Capital Deepening and Non-Balanced Economic Growth (2008)

Acemoglu and Guerrieri

Presented by:

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Overview

- Main point of paper is to reconcile Kaldor facts with changing sectoral composition
- Common alternative explanations of changing sectoral composition are demand-based, using Engel's law and non-homothetic preferences
- Acemoglu and Guerrieri use a supply-side approach, after Baumol (1967)
- Different sectors grow at different rates which means that some sectors grow and others shrink

Kaldor Facts

- Kaldor Facts
  - Output per worker grows at a roughly constant rate that does not diminish over time.
  - Capital per worker grows over time.
  - The capital/output ratio is roughly constant.
  - The rate of return to capital is constant.
  - The share of capital and labor in net income are nearly constant.
  - Real wage grows over time.

Kuznet facts

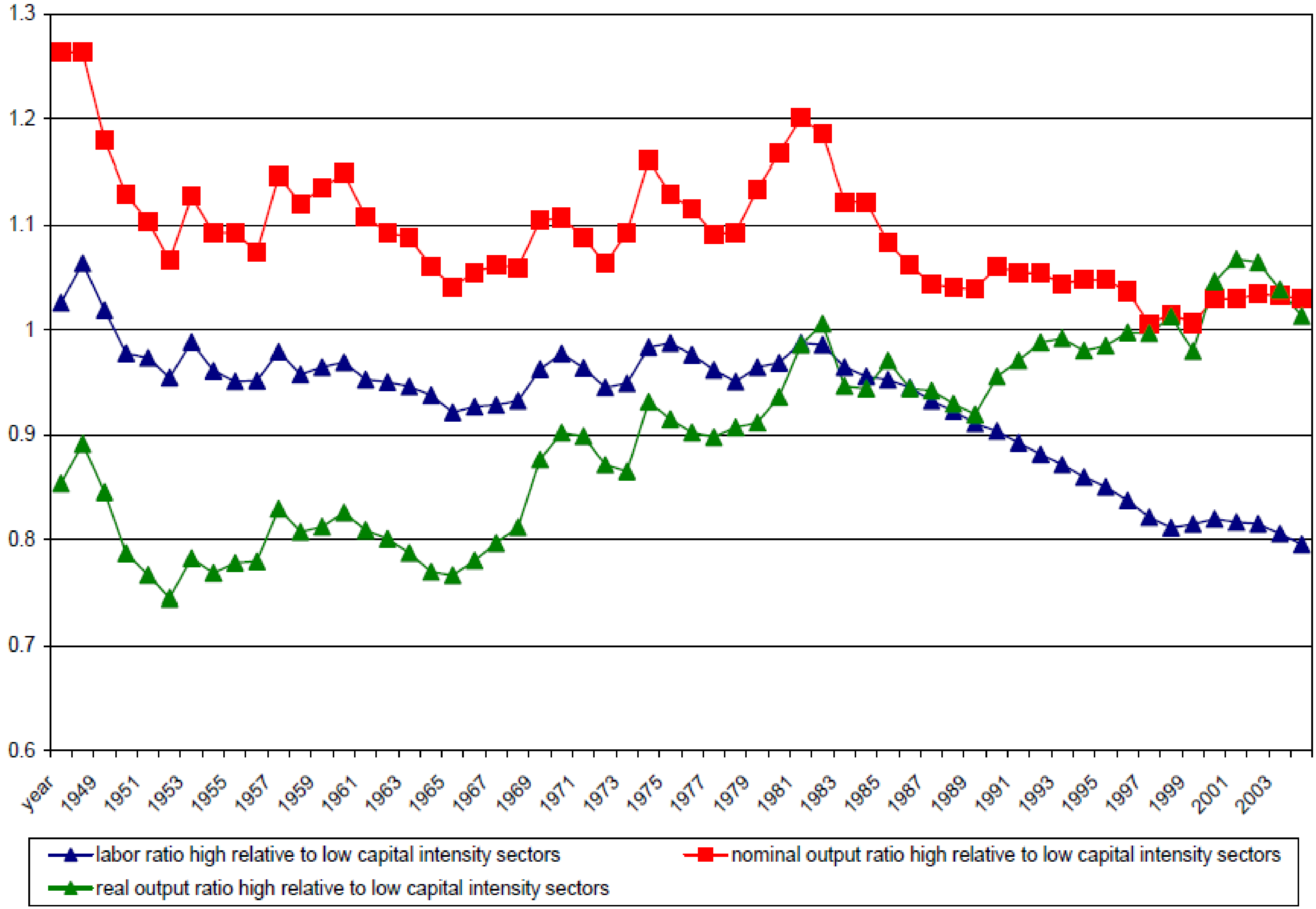
The Kuznets Facts:

	Share of Total Employment	Share of Total Consumption Expenditures
Agriculture	Declines	declines
Manufacturing	stable[7]	stable
Services	Increases	increases

- This paper just deals with capital/labor ratios, and doesn't directly address agriculture/industry/services

Main point of paper

- More capital intensive sector grows faster than the less capital intensive
- Relative prices move against capital-intensive sector
- Nominal output grows slower in capital-intensive sector
- Capital and labor constantly allocated away from rapidly growing sector. (capital intensive)



1.3
1.2
1.1
1
0.9
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0.7
0.6
year
1949
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
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2001
2003
labor ratio high relative to low capital intensity sectors
nominal output ratio high relative to low capital intensity sectors
real output ratio high relative to low capital intensity sectors

Setup (1)

$$\int_0^{\infty} \exp\left(-\left(\rho - n\right)t\right) \frac{\tilde{c}(t)^{1-\theta} - 1}{1-\theta} dt,$$

$$L\left(t\right) = \exp\left(nt\right) L\left(0\right).$$

- Final output produced by combining the intermediate output of both sectors

$$\begin{aligned} Y\left(t\right) &= F\left[Y_1\left(t\right), Y_2\left(t\right)\right] \\ &= \left[\gamma Y_1\left(t\right)^{\frac{\varepsilon-1}{\varepsilon}} + \left(1-\gamma\right) Y_2\left(t\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}, \end{aligned}$$

Setup(2)

$$\dot{K}(t) + \delta K(t) + C(t) \leq Y(t),$$

$$Y_1(t) = M_1(t) L_1(t)^{\alpha_1} K_1(t)^{1-\alpha_1} \text{ and } Y_2(t) = M_2(t) L_2(t)^{\alpha_2} K_2(t)^{1-\alpha_2},$$

- Her $\alpha_1 < \alpha_2$, so sector 2 is more capital intensive

Setup(3)

- Exogeneous Technological progress

$$\frac{\dot{M}_1(t)}{M_1(t)} = m_1 > 0 \text{ and } \frac{\dot{M}_2(t)}{M_2(t)} = m_2 > 0.$$

- Pricemin

$$1 \equiv P(t) = \left[\gamma^{\varepsilon} p_1(t)^{1-\varepsilon} + (1-\gamma)^{\varepsilon} p_2(t)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}$$

Important equations 1

$$\kappa(t) \equiv \frac{K_1(t)}{K(t)} \text{ and } \lambda(t) \equiv \frac{L_1(t)}{L(t)}.$$

- Kappa is the share of capital, lambda is the share of labor in the labor-intensive sector

$$\frac{d \ln \kappa(t)}{d \ln K(t)} = -\frac{d \ln \kappa(t)}{d \ln L(t)} = \frac{(1-\varepsilon)(\alpha_1 - \alpha_2)(1-\kappa(t))}{1 + (1-\varepsilon)(\alpha_1 - \alpha_2)(\kappa(t) - \lambda(t))} > 0 \Leftrightarrow (\alpha_1 - \alpha_2)(1-\varepsilon) > 0$$

- This equation means that if $\varepsilon<1$, then fraction of capital in the capital intensive sector declines as capital accumulates

Important equations (2)

- Equation 18 means that improvement in the technology of a sector of the economy means that the share of capital in that sector falls (for ε<1)

$$\frac{d\ln\kappa(t)}{d\ln M_2(t)} = -\frac{d\ln\kappa(t)}{d\ln M_1(t)} = \frac{(1-\varepsilon)(1-\kappa(t))}{1+(1-\varepsilon)(\alpha_1-\alpha_2)(\kappa(t)-\lambda(t))} > 0 \Leftrightarrow \varepsilon < 1$$

Important equations (3)

- This equation implies that M1 is “capital biased” and M2 is “labor biased”. If ε<1 then the labor-intensive sector's growth means wages fall faster than interest rates, so “capital-biased” (somewhat counterintuitive)

$$\begin{aligned}\frac{d\ln\sigma_K(t)}{d\ln M_2(t)} &= -\frac{d\ln\sigma_K(t)}{d\ln M_1(t)} \\ &= \frac{(\alpha_2-\alpha_1)(1-\varepsilon)(1-\kappa(t))\kappa(t)}{[1-\alpha_1+(\alpha_1-\alpha_2)\kappa(t)][1+(1-\varepsilon)(\alpha_1-\alpha_2)(\kappa(t)-\lambda(t))]} < 0 \\ &\Leftrightarrow (\alpha_1-\alpha_2)(1-\varepsilon) > 0\end{aligned}$$

Defining some terms

- So, s is for sectors and no s means aggregate

$$\frac{\dot{L}_s(t)}{L_s(t)} \equiv n_s(t), \frac{\dot{K}_s(t)}{K_s(t)} \equiv z_s(t), \ \frac{\dot{Y}_s(t)}{Y_s(t)} \equiv g_s(t) \text{ for } s = 1, 2, \text{ and } \frac{\dot{K}(t)}{K(t)} \equiv z(t), \frac{\dot{Y}(t)}{Y(t)} \equiv g(t)$$

- Asymptotics

$$\kappa^* = \lim_{t \to \infty} \kappa(t) \text{ and } \lambda^* = \lim_{t \to \infty} \lambda(t)$$

$$g^* = g_1^* = z^* = z_1^* = n + \frac{m_1}{\alpha_1},$$

$$z_2^* = n - (1-\varepsilon)\, m_2 + [1 + (1-\varepsilon)\,\alpha_2]\, \frac{m_1}{\alpha_1} < g^*$$

$$g_2^* = n + \varepsilon m_2 + (1 - \varepsilon\alpha_2)\, \frac{m_1}{\alpha_1},$$

- First line is balanced asymptotic growth rate of capital and output for sector 1 (labor-intensive)
- Second and fourth line shows that the capital intensive sector's share of capital and labor asymptotically vanishes, though output in KI grows faster than in the LI sector

$$n_1^* = n \text{ and } n_2^* = n - (1-\varepsilon)\left[m_2 - \alpha_2 \frac{m_1}{\alpha_1}\right] < n_1^*$$

Calibration

- NIPA data from 1948-2005
- use industry-level data for nominal value added, real value added index (chain weighted), total employee compensation, total number of employees, and fixed assets
- Classify all sectors into high and low-capital intensity sectors
- Calibrate with □, □, □, □, □, □$_1$, □$_2$, n, m_1 and m_2
- *Initialize* L (0), K (0), $M1$□(0), $M2$□(0) and □ (0).

Calibration of

- Can calibrate *should be less than 1*
- *They find th* $\varepsilon \simeq 0.76$ *which is good*

$$\log\left(\frac{Y_1^N(t)}{Y_2^N(t)}\right) = \log\left(\frac{\gamma}{1-\gamma}\right) + \frac{\varepsilon - 1}{\varepsilon}\log\left(\frac{Y_1(t)}{Y_2(t)}\right)$$

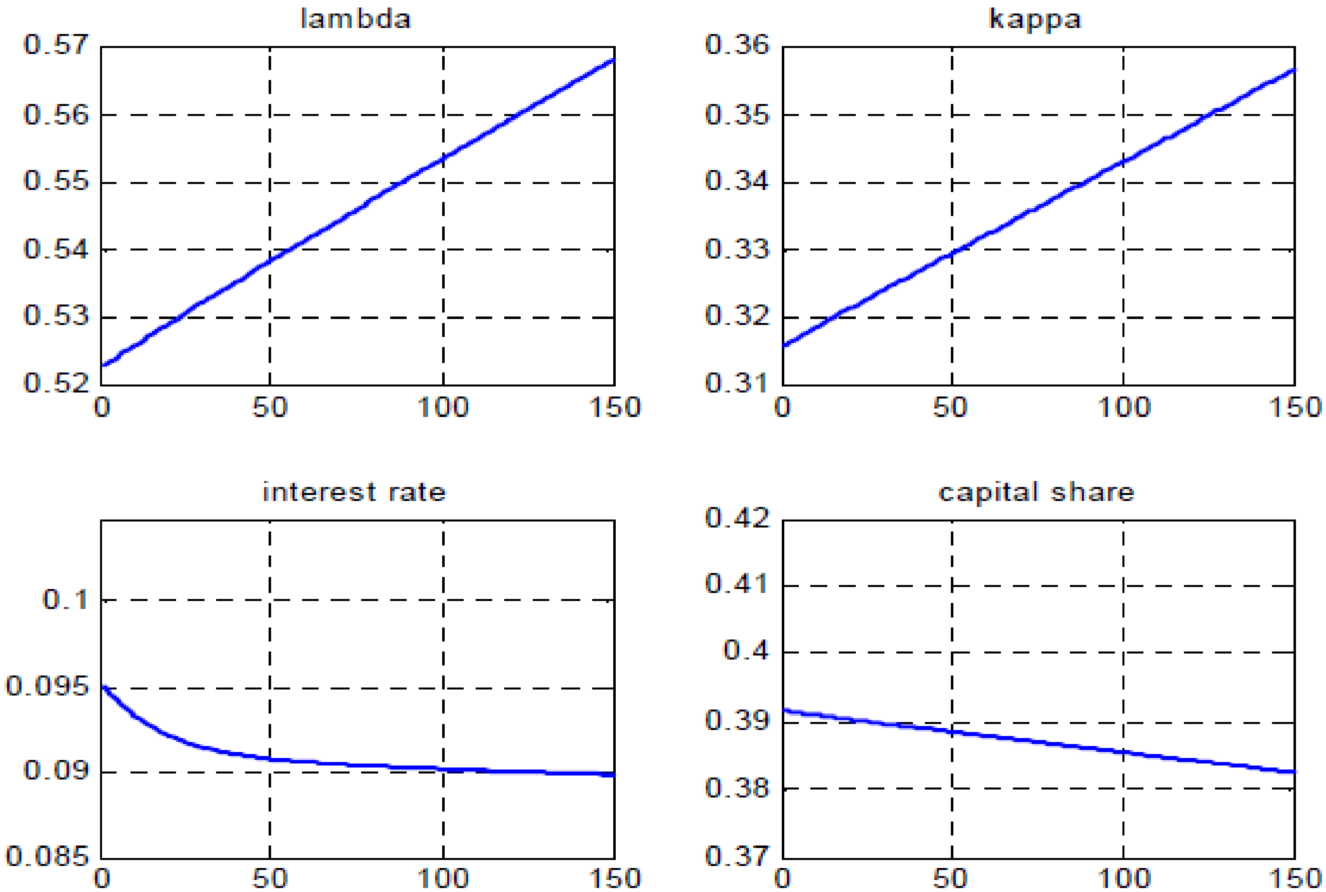
lambda
0.57
0.56
0.55
0.54
0.53
0.52
0
50
100
150
kappa
0.36
0.35
0.34
0.33
0.32
0.31
0
50
100
150
interest rate
0.1
0.095
0.09
0.085
0
50
100
150
capital share
0.42
0.41
0.4
0.39
0.38
0.37
0
50
100
150

Table 2: Data and Model Calibration, 1948-2005 (Robustness I)

	US Data		*Model* $\varepsilon = 0.56,\ m_2 = 0.0108$		*Model* $\varepsilon = 0.66,\ m_2 = 0.0108$		*Model* $\varepsilon = 0.86,\ m_2 = 0.0108$	
	1948	2005	1948	2004	1948	2004	1948	2004
Y_2/Y_1	0.85	1.01	0.85	0.96	0.85	0.98	0.85	1.02
L_2/L_1	1.03	0.80	0.91	0.83	0.91	0.85	0.91	0.89
σ_k	0.40	0.40	0.39	0.39	0.39	0.39	0.39	0.39

Note: US data from NIPA. Classifications and calibration described in the text.

Table 3: Data and Model Calibration, 1948-2005 (Robustness II)

	US Data		*Model* $\varepsilon = 0.76,\ m_2 = 0.0098$		*Model* $\varepsilon = 0.76,\ m_2 = 0.0118$		*Model* $\varepsilon = 0.76,\ m_2 = 0.0128$	
	1948	2005	1948	2004	1948	2004	1948	2004
Y_2/Y_1	0.85	1.01	0.85	0.96	0.85	1.05	0.85	1.09
L_2/L_1	1.03	0.80	0.91	0.88	0.91	0.86	0.91	0.85
σ_k	0.40	0.40	0.39	0.39	0.39	0.39	0.39	0.39

Note: US data from NIPA. Classifications and calibration described in the text.

Conclusion

- Acemoglu and Guerrieri provide a model that works
- Good to join capital deepening with a constant growth path, as these are both stylized facts
- Model is very robust

Thoughts

- Incorporating a demand-side would be nice
- Will share of inputs to capital intensive sector really vanish asymptotically?
- What about agriculture vs. industry vs. services? Will services keep increasing or will manufacturing come back?