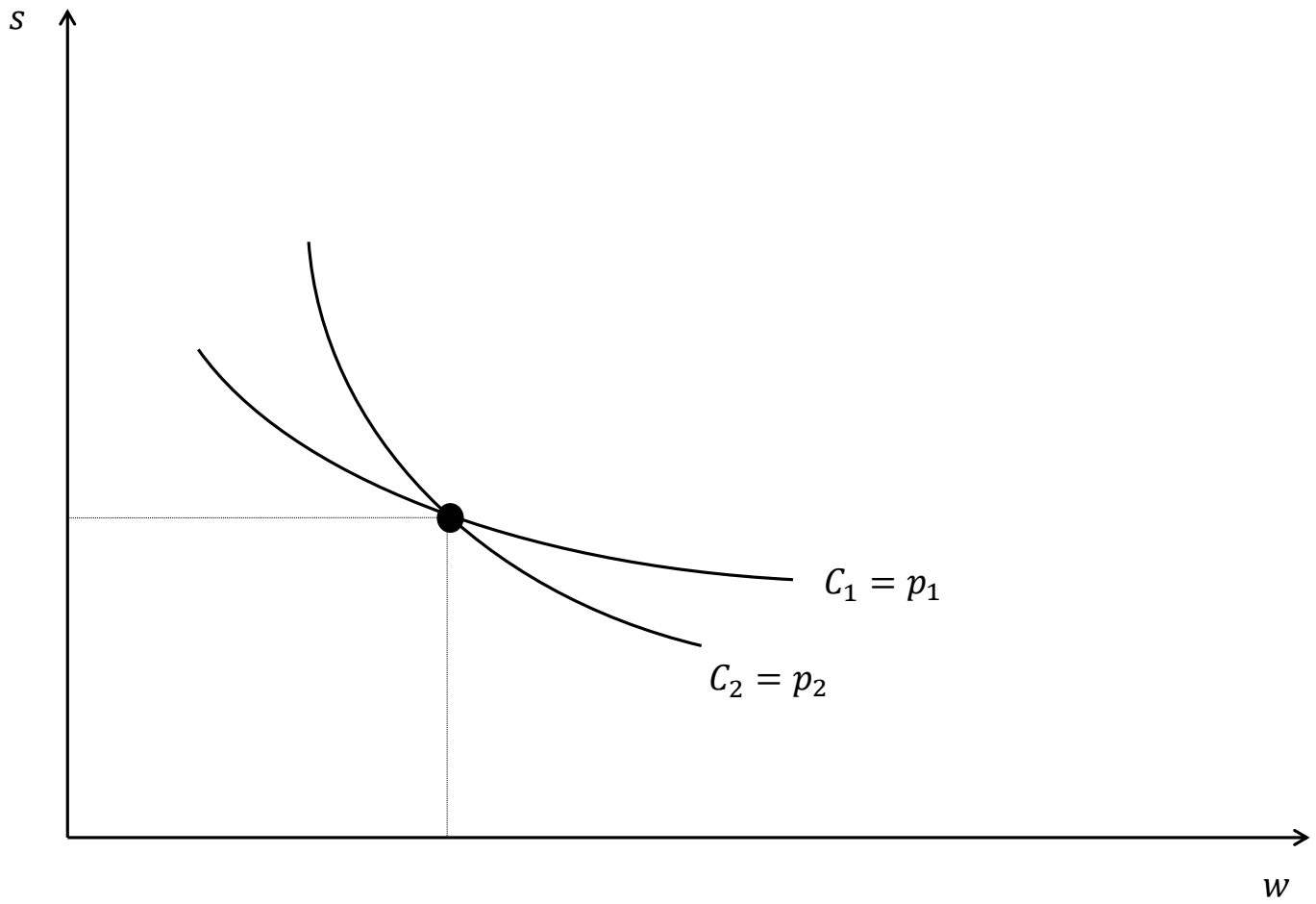
- Unit cost functions:

$$C_1(w,r,s) = r^{\alpha} s^{\beta} w^{1-\alpha-\beta} \overbrace{\alpha^{-\alpha}\beta^{-\beta}(1-\alpha-\beta)^{-(1-\alpha-\beta)}}^{\Delta_1}$$

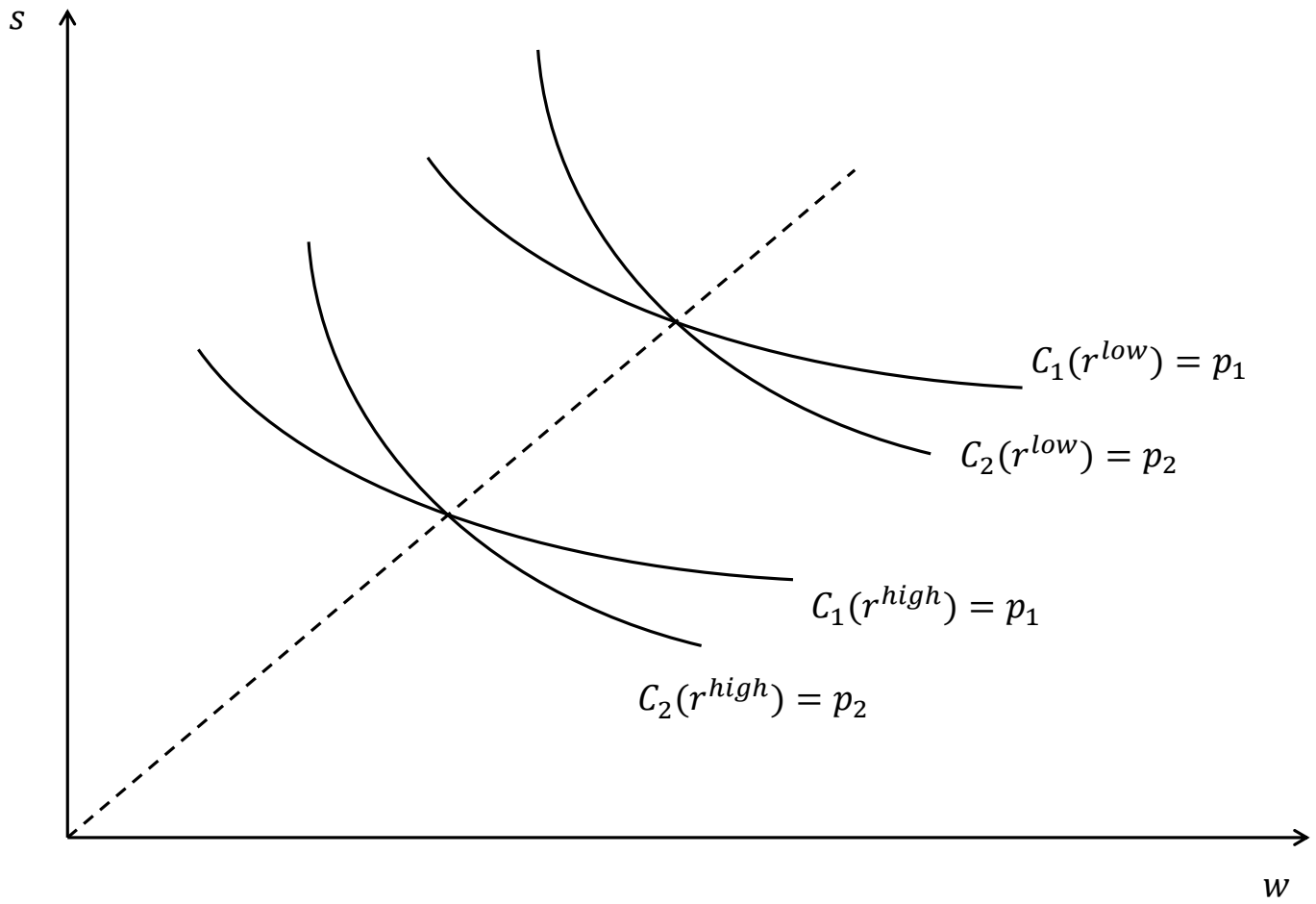
$$C_2(w,r,s) = r^{\alpha} s^{\gamma} w^{1-\alpha-\gamma} \underbrace{\alpha^{-\alpha}\gamma^{-\gamma}(1-\alpha-\gamma)^{-(1-\alpha-\gamma)}}_{\Delta_2}$$

- Free entry (and incomplete specialization) implies firms make zero profits, $C_i = p_i$

Zero Profit Conditions



Zero Profit Conditions



Zero Profit Conditions and relative wages

- Goods prices uniquely determine (relative) wages

$$\frac{w}{s} = \left(\phi \frac{p_2}{p_1}\right)^{\frac{1}{\beta-\gamma}}$$

where $\phi = \frac{\gamma^\gamma}{\beta^\beta} \frac{(1-\alpha-\gamma)^{1-\alpha-\gamma}}{(1-\alpha-\beta)^{1-\alpha-\beta}} = \frac{\Delta_1}{\Delta_2}$

Closing the model - demand side

- Utility of representative consumer:

$$U = X_1^{\theta} X_2^{1-\theta}$$

- Corresponding Price Index:

$$P = \left(\frac{p_1}{\theta}\right)^{\theta} \left(\frac{p_2}{1-\theta}\right)^{(1-\theta)}$$

Autarky Equilibrium

- By equalizing supply and demand, the autarky equilibrium price is given by

$$\left(\frac{p_2}{p_1}\right)_a = \frac{1}{\phi}\left[\lambda\frac{L}{H}\right]^{(\beta-\gamma)}$$

  where $\lambda = \frac{\theta(1-\alpha-\beta)+(1-\theta)(1-\alpha-\gamma)}{\theta\beta+(1-\theta)\gamma}$.
- This in close resemblance of standard Heckscher-Ohlin autarky equilibrium with CD-production and -utility functions.
- Capital scales production

Opening up for Trade

- Analyze move from (goods market) autarky to free trade, while holding the level of capital market openness constant
- On the world market, goods are traded for p_1^* and p_2^*
- Thus, also the price level P^* differs from autarky P

International Investment

- For the decision to invest in a country, the *real* interest rate, r/P, is decisive
- The world market real interest rate is given by r^*/P^*
- Capital market equilibrium may account for costs of investing abroad, i.e. for the home country it holds that:

$$\frac{r}{P} = \kappa \frac{r^*}{P^*}$$

with $\kappa \leq 1$

The real rental as a function of the relative goods price

- The real rental can be expressed as a function of the relative goods price

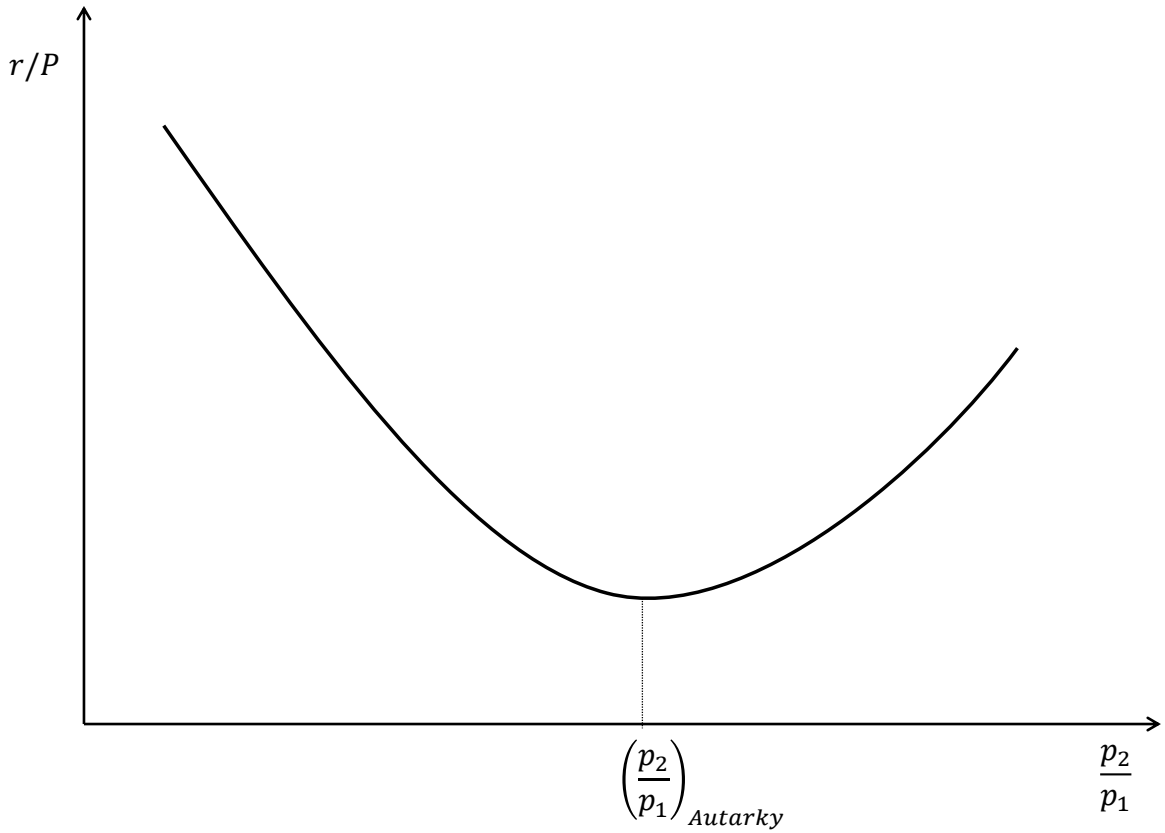
$$\frac{r}{P} = \Theta \left[\left(\frac{p_2}{p_1} \right)^{\frac{\gamma}{(\beta-\gamma)(1-\alpha)}} L + \phi^{\frac{1}{(\gamma-\beta)}} \left(\frac{p_2}{p_1} \right)^{\frac{-(1-\alpha-\gamma)}{(\beta-\gamma)(1-\alpha)}} H \right]^{(1-\alpha)} \left(\frac{p_2}{p_1} \right)^{\theta} K^{\alpha-1}$$

where

$$\Theta = \theta^{\theta}(1-\theta)^{(1-\theta)} \frac{\Delta_1^{\frac{\gamma}{(\beta-\gamma)}}}{\Delta_2^{\frac{\beta}{(\beta-\gamma)}}} \left(\frac{(1-\alpha)}{\alpha} \right)^{(\alpha-1)}$$

- r/P is decreasing in the domestic capital stock K
- If real rental is high, foreign capital will flow in to equalize real rentals

The real rental as a function of the relative goods price



The effect of opening up goods markets

- The real rental is lowest, when goods prices are equal to autarky prices
- Thus, every opening up to trade increases the real rental and hence the incentive of capital to move to the country
- This result doesn't depend on the direction of specialization

$\Rightarrow$ Gains from trade attract capital into the country

General Equilibrium Importance

- But: In two-country setting, result holds for both countries
- Question: Which country's capital returns increase more?

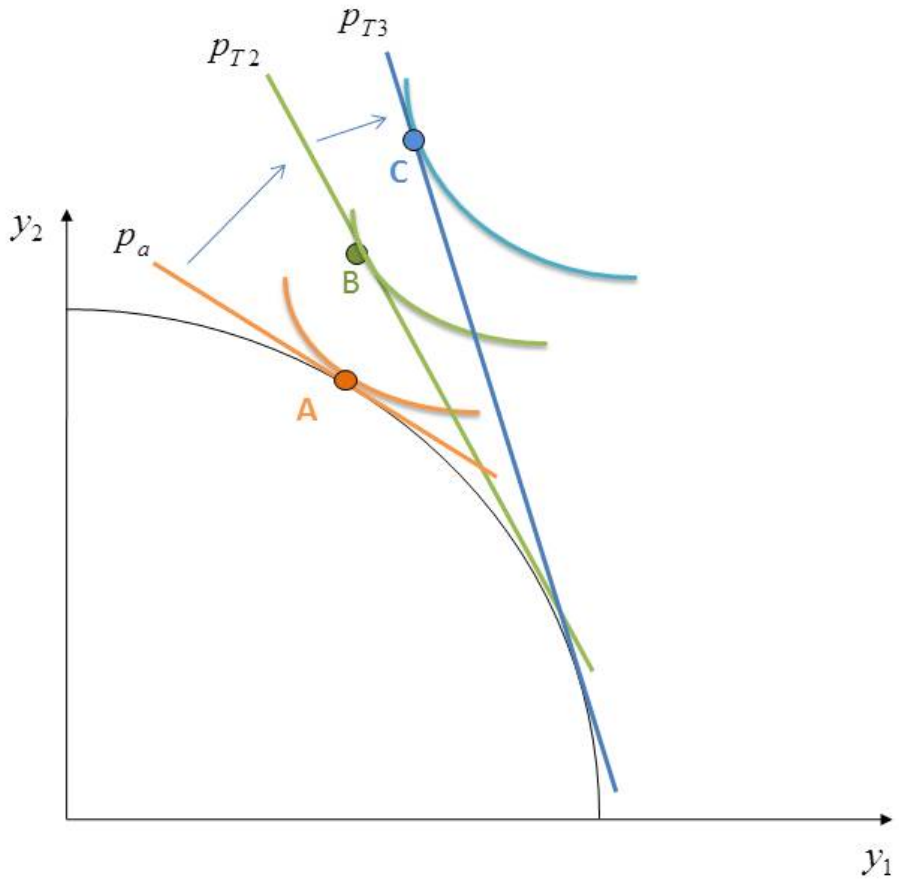
Some Intuition

- r is a monotone function of I by $r = \alpha \frac{I}{K}$ or

$$r = \frac{\alpha}{1-\alpha} \cdot \frac{wL + sH}{K}$$

- Therefore, r/P is also a monotone function of I/P
- Now, by definition, $I/P = U$.
- $\Rightarrow$ Real rental is a monotone function of utility

Utility and prices graphical



World market price

- By equalizing world demand and world supply, we can implicitly derive world market relative goods price:

$$\left(\frac{w}{s}\right)^{-1} = \lambda \left[= \frac{L + L^* \left(\frac{K^*}{K}\right)^{\alpha} \left(\frac{L + \left(\frac{w}{s}\right)^{-1} H}{L^* + \left(\frac{w}{s}\right)^{-1} H^*} \right)^{\alpha}}{H + H^* \left(\frac{K^*}{K}\right)^{\alpha} \left(\frac{L + \left(\frac{w}{s}\right)^{-1} H}{L^* + \left(\frac{w}{s}\right)^{-1} H^*} \right)^{\alpha}} \right]$$

- Not obvious who gains more in general equilibrium

Comparing countries

- The higher the price change, the higher the utility increase, the higher the increase in real rental
- Problem equivalent to 'who gains more from specialization?'

A primer:

- (Economically) smaller countries
- Those with extreme relative endowments
- Countries that have the 'highly demanded' factor in abundance

- Relevant: relative price change, and hence degree of specialization

Approach

- Testable predicition of the model: Specialization in either skill level should lead to capital inflows
- Both are likely to be correlated for other reasons
- We want to know effect of increased (Skill-)HOS-Trade for a given level of capital market openness

- Panel Regression:

$$\begin{aligned} CapInflows_{ct} =& \beta_0 + \beta_1 * HOS_{c;t} + \beta_2 * CapOpen_{c;t}^{dejure} + \beta_3 * InvRisk_{c;t} \\ &+ \alpha_t + \alpha_c + \epsilon_{ct} \end{aligned}$$

- We need a *de jure* measure of capital market openness as control variable

Approach detailed

- Dependent Variable: *Net* equity inflows
- Net FDI
- Net Investment = FDI + Portfolio Equity
- Both divided by GDP to exclude size effects
- Country and year fixed effects to control for trends
- Standard errors clustered on the country level

Data sources and combination

- Capital flow Data: IMF International Financial Statistics
- De jure capital market openness: Chinn-Ito (2006) - measure
- Investment Risk: International Country Risk Guide – only available from 1984
- Trade data: UN / Feenstra (2002) – only available until 2000
- Skill intensities of products: UNCTAD RFI / Shiratori et al. (2010), based on Barro & Lee (2001)
  - Computed from actual trade data and endowments

Skill intensity of exports

We relate countries' exports (and imports) to skill intensities of products on the 4-digit level

Most skill intensive Product classes	$H_{i;2000}$	Least skill intensive Product classes	$H_{i;2000}$
Ores and concentrates of uranium and thorium	11.03811	Oils,animal & vegetable,boiled,oxidized, etc.	2.625086
Mechanical wood pulp	10.79112	Cotton,carded or combed	2.703924
Sawlogs in the rough,whether/not stripped of bark	10.32102	Tea	2.759669
Barley,unmilled	10.24047	Jute & other textile bast fibres,nes,raw/processed	2.792496
Other phenols and phenol-alcohols	10.22291	Copra	2.96619
Cresols,n.e.s,and their salts	10.22291	Carpets of other textile materials	2.97924
Halogenated,sulphonated,etc.derivatives of phenol	10.22291	Carpets of wool or fine animal hair	2.97924
Phenol(hydroxybenzene),chemically pure,& its salts	10.22291	Groundnuts (peanuts),green,whether or not shelled	3.106773
Other phenols and phenol-alcohols	10.22291	Cotton seeds & Cotton seed oil	3.109285
Organo-mercury compounds	10.21946	Sheep and lamb skin leather	3.669646
Seep's or lambs' wool,greasy or fleece-washed	10.16085	Groundnut (peanut) oil	3.711931
Horses, asses, mules and hinnies, live	10.13878	Tin ores and concentrates	3.713806

Measure of Heckscher-Ohlin-Specialization

- As a first step, measure countries' skill specialization in exports – once relative to average worldwide exports ($H1$), once relative to the respective country's imports (H2)

$$H1_{c;t} = \frac{\frac{\sum_i H_{i;t} * EX_{c;i;t}}{\sum_i EX_{c;i;t}}}{\frac{\sum_j \sum_i H_{i;t} * EX_{j;i;t}}{\sum_j \sum_i EX_{j;i;t}}}$$

$$H2_{c;t} = \frac{\frac{\sum_i H_{i;t} * EX_{c;i;t}}{\sum_i EX_{c;i;t}}}{\frac{\sum_i H_{i;t} * IM_{c;i;t}}{\sum_i IM_{c;i;t}}}$$

where $EX_{c;i;t}$ and $M_{c;i;t}$ are the exports and imports of country c in product class i at time t

- Both measures are highly correlated (0.90)

Measure of Heckscher-Ohlin-Specialization cont'd

- We want to test whether specialization in both directions (skilled and unskilled labor) drives net capital inflows
- Hence, we relate measures of skill specialization (H1 & H2) to a specialization pattern

$$HOS1_{c;t} = |ln\left(\frac{H1_{c;t}}{H1_{MED;t}}\right)| \qquad (1)$$
$$HOS2_{c;t} = |ln\left(\frac{H2_{c;t}}{H2_{MED;t}}\right)|$$

where $Hj_{MED;t}$ is the median skill specialization of type j of all countries covered in a certain year

- Absolute value of logs of a fraction: always greater than zero and increasing, the more distant the fraction is from 1
- Higher value of HOS can be interpreted as greater level of specialization in either direction

Results

	(1)	(2)	(3)	(4)
VARIABLES	Net FDI / GDP		Net For. Investment / GDP	
HOS1	0.0197*		0.0349**	
	(0.0100)		(0.0154)	
HOS2		0.0204**		0.0364**
		(0.0100)		(0.0164)
CapOpen	0.00151	0.00141	0.00128	0.00105
	(0.00156)	(0.00158)	(0.00265)	(0.00264)
Inv. Risk	0.000749	0.000751	0.000717	0.000730
	(0.000642)	(0.000642)	(0.000765)	(0.000775)
Constant	0.0133**	0.0134**	0.0125	0.0127
	(0.00559)	(0.00561)	(0.00831)	(0.00830)
Country Fixed Effects	yes	yes	yes	yes
Time Fixed Effects	yes	yes	yes	yes
Observations	1,533	1,532	1,369	1,368
R-squared	0.069	0.070	0.054	0.055
Countries	119	119	118	118

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1

Results by type of Specialization

	High Skill Exporting Countries				Low Skill Exporting Countries			
VARIABLES	(1) Net FDI / GDP	(2) Net FDI / GDP	(3) Net For. Investment / GDP	(4) Net For. Investment / GDP	(5) Net FDI / GDP	(6) Net FDI / GDP	(7) Net For. Investment / GDP	(8) Net For. Investment / GDP
HOS1	0.0849		0.116*		0.0170**		0.0174	
	(0.0513)		(0.0635)		(0.00772)		(0.0117)	
HOS2		0.0913**		0.142**		0.0132*		0.0123
		(0.0401)		(0.0553)		(0.00753)		(0.0112)
CapOpen	-0.000193	-0.000841	0.00281	0.00219	0.00279	0.00246	0.000639	0.000187
	(0.00307)	(0.00292)	(0.00609)	(0.00643)	(0.00175)	(0.00165)	(0.00177)	(0.00172)
Inv. Risk	-0.000325	-0.000727	-0.000171	-0.000455	0.00149*	0.00193**	0.000849	0.00141
	(0.00113)	(0.00105)	(0.00156)	(0.00156)	(0.000750)	(0.000854)	(0.000865)	(0.000982)
Constant	0.0133**	0.0158**	-0.0226	-0.0324***	0.0104	0.0125	0.0174**	0.00818
	(0.00656)	(0.00663)	(0.0152)	(0.0117)	(0.00659)	(0.00900)	(0.00824)	(0.00727)
Country Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
Time Fixed Effects	yes	yes	yes	yes	yes	yes	yes	yes
Observations	791	772	718	697	739	753	648	665
R-squared	0.062	0.066	0.040	0.047	0.134	0.146	0.166	0.178
Countries	78	78	76	77	66	68	64	67

Robust standard errors in parentheses
*** p¡0.01, ** p¡0.05, * p¡0.1

Summary

- Introducing capital as a composite factor into a close-to HO-model yields diametrically different predictions regarding the complementarity of trade and capital flows
- Capital reaps part of the gains from increased efficiency from production for world markets
- More specialization should lead to more capital inflows
- By constructing a measure for HO-Specialization in skill levels, we test and confirm this hypothesis empirically
- Efficiency-enhancing mechanism also present when considering additional effects

Thank you for your attention!

Factor Inputs Production

- Cost minimization of producers yields the following optimal unit input coefficients $a_{iF} \equiv \frac{F_i}{Y_i}$ of the respective factors.
- Relative skill intensities in the two sectors depend only on relative labor costs $\frac{w}{s}$

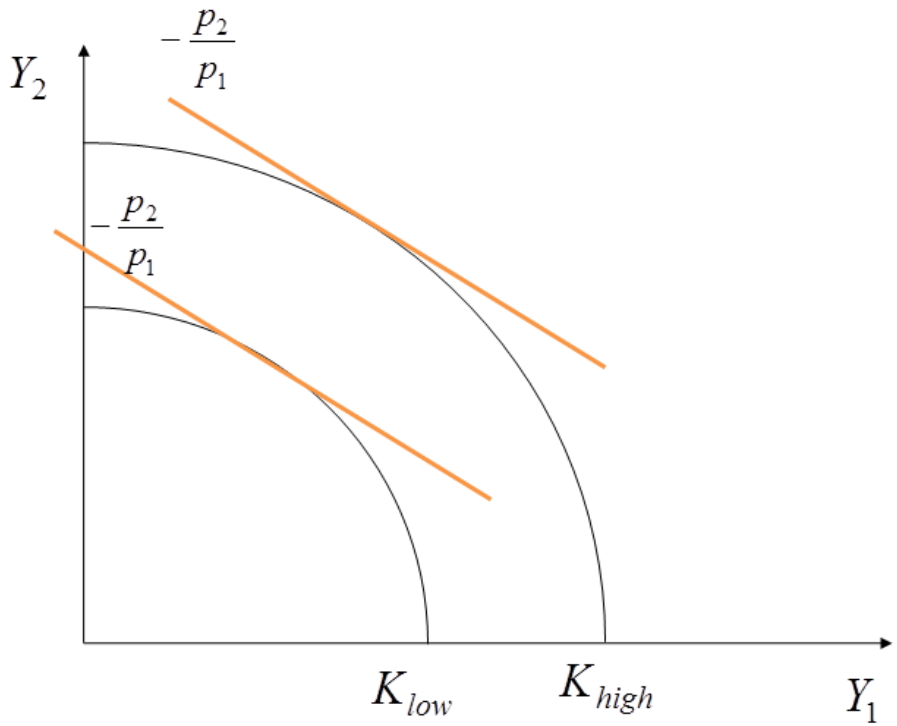
$$\frac{a_{1H}}{a_{1L}} = \frac{w}{s}\left(\frac{\beta}{1-\alpha-\beta}\right)$$

$$\frac{a_{2H}}{a_{2L}} = \frac{w}{s}\left(\frac{\gamma}{1-\alpha-\gamma}\right)$$

- Hence, sector 1 is the skill intensive sector, defined as $\frac{a_{1H}}{a_{1L}} > \frac{a_{2H}}{a_{2L}}$
- $C_i = ra_{iK} + sa_{iH} + wa_{iL}$ yields respective unit cost functions

Solving Production Side

- By full employment conditions for H and L and ZPC, production of the two goods can be solved for as functions of only the relative price



- For given prices p_2/p_1 and a numeraire chosen (p_1), the production side can be solved for r, s, w, Y_1, Y_2.

The Real Rental and Trade Opening

- The first derivative of $\frac{r}{P}$ is given by:

$$\frac{\partial(\frac{r}{P})}{\partial(\frac{p_2}{p_1})} = \Theta K^{\alpha-1}\left[\left(\frac{p_2}{p_1}\right)^{\frac{\gamma}{(\beta-\gamma)(1-\alpha)}} L + \phi^{\frac{1}{(\gamma-\beta)}}\left(\frac{p_2}{p_1}\right)^{\frac{-(1-\alpha-\gamma)}{(\beta-\gamma)(1-\alpha)}} H\right]^{-\alpha}\left(\frac{p_2}{p_1}\right)^{(\beta}$$
$$\left[\frac{\gamma+(\beta-\gamma)\theta}{(\beta-\gamma)}L - \frac{(1-\alpha-\gamma)-(\beta-\gamma)\theta}{(\beta-\gamma)}\phi^{\frac{1}{(\gamma-\beta)}}\left(\frac{p_2}{p_1}\right)^{\frac{1}{(\gamma-\beta)}} H\right]$$

- This is equal to zero, when the last bracket is equal to zero. Setting the bracket equal to zero delivers the autarky relative goods price $\left(\frac{p_2}{p_1}\right)_a = \frac{1}{\phi}\left[\lambda\frac{L}{H}\right]^{(\beta-\gamma)}$. It can be shown that the extremum is a minimum ($f'' > 0$).
- Hence, the real rental has a minimum at the autarky price level

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
$H_{i;t}$	30080	6.500017	1.908917	0.4108673	11.87007
H_i	651	7.828983	1.502626	2.625086	11.03811
$H1$	6156	0.7789046	0.2225288	0.1225655	1.317003
$H2$	6131	0.7822829	0.2573527	0.124897	4.972053
$HOS1$	6156	0.2485256	0.1960654	0	1.626207
$HOS2$	6131	0.265278	0.2104879	0	2.123068
Net FDI / GDP	2986	0.0122775	0.0468844	-0.552422	1.618238
Net Inv. / GDP	2722	0.0119369	0.0496237	-0.552422	1.618238
CapOpen	3890	-0.1992764	1.465446	-1.863972	2.439009
Inv. Risk	2657	6.814042	2.427348	0	12