

A Note for Greenwood, Hercowitz, and Krusell (1997)

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Abstract

This note is a short summary of [Greenwood, Hercowitz, and Krusell \(1997\)](#). This paper is on Section 5: Stochastic Dynamic Programming of ECON 330 Theory of Income I reading list at University of Chicago.

1. Empirical findings: equipment are less expensive in the post-war US
 - (a) Low frequency: relative price of equipment has declined 3% annually on average and equipment-to-GDP ratio has increased a lot.
 - (b) High frequency: negative correlation between detrended relative price of new equipment and new equipment investment
2. Question: what is the quantitative role of investment-specific technological change as an engine of growth.
3. Model:
 - (a) One-sector model with two investment (equipment and structures) + balanced growth path + representative agent + competitive equilibrium
 - (b) Law of motion for equipment investment

$$k'_e = (1 - \delta)k_e + i_e q \quad (\text{Equipment Investment})$$

- (c) Potential interpretation of q :
 - i. $1/q$ can be thought of the cost producing one unit of new equipment in terms of final output
 - ii. q productivity of new equipment.
- (d) Production

$$y = zF(k_s, k_e, l) = zk_e^{\alpha_e} k_s^{\alpha_s} l^{1-\alpha_e-\alpha_s} \quad (\text{Production Function})$$

- (e) Others are standard:
 - i. Household maximizes life-long discounted utility from consumption and leisure
 - ii. Government levies flat-tax on labor and capital income, rebate the revenue back to household
 - (f) Result: the stock of equipment sector grows at a higher rate than output if the relative price of new equipment in terms of output is declining over time.
4. Quantitative results:

- (a) Investment-specific technological change contributes about 58% of all output growth with neutral change providing the rest.
- 5. Growth accounting with investment-specific technological change
 - (a) Domar-Jorgenson's specification does not allow investment-specific technological change
 - i. Solow $c + i_e = zF(k_e, l)$ versus Domar-Jorgenson $c + i_e q = zF(k_e, l)$
 - ii. Both have law of motion $k'_e = (1 - \delta_e)k_e + i_e q$
 - iii. Substituting $i_e q = x$, one can find Domar-Jorgenson's specification is the same as standard law of motion without technological change on equipment.
 - (b) Reconciling [Hulten \(1992\)](#)
 - i. Quality adjusted output or not
 - ii. This paper is for aggregate economy while [Hulten \(1992\)](#) is for manufacturing
- 6. Extensions having similar results as benchmark model
 - (a) Two-sector models: sector 1 produces consumption and structures and sector 2 produces equipment.
 - (b) Human capital accumulation: two types of labor: unskilled in sector 1 and skilled in sector 2.
 - (c) Investment-specific externality
 - (d) Research and development as investment-specific technology

References

- GREENWOOD, J., Z. HERCOWITZ, AND P. KRUSELL (1997): "Long-run implications of investment-specific technological change," *The American economic review*, 342–362.
- HULTEN, C. R. (1992): "Growth accounting when technical change is embodied in capital," *The American Economic Review*, 964–980.