

A Kaldorian Theory of Economic Growth: The importance of the Open Economy

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Nicholas Kaldor 1908-1986



Some Background



Nicolas Kaldor (1908-1986):

- immediate dissatisfaction with the Solow model's ability to explain cross-economy growth disparities

 - to explain disparities need to:
 - > endogenise technological progress: The Verdoorn law and the importance of dynamic increasing returns to scale. (Technical Progress Function)
 - > give *demand* a central role (even in the long-run)
- Most important component of demand is the growth of exports

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The Kaldorian Model

The structure of the model:

Cumulative causation and the Verdoorn law (See Myrdal, 1957)

(a) Faster growth of output \Rightarrow faster growth of productivity \Rightarrow increasing price and non-price competitiveness \Rightarrow faster growth of output.

Balance-of-payments constrained growth model

(b) Faster growth of productivity \Rightarrow faster growth of exports \Rightarrow faster growth of output (Harrod foreign trade multiplier) \Rightarrow ...

Faster growth of domestic demand encounters the problem of the balance of payments

Purpose of the Lecture

1. Discuss Kaldor's views on the applied aspects of economic growth.
2. See how this forms the heart of the cumulative causation model of economic growth.
3. Show how growth cannot be understood without incorporating the open economy.



Introduction

The neoclassical (Solow and endogenous) approach to economic growth.

- Supply orientated *and a closed economy*
- Convergence clubs but difficulty in explaining divergence
- One-sector model – no emphasis on any particular sector e.g. exports or manufacturing.
- Kaldor – inductive approach. His three laws.



Manufacturing the key to growth?

Kaldor's Three Laws of Economic Growth (Inductive Approach)

- (i) Close relationship between manufacturing and GDP growth (or non-manufacturing growth). Does it still hold with deindustrialisation?
- (ii) Strong relationship between the growth of industrial productivity and industrial output (*Verdoorn's law*) Increasing returns in other sectors (e.g. IT)
- (iii) Close relationship between aggregate productivity growth and (a) the growth of manufacturing and (b) inversely with the growth non-manufacturing employment (consequence of (i) and (ii))



Kaldor's First Law

The linear specification of Kaldor's first law is:

$$g_{GDP} = a_1 + b_1 g_m \quad (1)$$

What is the importance of this?

Manufacturing subject to increasing returns to scale.

Manufactures are the largest component of exports \Rightarrow export led growth.

Many services depend on manufactured goods.



Africa (45 countries: 1980-1996): cross-section

$$g_{GDP} = 0.011 + 0.472 g_m$$

(2.8) (2.0)

$$r^2 = 0.535$$

- **China (28 regions)**

$$g_{GDP} = 1.79 + 0.56 g_m$$

(4.8) (19.9)

$$r^2 = 0.670$$

- **Latin America (7countries: 1985-2001): Panel Data, Random Effects**

$$g_{GDP} = 2.028 + 0.547 g_m$$

(4.7) (15.6)

$$r^2 = 0.666$$

Kaldor's Second Law (or Verdoorn's Law)



There are two main ways of testing Kaldor's second law, or Verdoorn's Law. A faster growth of output *causes* a faster growth of productivity.

The first is:

$$p_m = a_1 + b_1 q_m \quad \text{where } b_1 \text{ is the Verdoorn coefficient}$$

Since p_m is constructed from the difference between g_m and employment growth, the estimate of b_1 may be biased. ($p_m = q_m - e_m$)

The second method is therefore:

$$e_m = a_2 + b_2 q_m \quad , \text{ where the Verdoorn coefficient is } (1-b_2)$$



The Key is the Verdoorn law

$$p_m = 1.00 + 0.5q_m \quad (1) \quad \text{or}$$

$$e_m = -1.00 + (1-0.5)q_m \quad (2)$$

Equation (2) avoids spurious correlation.

e_m = *employment manufacturing growth*

p_m = *industrial productivity growth*

q_m = *output manufacturing growth (earlier written as g_m)*

Evidence of substantial increasing returns. Why?



The Verdoorn Law

A one percentage point increase in output increases productivity growth by half-a-percentage point (through increasing returns to scale) and employment growth by half-a-percentage point.

Thus productivity growth is determined by output growth.

“The greatest improvement in the productive powers of labour, and the greater part of the skill, dexterity, and judgment with which it is anywhere directed, or applied, seem to have been the effects of the division of labour.” Adam Smith, *The Wealth of Nations*, 1776



Increasing Returns in Economic Theory

Until recently peripheral to mainstream economics, with some exceptions such as:

1. Alexander Hamilton: First US Secretary to the Treasury, Tariffs (1794)
2. Fredrick List (1841)
3. Marshall *Principles of Economics*, Appendix H
Never central to his work, external economies, decline of entrepreneurial ability
4. Allyn Young, “Increasing Returns and Economic Progress”, *Economic Journal* 1928.
5. Joan Robinson/ Edward Chamberlin:
Imperfect/monopolistic competition



Why Was it Peripheral?

“Other aspects of perfectly competitive theory, such as the theory of demand, optimality theorems, and the relation between competitive equilibrium and bargaining outcomes, also have well-structured histories in which earlier work influenced the later work which subsumed it” (Arrow, 2000, p.172)

The paradigm was logically self consistent and, at the theoretical level, was replete with Kuhnian “puzzles” to solve.



Issues with the Verdoorn law

- What is the exogenous variable: employment or output growth?
- Is the direction of causation $p_m \Rightarrow q_m$ (through relative prices) or $q_m \Rightarrow p_m$ (through increasing returns to scale)?
- What about the contribution of capital?



Advantages of Regional Data

1. Common institutions
2. Common technology
3. High mobility of labour and capital
4. Common macroeconomic policy



An Example

Some new estimates the Verdoorn Law for EU regional manufacturing, 1986-2002 and the policy implications

Alvaro Angeriz; John McCombie and Mark Roberts

Introduction



- Understanding of whether or not localised increasing returns exist in EU crucial:
 - Impact of integration upon the EU’s economic geography
 - Important from a theoretical perspective
- Theoretical importance:
 - Traditional models based upon CRS \Rightarrow convergence of output per head, & regional production structures
 - Modern developments (“new economics” and NEG) \Rightarrow potentially intensified forces for divergence



- Present new estimates of returns to scale for EU regional manufacturing for the NUTS1 regions
- **Sample-period: 1986-2002**
- **“Verdoorn law” framework** \Rightarrow realisation of localised increasing returns partly conditional upon local demand growth
- Spatial econometric estimation (“spatial hybrid” model)



Reduced form equation

$$tfp_j = \frac{\beta\lambda'}{\nu} + \left(\frac{\nu-1}{\nu}\right)q_j + \zeta_1 \ln D_j + \theta_1 \ln TFP_0 + \varepsilon_j$$

Verdoorn
effect

Agglomeration economies
from density

tech. diffusion

ν = composite measure of returns to scale (includes localized knowledge spillovers)

Spatial Econometric Framework



- What is spatial autocorrelation
- Try to separate out 2 different types of spatial autocorrelation:
 - “nuisance”: ε_i correlated with ε_j because of, e.g., non-functional definitions of regional boundaries
 - “substantive”: due to genuine economic interactions between regions (e.g. cross-regional knowledge spillovers)

Spatial econometric framework



- General form of the “spatial hybrid” model:

$$y = X\delta + WX\rho + \varepsilon$$

Matrix of
independent
variables

“Spatial lags” of
independent
variables

$$\text{where } \varepsilon = \xi W\varepsilon + \mu$$

Error term with SAR
structure

W = weights matrix defining regions that are in the “neighbourhood” of region j

$\Rightarrow WX$ = weighted average of independent variables for “neighbourhood” set

Baseline results



ML estimation for single cross-section, 1986-2002 (59 regions):

$$\begin{aligned} tfp_j &= - 0.003 + \mathbf{0.673}q_j + 0.006\ln(D_j) - 0.026\ln(TFP_{0,j}) \\ &\quad (- 0.73) \quad (8.73) \quad (5.60) \quad (- 4.55) \\ &+ 0.297Wq_j + 0.006W\ln(D_j) + 0.011W\ln(TFP_{0,j}) + \varepsilon_j \\ &\quad (3.40) \quad (3.95) \quad (1.11) \end{aligned}$$

$$\xi = 0.499 (4.63), \nu = 3.060, \phi = 2.17 \% \text{ p.a.}, \text{pseudo-R}^2 = 0.666$$

Two Econometric Problems



- Problem (1): omitted heterogeneity
 - E.g. absence of human capital
 - Expect to be positively correlated with both tfp_j and q_j (likewise for spatial lags) \Rightarrow potential upwards bias
 - Tackle using panel data techniques- 2-way FE estimation
 - $\Rightarrow v = 1.968$, co-efficient on $Wq_j = 0.007$ (t = 1.00)
- Problem (2): simultaneity bias
 - Real possibility of simultaneous reverse causation $tfp_j \rightarrow q_j$
 - Tackle using IV techniques
 - $\Rightarrow v = 1.713$, co-efficient on $Wq_j = 0.008$ (t = 0.40)



What is the Static-Dynamic Verdoorn Paradox?

- When the Verdoorn law is estimated using cross-sectional *logged level* data, it invariably produces estimates close to, or not significantly different from, *constant returns to scale*.
- When the same data set is used but cross-country (region) *growth rates* are used, the estimates suggest substantial *increasing returns to scale*.

Why?

- This takes us into a consideration of what we term *spatial aggregation bias*.
- Similar to (but not identical to) the *ecological fallacy* and *Simpson's paradox*.



Is the Underlying Functional Form the Cobb-Douglas?

$$Q = K^\alpha (A_0 e^{\lambda t} L^\beta)$$

Black, *Economica* (1962) No different; McCombie (1982) Yes, it is different; depends on constant of integration: First mention of paradox.

But output is the regressor; demand –orientated approach; heart of the cumulative causation model of growth.

TABLE 1 US State Data: Returns to Scale, 1963 and 1963-1972



Standard Industrial Classification Estimates	(i) Static Estimates		(ii) Dynamic	
	(a)	(b)	(c)	(d)
20 Food and Kindred Products	1.04	1.05	1.07	1.41
21 Tobacco Manufactures	n.a.	n.a.	n.a.	n.a.
22 Textile Mill Products	1.00	0.96	1.01	1.56
23 Apparel and Related Products	1.03	1.00	1.05	1.42
24 Lumber and Wood Products	1.06	0.92	1.02	2.39
25 Furniture and Fixtures	1.03	1.04	1.11	1.39
26 Paper and Allied Products	1.04	1.04	1.00	1.36
27 Printing and Publishing Products	1.04	1.03	1.09	1.50
28 Chemicals and Allied Products	1.02	1.03	1.09	1.57
29 Petroleum and Coal Products	1.04	0.91	0.95	n.a.
30 Rubber Products	1.03	1.05	0.94	1.21
31 Leather and Leather Products	1.01	1.00	1.01	1.24*
32 Stone, Clay and Glass Products	1.00	1.01	1.03	1.80
33 Primary Metal Industries	1.00	0.98	0.95	1.53
34 Fabricated Metal Products	1.01	1.00	1.02	1.60
35 Machinery (except Electrical)	1.03	1.03	1.03	1.38
36 Electrical Machinery	1.03	1.05	1.03	1.61
37 Transportation Equipment	1.08	1.06	1.00	1.96
38 Instruments and Related Products	1.06	1.11	1.06	4.14
39 Miscellaneous Manufactures	n.a.	n.a.	n.a.	n.a.
Unweighted mean			1.03	
Total Manufacturing	1.02	1.01	n.a.	1.45



Other Studies

<i>Study</i>	<i>Coverage</i>	<i>Dynamic law</i>	<i>Static law</i>
Kaldor (1966)	OECD	IRS	n.a.
McCombie (1982)	OECD	IRS.	CRS
Michl (1985)	OECD	IRS	n.a.
McCombie and de Ridder (1984)	US states	IRS	CRS
Bernat (1996)	US states	IRS	n.a.
Fingleton and McCombie (1998)	EU regions	IRS	CRS
Hansen and Zhang (1996)	China, regions	IRS	n.a.
León-Ledesma (1999, 2000)	Spain, regions	IRS	CRS/IRS*
<i>Time-series</i>			
Harris and Lau (1998)		UK Regions	IRS
Harris and Liu (1999)		International	IRS



A Simulation Exercise

The law is taken to be

$$E_{ij} = BQ_{ij}^{\gamma}$$

Data generated assuming

- i = unit of observation (Functional Economic Area); j = region (20).
- $\gamma = 0.5$ (Verdoorn coefficient).
- Capital-output ratio is constant and equals unity.
- $B = 1.0$
- *First region has 1 FEA; second region 2 FEAs; Twentieth region has 20 FEAs.*
- $E_0 = 100$; $Q_0 = 100$
- Each region grows at 5% per annum.



Estimations Using Simulated Data

Table 1 The Dynamic Verdoorn Law

	<i>Constant</i>	<i>Verdoorn Coefficient</i>	<i>(t-value)</i>	<i>Rsq</i>
20	-0.006	0.512	51.82	0.993

Table 2 The Static Verdoorn Law:

	<i>Constant</i>	<i>Verdoorn Coefficient</i>	<i>Dummy</i>	<i>Rsq</i>
40	-2.283 (-52.79)	0.997 (157.17)	-0.251 (-23.79)	0.998

D is a dummy variable taking a value of 0 in period 0 and 1 in period 2.



How Do We Interpret the Dummy Variable in the Static Law?

- (a) It is a shift in the intercept over the period. Is it *exogenous technical change*?
Normal interpretation. From the estimated values this comes out as 2.5 percent. But we know that by construct, there is *no* exogenous technical change.

So what is happening?

- (b) The static Verdoorn law attributes the *increase* in the average level of productivity to exogenous productivity growth whereas in the Dynamic Verdoorn law it is (correctly) endogenous, captured by the Verdoorn coefficient.

Why?



An Explanation of the Paradox

Consider the static Verdoorn Law again:

$$\ln E'_j = c + b_2 \ln Q'_j$$

The levels of employment and output for each region are the sum of the number of FEAs in each region

<i>Region</i>	<i>No. of FEAs</i>	$E' (= L_0 n_j)$	$Q' (= Q_0 n_j)$
1	1	10	100
2	2	20	200
3	3	30	300
j	$n_j (=j)$	$E_0 n$	$Q_0 n_j$

It can be seen that the relationship between the aggregate E and Q displays constant returns to scale.



The Dynamic Verdoorn Coefficient

But why is the dynamic Verdoorn coefficient the true (unbiased) estimate?

Because each FEA grows according to $e = 0.5q$

For the regions we aggregate so $\theta e = 0.5\varphi q$

Where θ is the share of the FEA's employment in the total regional employment and φ is the share of FEA's output in the regional total output.

If $\theta \approx \varphi$ then $e = 0.5q$



Export-led growth

- Output growth is the key to productivity growth.
- What determines the growth of (industrial) output?
- Importance of demand side factors; growth of exports

Fast export growth \Rightarrow fast output growth (dynamic Harrod foreign trade multiplier) \Rightarrow increasing competitiveness of manufacturing and exports (Verdoorn Law).

Structure of the KDT model



The export base relationship: The growth of output depends upon the growth of exports

$$q_t = \gamma x_t$$

⇒ key role for demand

Export demand growth:

$$x_t = -\eta p r_{d-1} + \delta p r_z + \varepsilon z$$

⇒ export demand growth dependent upon:

- (1) relative price competitiveness ($-\eta, \delta$)
- (2) growth of income in export markets (z)
- (3) non-price competitiveness (ε)

Structure of the KDT model



Growth of prices: depends on the growth of wages, the change in the markup, less the growth of productivity.

$$p r_{dt} = w + \tau - p_t$$

⇒ imperfect competition & perfectly elastic labour supply

Verdoorn's law (Verdoorn, 1949):

$$p_t = p_0 + \lambda q_t$$

⇒ *dynamic increasing returns*: faster demand growth endogenously stimulates faster technological progress

Structure of the KDT model

Complete overview



$$q_t = \gamma x_t \quad (1)$$

$$x_t = -\eta pr_{dt-1} + \delta pr_z + \varepsilon z \quad (2)$$

$$pr_{dt} = w + \tau - p_t \quad (3)$$

$$p_t = p_o + \lambda q_t \quad (4)$$

⇒ regional growth is a “circular and cumulative” process

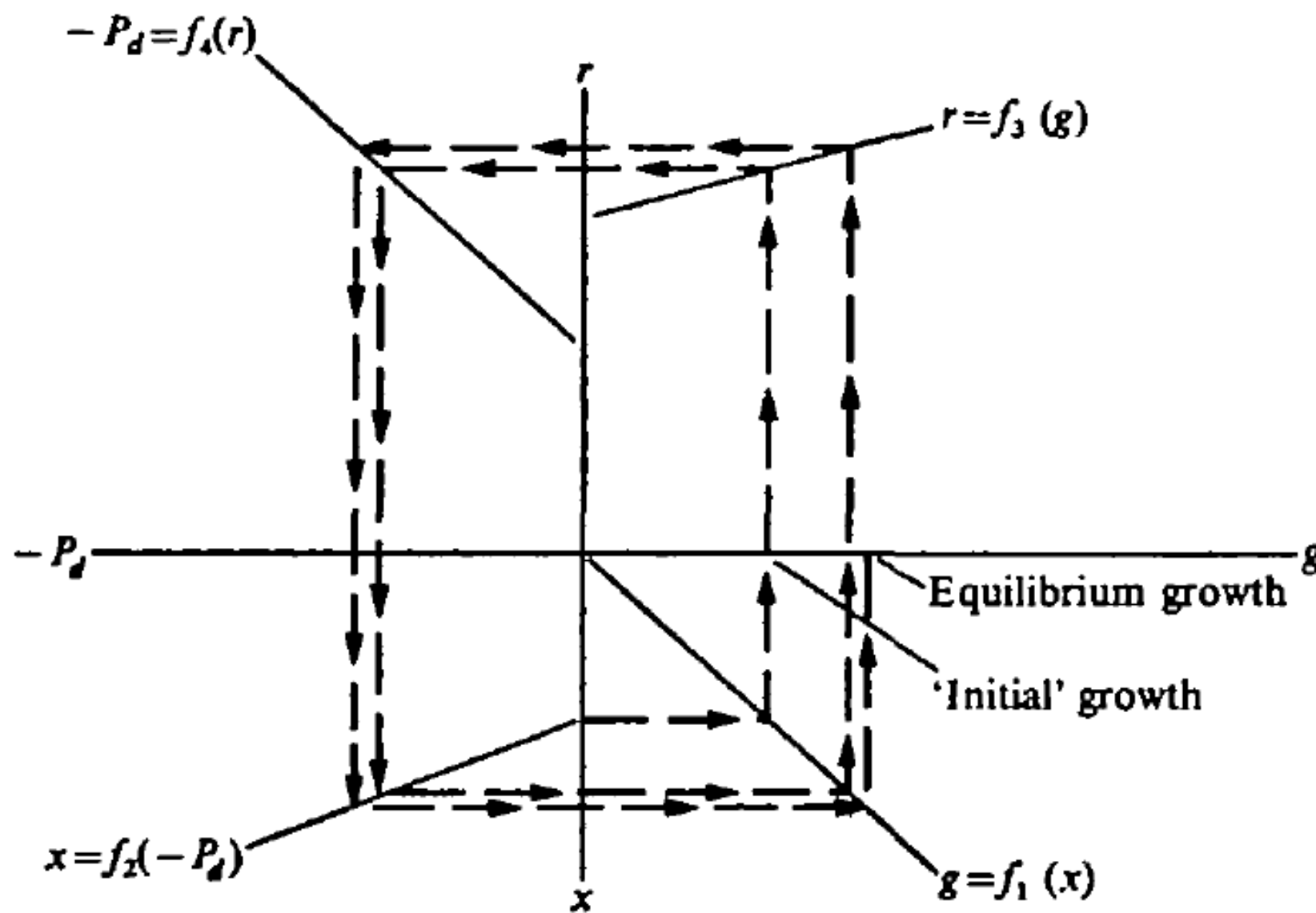


FIG. 1

The solution of the KDT model



Export demand growth:

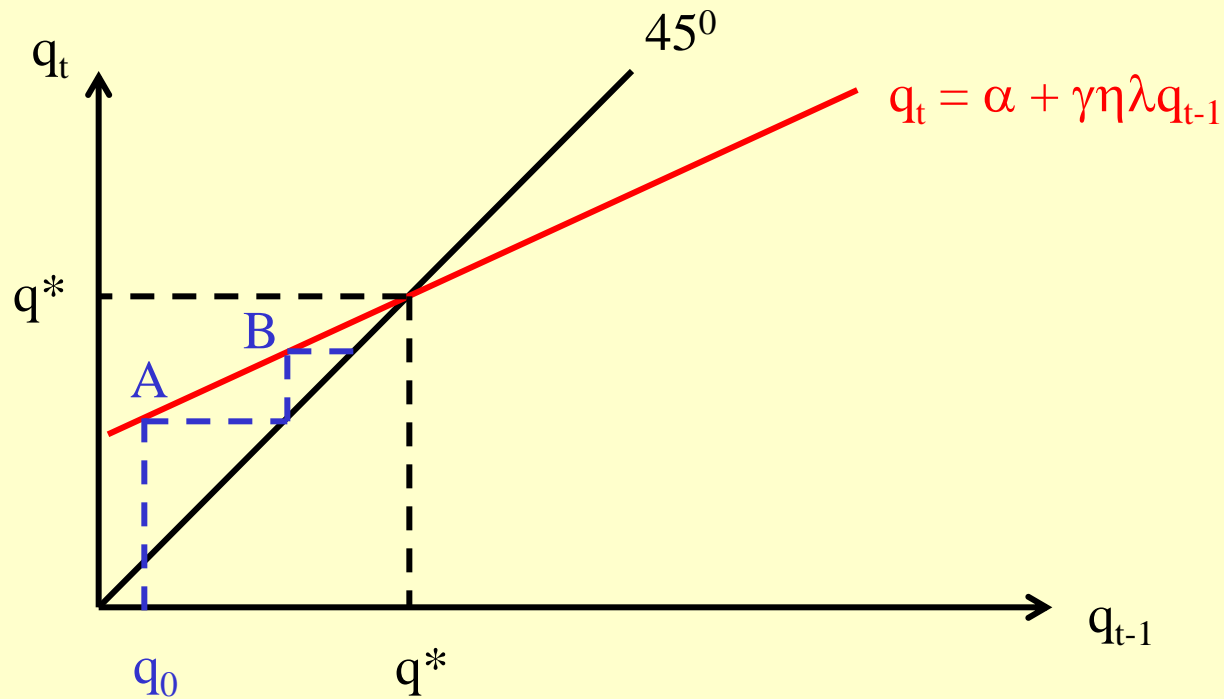
$$x_t = -\eta p r_{dt-1} + \delta p r_z + \varepsilon z$$

\Rightarrow *growth reacts with a lag of one year:*
due to imperfect information?

The solution of the KDT model



The model diagrammatically: stable growth process

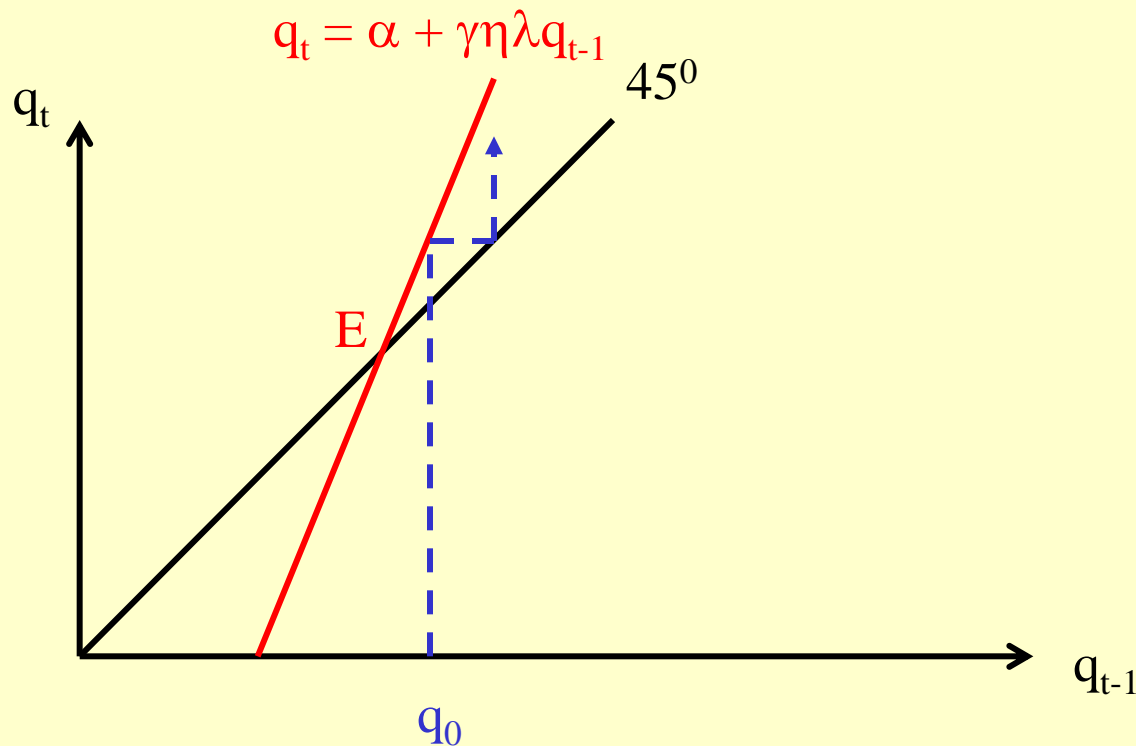


The solution of the KDT model



The model diagrammatically: explosive growth process

An explosive growth process will occur if $\gamma\eta\lambda > 1$:



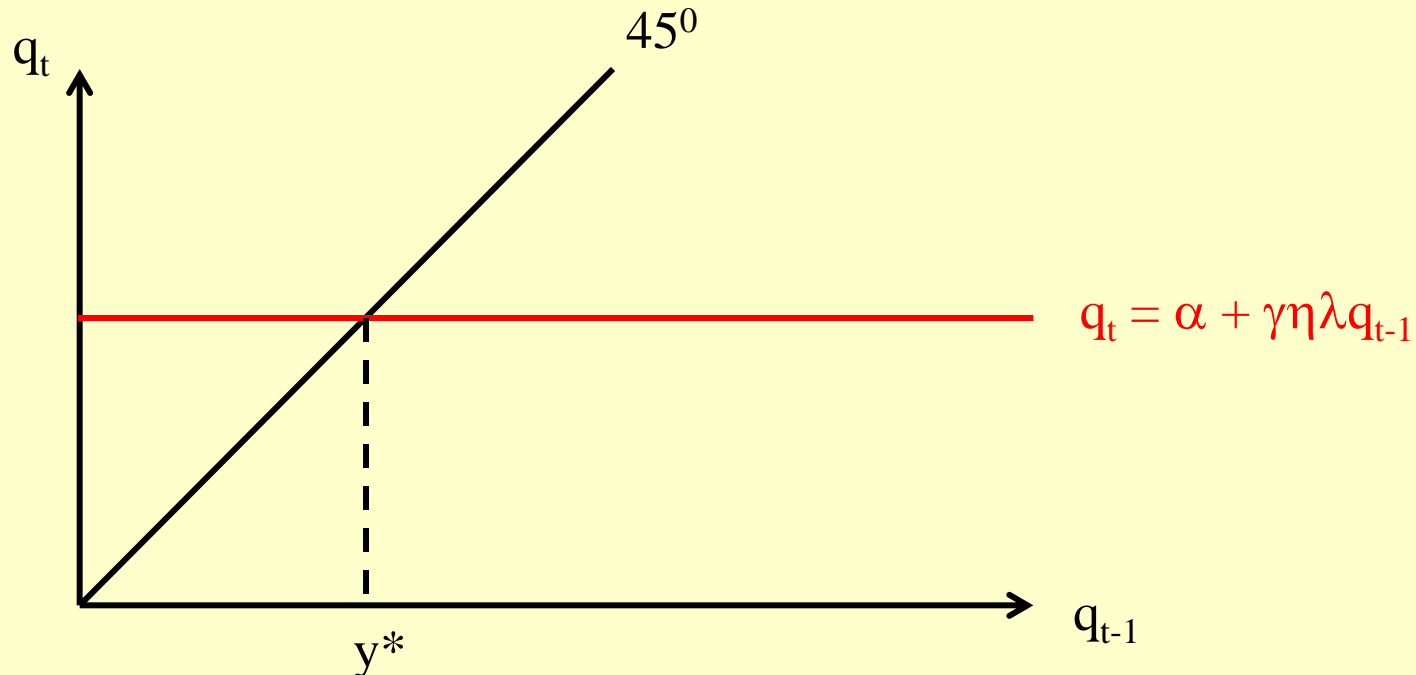
\Rightarrow the solution E is unstable- any small deviation from it will cause the economy to spiral away...

The solution of the KDT model

The model diagrammatically: the crucial role of the Verdoorn co-efficient



$\lambda = 0 \Rightarrow$ no cumulative causation:

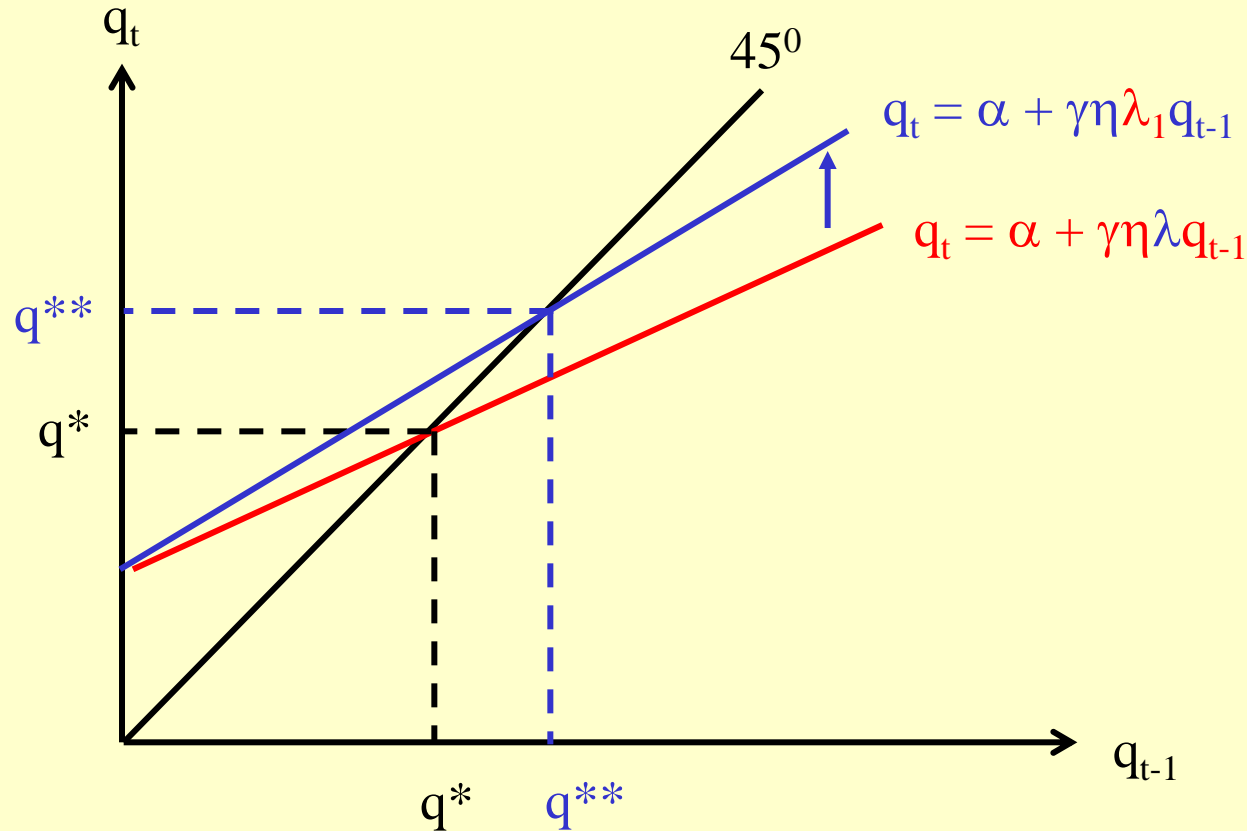


\Rightarrow dynamic increasing returns are required for circles of virtuous and vicious growth

The solution of the KDT model



The effect of an increase in the Verdoorn co-efficient



\Rightarrow stronger dynamic increasing returns \rightarrow
 \uparrow in equilibrium growth rate



Stability Conditions

These depend on the Verdoorn coefficient, the price elasticity of demand for exports and the elasticity of output growth with respect to exports.

Convergent growth: Dixon and Thirlwall

Divergent growth: Kaldor



But if Kaldor is correct and we don't observe divergent growth – why?

- (a) There is a limit to how fast the capital goods industries and, indeed, capacity can be increased.
- (b) Short run constraints such as labour or sectoral bottlenecks may occur, causing price rises and a reduction in price competitiveness.
- (c) In a regional context, external diseconomies may come into play; rising urban rents (a scarce factor of production which may offset increasing returns to the other factors of production); increasing congestion.



Not all countries are demand constrained

But not a return to the neoclassical growth model –

Japan 1950-1973. Growth *constrained* by the growth of capacity and speed of movement of labour into manufacturing (i.e. by the growth of the factor inputs), but *not* determined by the *exogenous* growth of factor inputs and technical change as in the neoclassical scenario.

Policy implications of the KDT model



Policy implication 1: improve non-price competitiveness:

- \Rightarrow increase income elasticity of demand for exports (ε)

- encourage diversification into exports with high values of ε (i.e. into higher-quality products for which world demand is likely to grow strongly)

- create attractive conditions to attract successful industries:
 - > improve human capital
 - > improve infrastructure



Policy implications of the KDT model

Policy implication 2: encourage diversification into industries with strong dynamic economies of scale:

- \Rightarrow improved Verdoorn co-efficient

Policy implication 3: restrain nominal wage growth:

- \Rightarrow improved relative price competitiveness

- > tackle TU power?

- > look at benefits?

- **but**, relative price competitiveness not that important...

Shortcomings of the KDT model



- (1) Unimportance of relative price competitiveness:
 - \Rightarrow let cumulative causation instead work through *non*-price competitiveness

- (2) Exogeneity of nominal wage inflation:
 - *attempts to endogenise*: Pugno (1998); Setterfield (1997); Roberts (2002)

- (3) Absence of a balance-of-trade constraint:
 - difficulty addressed by Thirlwall (1979) and discussed in the next lecture.

Conclusions

- The Kaldorian model have all emphasised the *role of demand* as a determinant of growth in the long run.
- Difference between moving down the demand curve (price competition) and shifting the demand curve out (non-price competition).
- This stands in marked contrast to the neoclassical approach.