Neoclassical empirical evidence on employment and production laws as artefact (short version)

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An artefact: definition

- An artefact or artifact is a spurious finding caused by faulty procedures.
- In the fantasy literature, an artifact is a magical tool with great power.

INTRODUCTION -- JUSTIFICATION

- Heterodox economists often claim that neoclassical production functions, substitution effects, etc., make little sense in our world of fixed coefficients and income effects. Claims to that effect also arose from the Cambridge capital controversies in the 1960s and 1970s.
- Neoclassical economists, however, have come up with a large number of empirical studies that seem to "verify" neoclassical theory, in particular when fitting Cobb-Douglas production functions ($Q = e^{\mu t} L^{\alpha} K^{\beta}$).
- The purpose of this lecture is to explain this apparent paradox, and show that the "good fits" of neoclassical number crunchers is no evidence at all.

Conclusions to be reached

- Neoclassical production functions and labour demand functions are not behavioural concepts that can be empirically refuted.
- Neoclassical production functions are statitical artefacts: they claim to measure the output elasticities with respect to capital and labour, whereas in reality they are estimating the profit share and the wage share in income!

Why is it important?

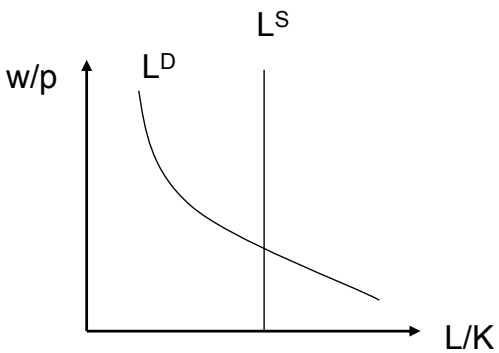
- « *The neoclassical production function is the cornerstone of the [neoclassical growth] theory and is used in virtually all applied aggregate analyses* ».
- (Prescott 1998)

Outline

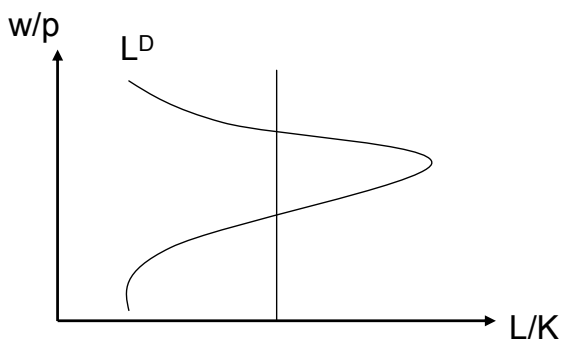
- Some background (capital controversies)
- Some basic notions
- Showing that estimates of production functions cannot « validate » neoclassical theory.
- Showing that neoclassical production functions are statistical artefacts.
- Implications

The Cambridge capital controversies

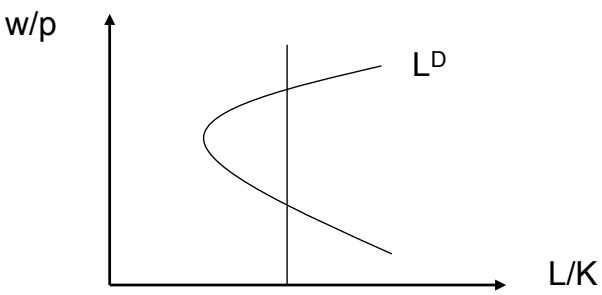
- Occured in the 1960s and 1970s
- Pitted Cambridge (MIT) vs Cambridge (England)
- Both research teams were concerned with profit-maximizing models with fixed technical coefficients (activity analysis), with several techniques or an infinity of techniques.
- The controversies put in jeopardy the concept of scarcity.
- It was admitted by Samuelson (1966) that these models could generate (see Cohen and Harcourt 2003):
  - Reswitching (a technique which was optimal at high interest rates, and then abandoned, becomes optimal again at low interest rates).
  - Capital reversal (or real Wicksell effects: a lower interest rate is associated with a technique that is less mechanized (K/L is lower), even without reswitching.
  - An infinitely small change in the interest rate can generate an enormous change in the K/L ratio (discontinuity, rejection of the discrete postulate).



Neoclassical



Garegnani 1970



Garegnani 1990

The replies of neoclassical authors to the Cambridge-Sraffian arguments

- Neoclassical authors minimize the capital paradoxes, making an analogy with Giffen goods in microeconomics.
- They look for the conditions that would be required to keep production functions as 'well behaved'
- They claim that general equilibrium theory is impervious to the critique.
- They plead ignorance.
- **Empiricism** (It works, therefore it exists).

Recall

- $Q = e^{\mu t} L^{\alpha} K^{\beta}$
- $dQ/dL = \alpha(e^{\mu t} L^{\alpha} K^{\beta}/L) = \alpha(Q/L)$
- With the standard neoclassical conditions (constant returns to scale, perfect competition), the real wage is such that: $w/p = dQ/dL$
- Thus the share of wages in national income is:
- $wL/pQ = (w/p)(L/Q) = \{\alpha(Q/L)\}\{L/Q\} = \alpha$
- And the share of profits in national income is β
- Thus, when estimates of the Cobb-Douglas production function yield coefficients that closely approximate the share of wages and profits, neoclassical economists marvel at the fact that the economy behaves as if it were perfectly competitive, although we know that there exist oligopolies, market imperfections, and so on.

It works, but why?

- « *The estimated elasticities that seem to confirm the central prediction of the theory of labor demand are not entirely an artefact produced by aggregating data. … The Cobb-Douglas function is not a very severe departure from reality in describing production relations*» (Hamermesh 1986).
- Cobb-Douglas production functions are mathematically very close from derivations of the national accounts, which are an identity.

Several authors in the past have rejected the aggregate Cobb-Douglas functions (or other similar CES or translog functions), because they simply reproduce the identities of the national accounts:

- Phelps-Brown 1957
- Shaikh 1974, 1980, 2005
- Herbert Simon 1979
- Samuelson 1979
- McCombie and Dixon 1991
- McCombie 1987, 1998, 2000-1, 2001
- Felipe and McCombie 2001, 2002, 2005, 2006
- Sylos Labini 1995
- (Lavoie 1987, 1992, 2000)
- Fisher 1971(in his work on aggregation)

Why is this so?

- Production functions, when they are correctly estimated, only reproduce the relationships of the national accounts.
- If the wage share is approximately constant, and if technical progress is adequately estimated, one will always discover that a Cobb-Douglas production function provides a good fit.
- If the wage share is not constant, then CES or translog functions will yield better fits. But these production functions are subject to the very same criticisms as the Cobb-Douglas function (Dixon and McCombie 1991).
- If technical progress is misrepresented (for instance through a linear function in time, rather than by a non-linear one), the elasticity estimates will not equal the profit and wage shares, and the elasticities may even turn out to be negative.

Cobb-Douglas vs national accounts

- **The Cobb-Douglas function:**
- With constant returns to scale: $\alpha+\beta=1$
- With factors of production paid according to their marginal productivity ($w/p = dQ/dL$)
- With output per head and capital per head, $y = Q/L$ and $k = M/L$, and calling β (beta) the capital output elasticity, the Cobb-Douglas function yields:
- $\log y = \mu t + \beta \log k$
- Or in growth terms, taking the log difference, $\Delta\log$:

  $y' = \mu + \beta k'$

- **The national accounts:**
- Taking the log derivative of the national accounts per unit of labour yields essentially the same result:
- $y' = \tau + \pi k'$ with $\tau = \alpha(w/p)' + \pi R'$
- Or else in logs:

  $\log y = \tau t + \pi \log k$
- With π the profit share, α the wage share, and R the profit rate.
- Thus, one is not surprised to find out that the best econometric estimates of aggregate production functions, as claimed by Jorgenson (1974), confirm that $\alpha+\beta=1$.

But Cobb-Douglas production functions sometimes seem to be « falsified »

- Sometimes the Cobb-Douglas function yields non-sensical results, and hence is not « verified », as pointed out by Lucas, Romer, and Shaikh, as shown in the following Table.

Table 1: Cobb-Douglas production functions fitted to actual and simulated aggregate data (OLS)
With constant time trend: log y = cste + μt + βlog k

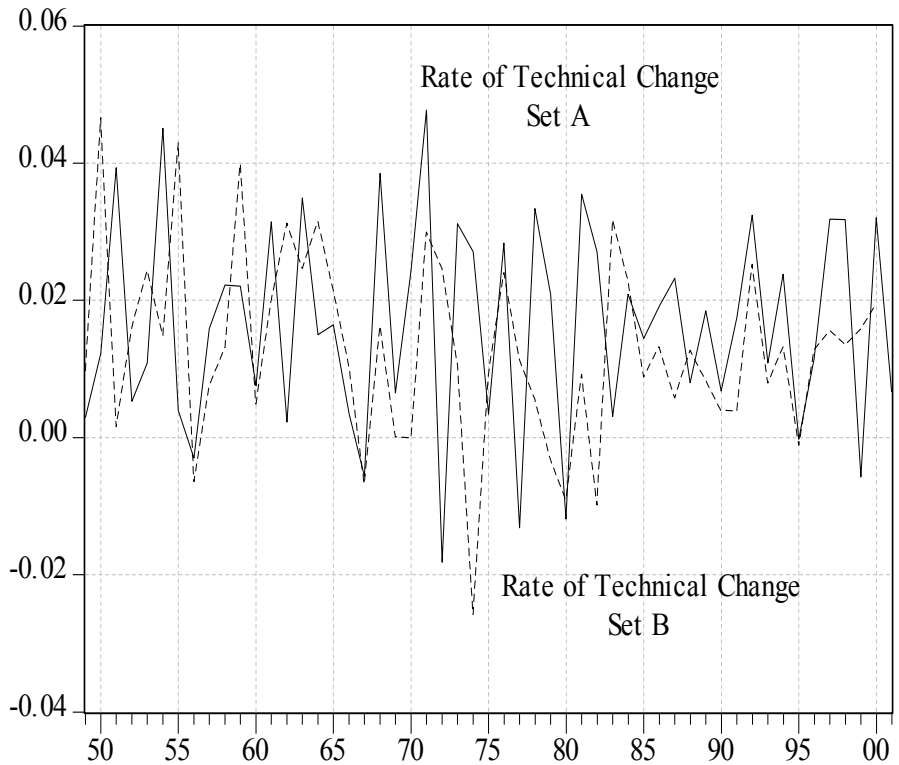
Dependent Variable	**$\ln(y_t)$**		**$\Delta\ln(y_t)$ en taux de croissance**	
	Data A Goodwin	Data B USA	Data A	Data B
Constant	-3.442* (-9.768)	-2.109* (-4.561)	0.0205* (6.871)	0.015* (6.340)
Time	0.020* (9.705)	0.009* (4.488)		
$\ln(k_t)$	0.022 (0.219)	0.395* (2.929)		
$\Delta\ln(k_t)$			-.0029 (-0.280)	0.063 (0.636)
Adj. R^2	0.999	0.977	-0.018	-0.012
D.W.	2.036	0.185	2.974	1.930
Implied Wage Share [Actual Wage Share]	0.978 [0.840]	0.605 [0.810]	1.0029 [0.840]	0.937 [0.810]
Implied Profit Share β [Actual Profit Share π]	0.022 [0.160]	0.395 [0.190]	-.0029 [0.160]	0.063 [0.190]

Source: Anwar Shaikh, *Eastern Economic Journal* (2005)

Technical progress is the problem

- The trick is avoiding to impose a linear trend to technical progress. Rather one must introduce a non-linear trend (some sine function, or a Fournier series), because technical progress is highly variable.

Figure 7: Rates of Technical Change



Source: Shaikh 2005

Tricks providing good estimates

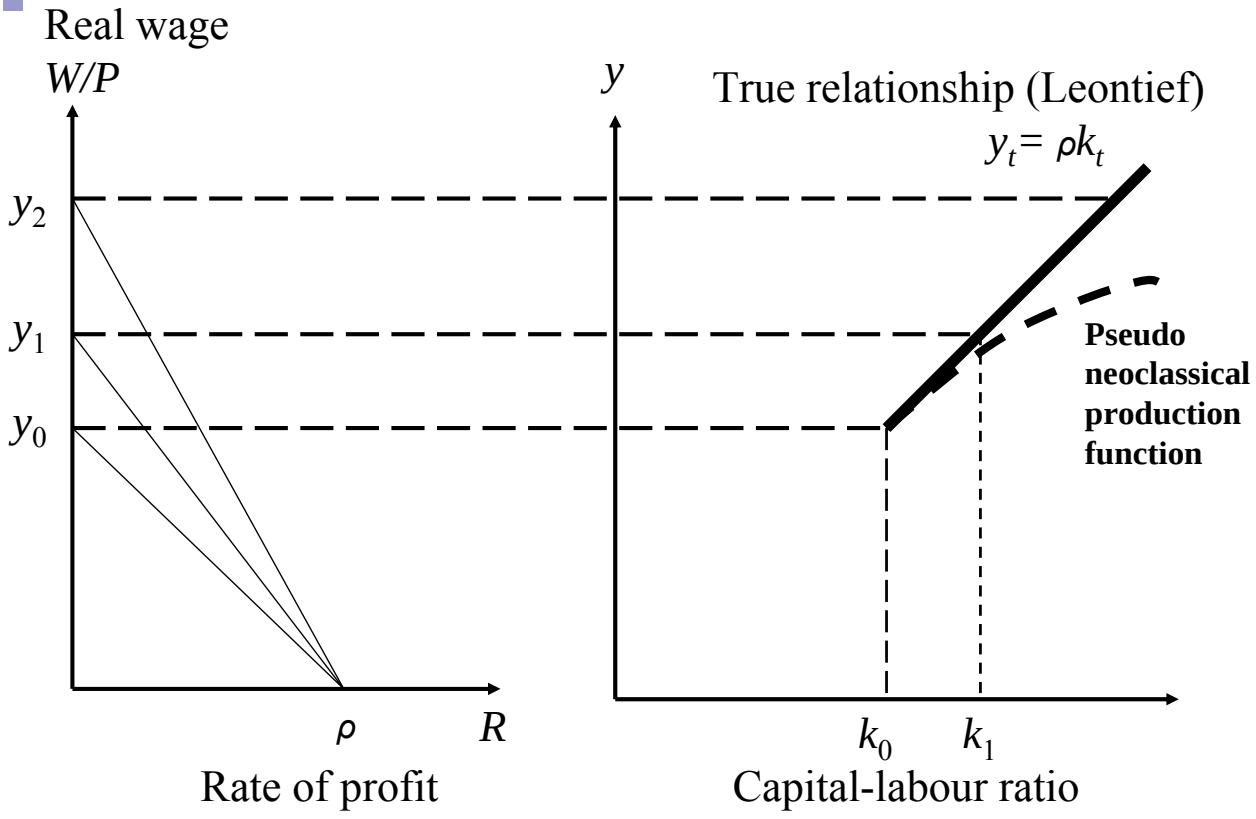
- Solow (1957) in his equation, $y' = \mu + \beta k'$, creates a technical progress variable which is exactly equal to: $\mu = \alpha(w/p)' + \pi R'$, which he derived straightforwardly from the national accounts. In other words, he tested the national accounts identity, while claiming he had corroborated the neoclassical theory of income distribution, and got the Nobel Prize for this!
- Indeed, nowadays, neoclassical authors that still « test » the Cobb-Douglas production function adjust the data by making corrections to the capital stock, deflating the capital index by taking into account the rate of capacity utilization, which is tightly linked to the rate of technical progress, thus obtaining a good « fit » with their regressions.

An « ad absurdo » proof

- Shaikh (2005) shows that:
- Variables generated by a Goodwin-cycle model,
- with a Leontief input-output technology (fixed technical coefficients)
- and constant markup pricing,
- so that neither marginal productivity nor marginal cost pricing exist,
- will still yield econometric estimates that seem to support the existence of a neoclassical production function with factors of production being paid at productivity, and with elasticities equal to the profit and wage shares, as neoclassical theory of perfect competition would have it,
- provided technical progress is specified appropriately.

Table 2: Constant returns Cobb-Douglas functions with **variable** time trends for technical change (OLS) $\log y = \text{cste} + \log A_t + \beta \log k$

Dependent Variable	**$\ln(y_t)$**		**Growth terms**	**$\Delta\ln(y_t)$**
	Data A Goodwin	Data B USA	Data A Goodwin	Data B USA
Constant	-2.932* (-245.72)	-2.825* (-550.96)	-0.000158* (-2.093)	.0000638* (1.198)
$\ln(A_t)$	1.021* (244.31)	1.007* (544.43)		
$\ln(k_t)$	0.156* (45.321)	0.201* (137.045)		
$\Delta\ln(A_t)$			1.027* (392.366)	1.012* (421.009)
$\Delta\ln(k_t)$			0.158* (81.209)	0.193* (114.295)
Adj. R^2	0.9999	0.9999	0.9997	0.9997
D.W.	0.311	0.286	1.834	1.515
Implied Wage Share [Actual Wage Share]	0.844 [0.840]	0.799 [0.810]	0.842 [0.840]	0.807 [0.810]
Implied Profit Share β [Actual Profit Share π]	**0.156 [0.160]**	**0.201 [0.190]**	**0.158 [0.160]**	**0.193 [0.190]**



Source: Shaikh, 1990

But here are some even more compelling « reductio ad absurdum » arguments against the neoclassical production function …

- McCombie (2001) takes two firms *i* each producing in line with a Cobb-Douglas function
- $Q_{it} = A_0 L^{\alpha}_{it} M^{1-\alpha}_{it}$
- With $\alpha = 0.25$ (labour output elasticity).
- Inputs and outputs are identical and can be measured in volumes (**quantities**): there is no aggregation problem (the 1971 Fisher problem is avoided).
- If *L* and *M* grow through time, with no technical progress, with some random fluctuations, the econometric regression will yield an α coefficient close to 0.25 as expected.
- In this case, the estimate is based on **physical data**, and there is no problem.

However ….

- Start again with the same two firms, without technical progress, and try to estimate an aggregate production function using deflated monetary values, as must be done in macroeconomics and often in microeconomics.
- To do so, assume, by construction, that firms impose a markup equal to 1.33 ($\theta = 0.33$) with $P = (1+\theta)WL/Q$, which implies that the wage share is 75% (1/1.33).
- In this case the regression will yield an estimate of the α coefficient that turns out to be 0.75.

Elasticity estimates are in fact estimates of factor shares

- Thus, we started with production functions and physical data according to which the labour output elasticity is 0.25. Yet, the estimated aggregate production function (in deflated monetary terms) tells us that this elasticity is 0.75.
- In other words, estimates of aggregate production functions (both at the industry and at the macro levels) measure wage shares and profit shares, not the elasticities of factors of production.
- These aggregate production functions are useless to provide any information about the kind of technology in use or about elasticities.

A recap

- The studies of Shaikh and those of McCombie and Felipe show that the econometric estimates of neoclassical production functions based on deflated monetary values, as is the case at the macro and industry levels when direct physical data is not used, yield pure artefacts (purely imaginary results). This affects:
  - Labour demand functions and NAIRU measures;
  - Measures of multifactor productivity (Solow residuals, technical progress);
  - Estimates of endogenous growth, theories of economic development;
  - Theories of income distribution;
  - Measures of output elasticities with respect to labour and capital;
  - Measures of potential output;
  - Theories of Real business cycles.

Instrumentalism

- Virtually, there is nothing left of applied neoclassical macroeconomics that relies on production functions.
- Instrumentalism is the philosophy of science that claims that assumptions need not be realistic, as long as they help making predictions. Instrumentalism is endorsed by the Chicago school, Milton Friedman (1953), and many neoclassical economists (often without realizing it). The VAR methodology used in time-series econometrics is another example of instrumentalism.
- Neoclassical economists are pushing instrumentalism to the hilt: what counts is their ability to make predictions (based on estimates of elasticities), even if these predictions are meaningless (the estimates do not measure elasticities, but instead measure something else – profit shares and wage shares)!

Main References

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