Industrial Structure and Financial Capital Flows

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Introduction

- "Two Engines of Integration":
  - **commodity trade**
  - **financial capital flows**

This paper: develops a framework that combines factor-proportions trade and financial capital flows

Investigate how their *interplay* determines:
- Sectoral and Aggregate Asset Prices
- Capital flows

A Multi-country, Multi-sector Setup

- Two Countries: Home and Foreign
- Two Commodities: Cotton and Steel
- Two Factors: Capital (K) and Labor (N)
- Labor: immobile internationally
- Capital: mobile internationally
- Adjustment costs break FPE

What changes with multiple sectors?

Consider a permanent labor force increase in Foreign:

- Two forces at work in determining capital flows:
- – Standard: **“convergence effect”**—(Home to Foreign)
- – New: **“composition effect”**—(Foreign to Home)

If composition effect dominates:

- – “Reverse Capital Flows”
- – Investment comovement
- – Asset Price comovement

⇒ With basic ingredients, sharp and surprising results.

In a multi-sector model, 3 cases are encompassed:

- No factor-intensity differences: **convergence force**
- Multiple sectors: **convergence + composition effect**
- Multiple sectors where most labor-intensive sector uses only labor as an input: **composition effect**

Relationship to the Literature

- Hecksher-Ohlin-Mundell (1965) tradition
- Benchmark model: Two-Country stochastic investment model
  - one good: Backus Kehoe and Kydland (1992)
  - two goods: Backus Kehoe and Kydland (1994)

  ⇒ Departure of this paper: factor-proportions trade

- Models with sectors that differ in factor intensities:
  - Ventura (1997), Atkeson and Kehoe (2002), Baudry and Collard (2004)...all assume balanced trade
    ⇒ Departure of this paper: financial capital flows

- Trade and Capital flows: Ju and Wei (2007), Antras and Caballero (2009)

When Do Multi-Sectors Become Essential?

- When shocks alter a country's comparative advantage

- Empirically relevant "shocks":
  - Globalization
  - Labor Force/Productivity
  - Demographic heterogeneity

Main Predictions

- **Current account**
  ▶ deficit in industrialized core surplus in emerging periphery

- **Lucas Puzzle Revisited**
  ▶ South to North flows *despite* low complementary factors in South

- **Demographics and Asset Prices**:
  ▶ Young and fast growing developing countries can emerge as a solution to the "ave wave crisis"

Roadmap

- Model Setup
- Special case: Composition effect in isolation
- General case: Competing Forces
- An application: Lucas Puzzle
- Suggestive Empirics
- Conclusion and future research

Outline

1. A Stochastic Two-Country Multi-Sector Model
2. Case I: The Composition Effect
3. General Case: Numerical Solutions
4. An Application: Lucas Puzzle Revisited
5. Conclusion

Model Ingredients

- **Symmetric Two-country OLG model** with capital accumulation (Abel (Econometrica 2003))
- **Free and costless trade** in goods and financial assets
- **Multiple sectors** that differ in factor intensity
- **Adjustment costs** to pin down capital stock and analyze the price of capital

Production Technologies

- Intermediate Goods Production:

$$Y_{it}^{j} = \left(K_{i,t}^{j}\right)^{\alpha_i} \left(A_t^j N_{it}^{j}\right)^{1-\alpha_i} \tag{1}$$

$$lnA_t^j = \ln A_{t-1}^j + \epsilon_{At}^j$$

$$lnN_t^j = \ln N_{t-1}^j + \epsilon_{Nt}^j$$

- Investment Good

$$I_{it}^{j} = \left[\sum_{k=1}^{m} \gamma_i^{\frac{1}{\theta}} \left(i_{ki,t}^{j}\right)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}$$

where $i_{ki,t}^{j}$: amount of good k used for investment in the i'th sector of country j.

- **Capital accumulation equation** [Abel (2003)]:

$$K^j_{i,t+1} = a\left(I^j_{it}\right)^{\phi}\left(K^j_{it}\right)^{1-\phi}$$

  - $a = 1$, $\phi = 1$: neoclassical growth model with complete depreciation.
  - $\phi = 0$: Lucas fruit-tree model.

▶ Compare with:

$$K^j_{i,t+1} = (1-\delta)K^j_{it} + I^j_{it} - \frac{b}{2}\left(\frac{I^j_{it}}{K^j_{it}} - \delta\right)^2 K^j_{it}$$

  - Equivalent up to second-order if $\phi = \delta$, $b = \frac{1-\phi}{\phi}$

- Price of Capital:

$$q^j_{it} = (\frac{dK^j_{it+1}}{dI^j_{it}})^{-1} = \frac{1}{a\phi}(\frac{I^j_{it}}{K^j_{it}})^{1-\phi}$$

  - Alternatively,

$$q^j_{it} K^j_{i,t+1} = I^j_{it}/\phi$$

- Rate of Return:

$$R_{it} = \frac{\alpha_i p_{it} \frac{Y_{it}}{K_{it}} + \frac{1-\phi}{\phi} \frac{I_{it}}{K_{it}}}{q_{i,t-1}}$$

- Wages:

$$w_t = (1-\alpha_1) p_{1t} \frac{Y_{1t}}{N_{1t}} = (1-\alpha_2) p_{2t} \frac{Y_{2t}}{N_{2t}}$$

  - Determines specialization patterns

Consumers

- **Demographics:**

– Overlapping generations: N_t young, N_{t-1} old.

$$lnN_t^j = lnN_{t-1}^j + \epsilon_{N,t}^j$$

- **Preferences:**

$$u(c_t^j) = \frac{\left(c_t^j\right)^{1-\rho}}{1-\rho}$$

- **Consumption index**:

$$C_t^j = \left[\sum_{i=1}^{2} \gamma_i{}^{\frac{1}{\theta}} \left(c_{it}^j\right)^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}$$

- Objective:

$$\max \quad u(c_t^y) + \mathbb{E}_t u(c_{t+1}^o)$$

- Constraints:
  Young:

$$c_t^{y,h} = w_t^h - \sum_{j=h,f} \sum_{i=1}^{2} q_{it}^j k_{i,t+1}^{h,j}$$

  Old:

$$c_{t+1}^{o,h} = \sum_{j=h,f} \sum_{i=1}^{2} R_{i,t+1}^j q_{it}^j k_{i,t+1}^{h,j}$$

- Price Index

$$P = [\gamma p_1^{1-\theta} + (1-\gamma) p_2^{1-\theta}]^{\frac{1}{1-\theta}} = 1$$

- Price of Intermediate goods:

– Law of one price : international prices p_1 and p_2

$$\frac{p_1}{p_2} = \left(\frac{\gamma_1 Y_2^g}{\gamma_2 Y_1^g} \right)^{\frac{1}{\theta}}$$

Semi-closed form and closed-form solutions rely on :

Assumptions

(i) Unitary elasticity of substitution of intermediate goods ($\theta = 1$)

(ii) The capital-adjustment technology is log-linear

(iii) $u(c) = log(c)$

Equilibrium

Home's Investment: $I_t^h \propto \eta_t Y_t^g$

one sector:
$$\eta_t = \lambda \sum_{k=0}^{\infty} (1-\lambda)^k \mathbb{E}_t \left[\frac{Y_{t+k+1}^h}{Y_{t+k+1}^g} \right]$$

two sectors:
$$\eta_t = \underbrace{[\frac{\alpha_1 \gamma}{\alpha_1 \gamma + \alpha_2 (1-\gamma)} \eta_{1t} + \frac{\alpha_2 (1-\gamma)}{\alpha_1 \gamma + \alpha_2 (1-\gamma)} \eta_{2t}]}_{\text{weighted-average share of global production}}$$

⇒ Investment depends on the composition of production

Outline

Special Case: the Composition Effect

Assumption (iv): $\alpha_1 = 0$

- Commodity trade $\Rightarrow$

$$\begin{aligned} w_t &= w_t^* = p_{1t} \\ \Rightarrow k_{2t} &= k_{2t}^* \qquad\qquad \forall t \end{aligned}$$

  - achieved through **labor reallocation** across sectors

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  - achieved through **labor reallocation** across sectors
- The "**convergence effect**" is effectively **shut down**

How is a marginal unit of savings allocated?

- Rental earned from production, $\alpha_2 p_{2t} k_{2t}^{\alpha_2 - 1}$, is equalized across countries

  $\Rightarrow$ Allocate savings such that marginal **adjustment costs**, ($\propto \frac{I_i}{K_i}$), are **equalized** across countries

Proposition

Home's investment share of world GDP in any period t is determined by its initial capital intensity.

$$\eta_t = \frac{K_{init}}{K^g_{init}}$$

Results (1)

- **Investment comovement**:

$$I_t \propto \eta_{init} Y_t^g$$

- **Current account falls**:

$$NFA_t \equiv q_t^f k_{t+1}^{h,f} \cdot N_t^h - q_t^h k_{t+1}^{f,h} \cdot N_t^f$$
$$CA_t \equiv \Delta NFA_t = S_t^y - q_t^h K_{t+1}^h - (S_{t-1}^y - q_{t-1}^h K_t^h)$$

- **Evolution of Capital Stock**: (labor share: $s_l = 1 - \alpha\gamma$)

$$ln(\tilde{k}_{t+1}^j) = ln\Theta + (1 - \phi s_l) ln(\tilde{k}_t^j) + \phi s_l ln\left(\sum_i \mu_i \eta_{i0}^j\right)$$
$$+\phi s_l \left(ln\tilde{N}_t^g - ln\tilde{N}_t^j\right) - (\epsilon_{N,t+1}^j + \epsilon_{A,t+1}^j)$$

A Graphical Exposition

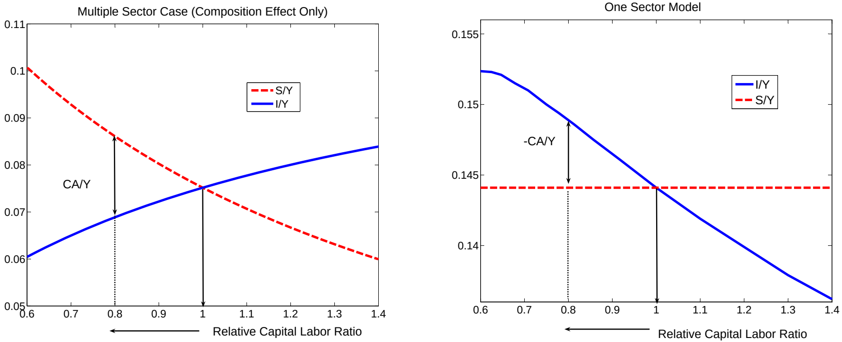


Figure: Impact effect of a change in $\frac{k^j}{k^w}$

Long-Run Behavior

Sector-level effective-capital-labor ratio:

$$\tilde{k}_i^j \propto \left[\left(\frac{1}{\beta} + 1 \right) \left(\frac{1}{s_l} - 1 \right) \right]^{-1/s_l}$$

Country level:

$$\tilde{k} \propto \eta_{init} \left[1 + \left(\frac{\tilde{N}^*}{\tilde{N}} \right) \right]$$

- FPE attained after one period
- Speed of mean reversion depends on ϕ and labor share, s_l

Outline

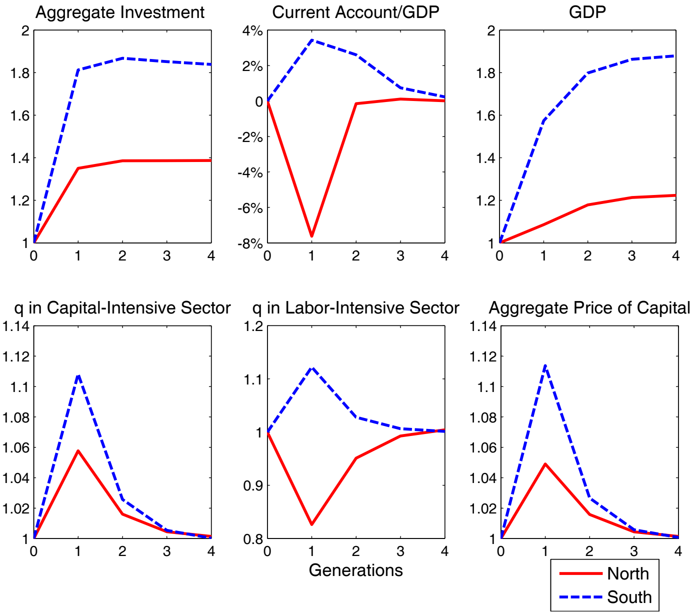
The General Case

- **Special Case** ($\alpha_1 = 0$):
  - FPE occurs after one period (through labor reallocation)
  - Investment and Asset Prices always comove
- **General Case**:
  - $k_{it} \neq k_{it}^*$
  - composition effect and "convergence" effect are competing
  - Quantitative exercise: composition effect dominates
  - Show conditions under which one dominates the other

Benchmark Parameter Values		
Preferences	$\beta = 0.45$	$\gamma = 0.61$
	$\rho = 1$	$\theta = 1$
Technology	$\alpha_1 = 0.52$	$\alpha_2 = 0.11$
	$b = 0.2$	

Table: Parameters for Simulation

- α_i from OECD Annual National Accounts (Cunat and Maffezzoli (2004))
- γ_i: the share of each sector in total OECD value added
- From Data, $s_k = 0.36$, weighted variance=0.04
- b to match output adjustment costs paid over a 20 year period
- Assume initally that capital-labor ratio in North is six times that of South
- Initial technology level chosen to normalize North's income per capital to 1, South's to one-seventh of that of North: $A^n = 2.48$, $A^s = 1.2$.


Aggregate Investment
Current Account/GDP
GDP
q in Capital-Intensive Sector
q in Labor-Intensive Sector
Aggregate Price of Capital
Generations
North
South

Comparison: One sector and Two Sector model

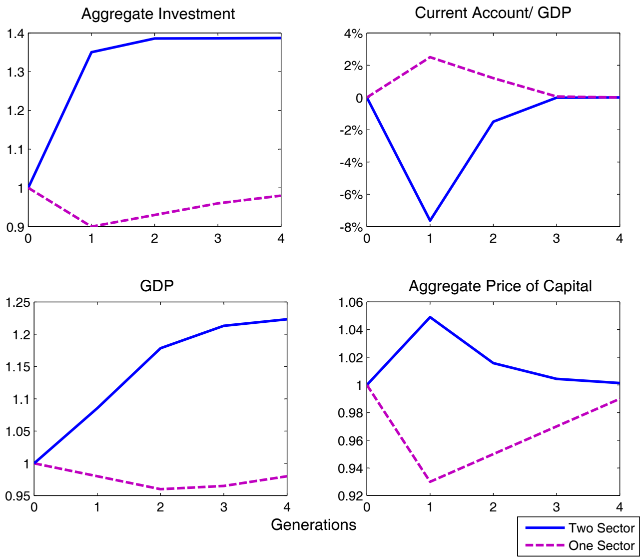


Figure: A Foreign Labor Force Boom in the one and two sector case.

When is the Composition Effect Strong Enough?

Relevant Statistic:

$$\boxed{\text{weighted variance} = \sum_{i=1}^{m} (\alpha_i - s_k)^2 \gamma_i}$$

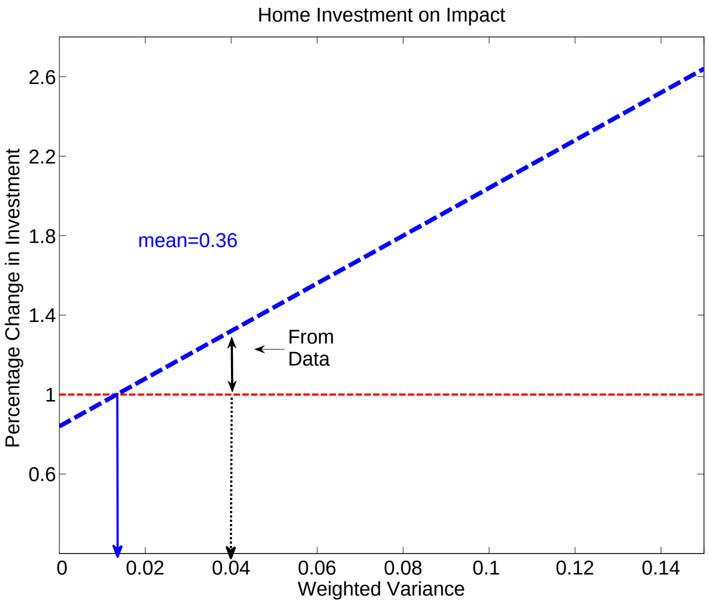
- From the data

$$s_k = \sum_{i=1}^{m} \alpha_i \gamma_i = 0.36$$

$$\text{weighted variance} = 0.04$$

- Experiment: hold constant s_k, vary the weighted variance.

5 Sectors


Home Investment on Impact
Percentage Change in Investment
2.6
2.2
1.8
1.4
1
0.6
mean=0.36
From
Data
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
Weighted Variance

Outline

Application: The Lucas Puzzle Revisited

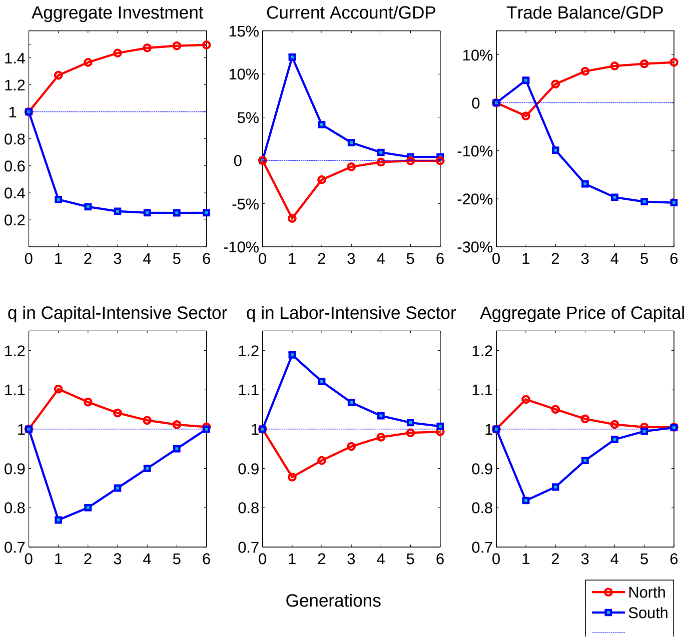
- A main explanation to the "Lucas Puzzle": complementary factors are low in poor countries
- In a multi-sector framework, equalization of returns does not imply little capital flows once countries integrate
- Trade induces capital flows

A Globalization Experiment

- Suppose countries North and South are initially in autarky:

$$\frac{p_s^{aut,n}}{p_c^{aut,n}} < \frac{p_s^{aut,s}}{p_c^{aut,s}}$$

- Trade and financial liberalization:
  - $p_{\text{steel}} \uparrow$ for North , $p_{\text{cotton}} \uparrow$ for South $\Rightarrow$ specialization
  - Composition effect causes investment demand $\uparrow$ in North



Aggregate Investment
Current Account/GDP
Trade Balance/GDP
q in Capital-Intensive Sector
q in Labor-Intensive Sector
Aggregate Price of Capital
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Outline

Concluding Remarks

- Trade + Capital Flows should be jointly analyzed
- Is the canonical international-macro workhorse model missing an important dimension?
- Potential link between global imbalances and specialization

  Back to original Question:

- Younger and fast-growing developing countries may help sustain asset prices in an aging North
- All of this depends on how integrated the world is

An Empirical Exercise

- Is there a link between specialization and the current account?
- Do changes in demographics affect specialization patterns?

A Measure of Specialization, α_c, for each country c:

$$x_{cz} = \beta_c + \alpha_c \cdot k_z + \alpha_{c,2} \cdot s_z + \epsilon_{cz}$$

where x_{cz} is the country c's market share of U.S. imports of good z, k and s are the capital and skill intensity of industry z.

- α_c is a measure of country c's "revealed comparative advantage" in capital-intensive sectors.
- Data:
  - Factor intensity data: NBER manufacturing productivity database.
  - U.S. imports: Feenstra (4-digit SIC).

Table: South's "RCA" in Capital Intensity over Time

	1989	**1993**	**1998**
α_c	-0.38^{***}	-0.65^{***}	-0.60^{***}
	(0.008)	(0.008)	(0.007)
	2002	**2006**	
	-0.66^{***}	$-0.77\ ^{***}$	
	(0.006)	(0.006)	
R^2	0.32	0.32	0.29
	0.25	0.27	

Aggregate South is defined to be countries with per capita GDP less than 50% of that of U.S. at PPP.

An Example			
	α_c	CA	Predicted ΔCA
India	-0.7	1.38	
U.K.	2.9	-1.56	0.72
China	-2.19	2.4	
Australia	1.1	-3.7	1.22

- In 2002, If India had U.K's degree of specialization, the predicted difference in CA amounts to $\frac{0.72}{2.94} = 25\%$ of the difference in actual CA.
- If China had Australia's degree of specialization, the predicted difference in CA amounts to $\frac{1.22}{6.1} = 20\%$ of the difference in actual CA.

	Pooled	Pooled	Between	Within	F-E
	(1)	(2)	(3)	(4)	(5)
α_c	-0.193^{***}	-0.19^{***}	-0.30^{**}	-0.17^{*}	-0.23^{***}
	(0.07)	(0.074)	(0.127)	(0.09)	(0.07)
Openness		1.98^{***}	1.54	-0.42	1.25
		(0.69)	(1.03)	(0.28)	(1.09)
Annual GDP growth		-0.03	2.8	-0.1^{***}	-0.15
		(0.074)	(12.7)	(0.01)	(0.07)
Population growth		-0.67^{**}	-1.3	-0.22	-0.08
		(0.27)	(13.5)	(0.35)	(0.38)
Country Fixed Effect	No	No	-	Yes	Yes
Year Fixed Effect	No	No	-	No	Yes
R^2	0.01	0.05	0.07	0.55	0.20
Number of Observations	450	450	86	450	450

- $CA_{ct} = \alpha + \beta_1 \cdot \alpha_{ct} + \gamma' Z_{ct} + u_{ct}$
- Period: 1989, 1993, 1998, 2002, 2006 for all countries
- Additional Controls: GDP, population growth, GDP per capita
- Pooled (2) uses the average current account over a period as a dependent variable, CA_t.

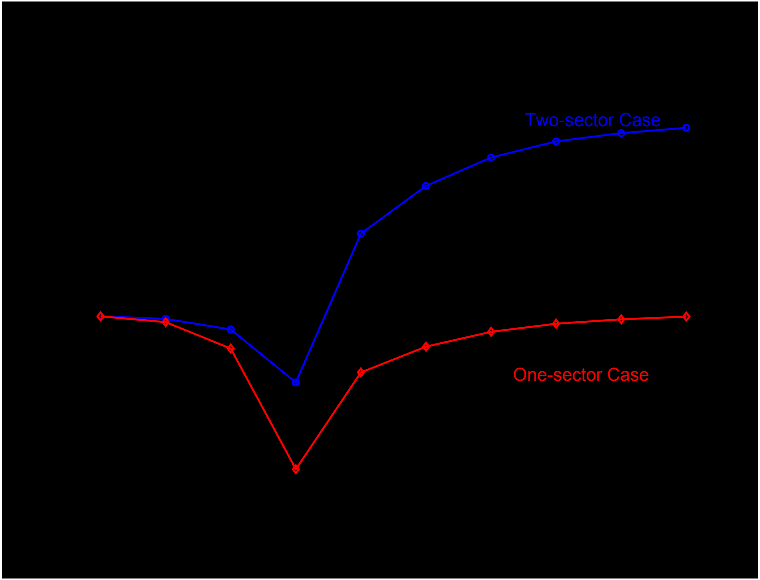

Figure: An anticipated Foreign labor force boom that occurs at $t = 4$.

	Pooled (1)	Pooled (2)	Within (3)	F-E (4)
Share	-0.03^{***}	-0.03^{***}	-0.25^{***}	-0.27^{***}
	(0.005)	(0.02)	(0.01)	(0.02)
Annual GDP growth		-0.05^{***}	0.04^{***}	0.03^{***}
		(.0045)	(0.005)	(0.005)
Initial Openness		0.62^{***}	1.61^{***}	1.85^{***}
		(0.07)	(0.17)	(0.18)
Initial Capital Stock		0	0	0
Country Fixed Effect	No	No	Yes	Yes
Year Fixed Effect	No	No	No	Yes
R^2	0.02	0.04	0.62	0.64
Number of Observations	350	350	350	350

- $\alpha_{ct} = \beta_c + Share_{ct} + \gamma' Z_{ct} + \epsilon_{ct}$
- Share of working age population in total population

Sensitivity to the Adjustment Cost Parameter and Factor Intensities					
Two-Sector	**CA**:	T=1	**q**:	T=1	T=5
(1) Varying Adjustment Costs					
b=0.05		−8.37%		2.96%	0
b= 0.1		−8%		5.04%	0
b= 0.3		−7.04%		9.41%	0.31%
b= 0.5		−6.43%		11.27%	1.12%
(2) Varying Factor Intensity					
$\alpha_2/\alpha_1 = 1$		0.1%		−0.1%	0
$\alpha_2/\alpha_1 = 3$		−4.84%		5.88%	0.1%
$\alpha_2/\alpha_1 = 9$		−5.06%		6.08%	0.47%
(3) Interaction					
High b and high α_2/α_1		−7.57%		16.75%	4.04%
low b and high α_2/α_1		−9.10%		5.45%	0
high b and low α_2/α_1		−2.95%		5.97%	2.85%
(4) Elasticity of Substitution					
$\theta = 0.8$		−5.77%		6.29%	0.1%
$\theta = 4$		−6.31%		6.41%	0.08%
(5) Risk Aversion					
$\rho = 0.8$		−6.33%		6.71%	0.17%
$\rho = 2$		−4.56%		4.4%	0.44%
One-Sector					
b=0.1		0.01%		−0.3%	0
b= 0.3		0.02%		−1%	0
b= 0.5		1.22%		−4%	0

An Illustration of Composition Effects

- $\hat{I}_t = \hat{\eta}_t + \hat{Y}_t^g$

Investment in Home		
	$\alpha = 0.3$	$\alpha_1 = 0.1$, $\alpha_2 = 0.5$
$\hat{\eta}_i$	-11.13%	-12.46%, -1.4%
w.a.$\hat{\eta}$		-3.24%
$\hat{Y}^g$	$+10\%$	$+6.86\%$
$\hat{I}$	-1.13%	$+3.62\%$

Table: Impact Effect of an unexpected 20% labor force boom in Foreign, $\gamma_i = 0.5$.

The Future: Demographic heterogeneity