ENVIRONMENTAL MACROECONOMICS

A Neglected Theme In Environmental Economics (Leave Alone Economics)

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Main Argument here:

Most Texts and Reviews of Environmental Economics do not consider Macroeconomics – they are confined to Microeconomics

BUT

The role of Environmental Capital (KN) in Macroeconomics goes back to Marshall (1891), Fisher (1905)

Marshall: KN as Ultimate Capital and

Fisher's theory capital originates from nature as capital

Y = f(KM, L, KN) prevailed until about the 1950s

(KM = Manufactured Capital, L= Labour)

Samuelson, Solow and others reduced the explanation of Y to two factors --- Y = g(KM, L) - mainly for analytic convenience

Since then neoclassical economics – including most of (neoclassical) environmental economics has proceeded on

Y = g(KM, L)

Most macroeconomists argue that KN issues are allocative ones

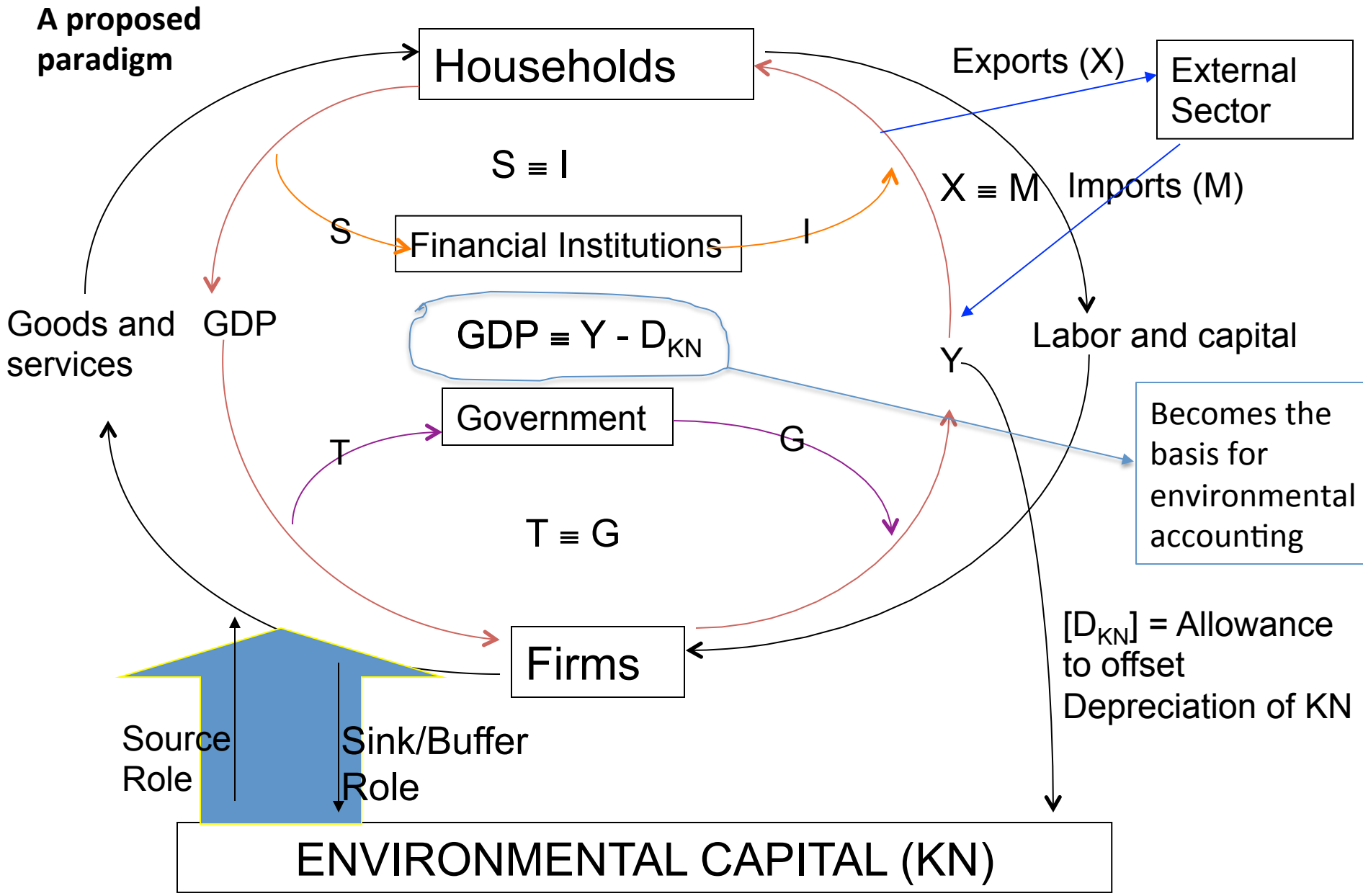
Environmental issues fall exclusively within the domain of microeconomics and is accommodated through **internalization of externalities**

The symmetry between the markets in equilibrium and the overall macroeconomic equilibrium (GDP ≡ Y)
GDP is sum of product market expenditures; Y is sum of factor market expenditures. So, when externalities are internalized GDP and Y would be revised accordingly

BUT externalities are never fully internalized. RESIDUAL EXTERNALITIES EXIST AND THEY ACCUMULATE

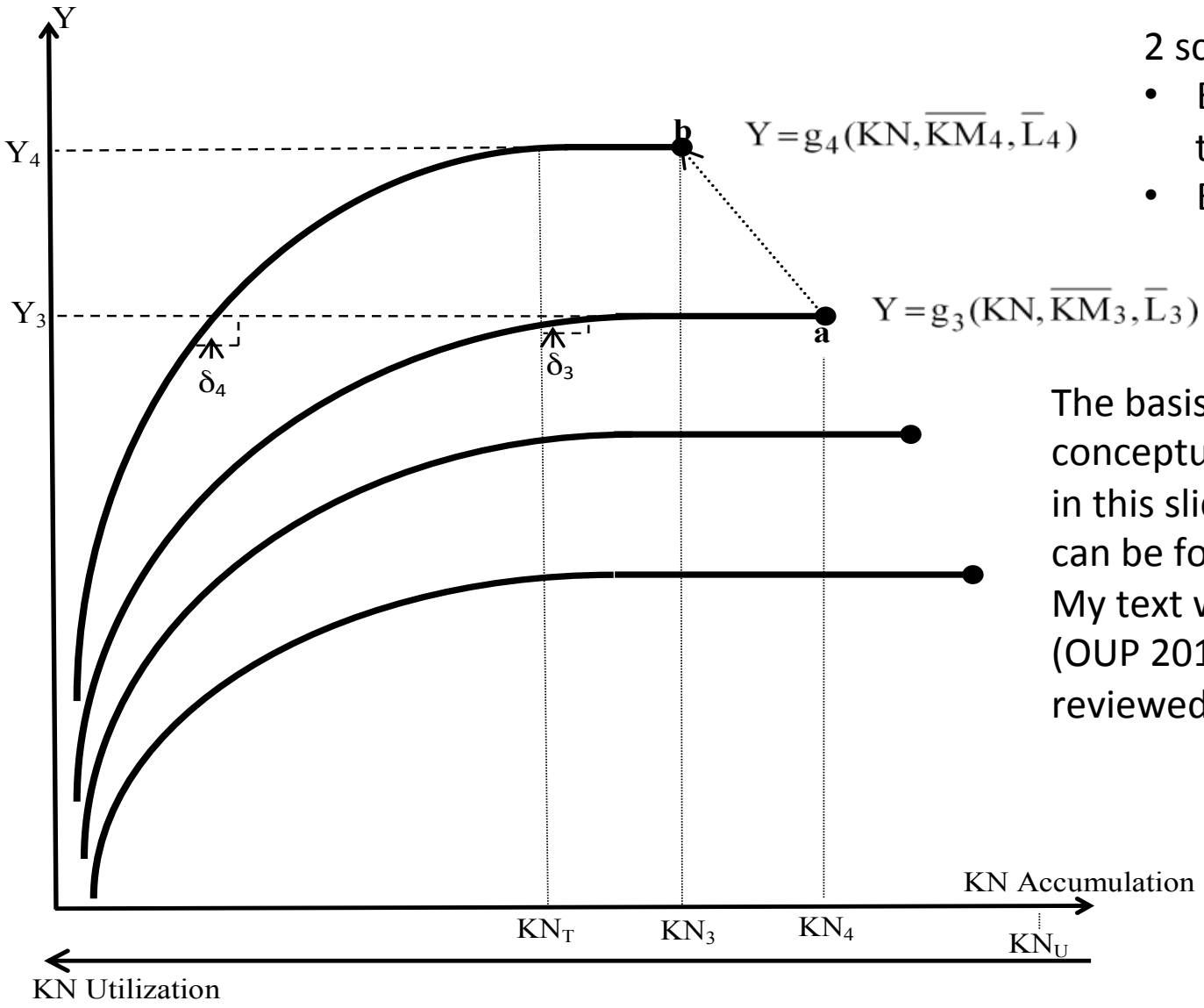
So the revised equilibrium needs to be: ($GDP' \equiv Y - D_{KN}$), where D_{KN} represents a measure of the residual externality that remains

So, we need to introduce the principles of environmental and social accounting. Almost all text books and leading authors (including those in Environmental Economics don't!)



KN is the foundation stone that supports the economic system by providing it with basic resources and also acting as a buffer to withstand the fallouts that emerge from the economic system

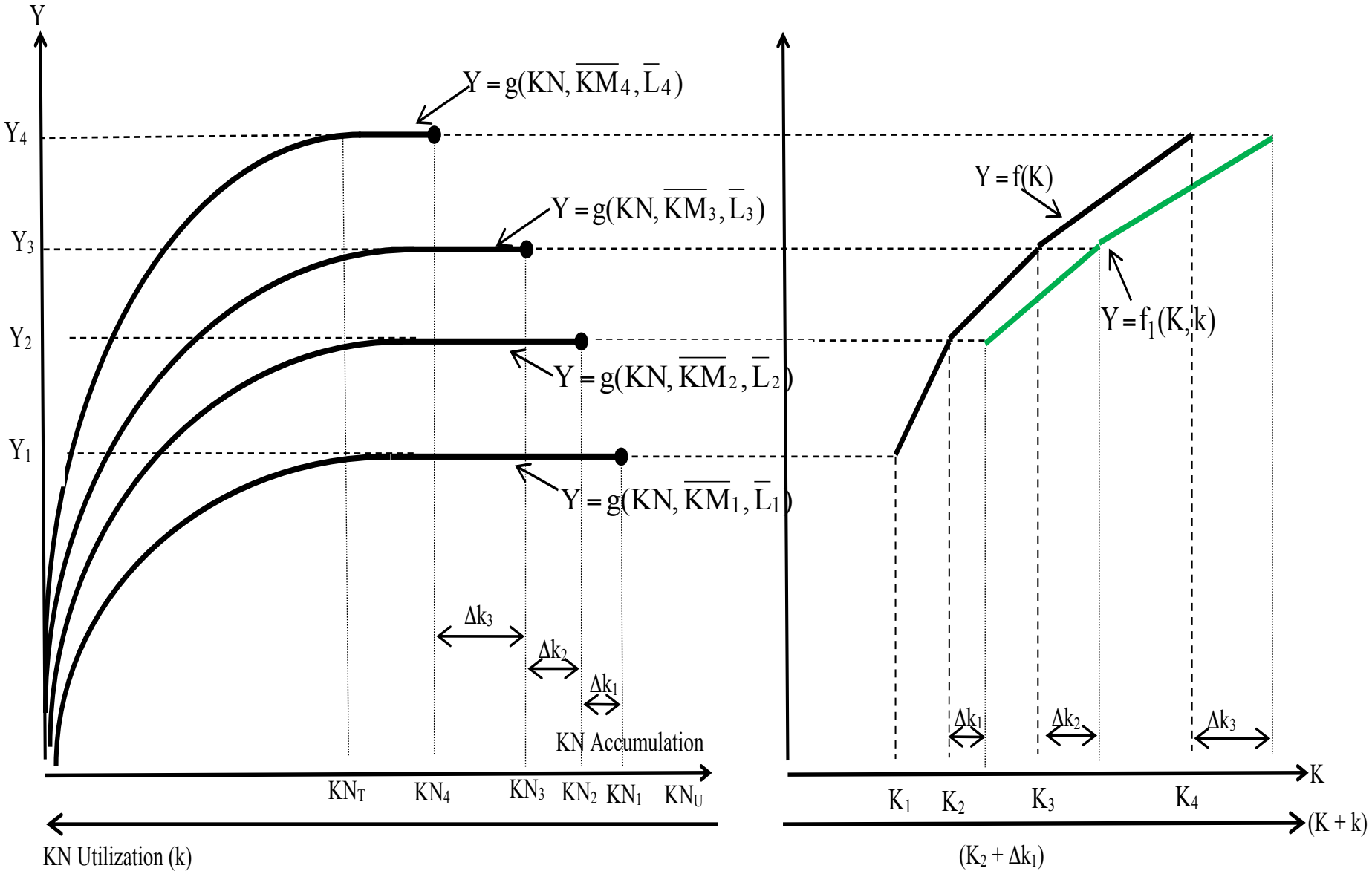
Given the relevance of the paradigm, we need to replace Y = f(KM, L) with Y =g(KM, L, KN): We have to consider KN in terms of Utilization (depletion) Vs Accumulation



2 scientific principles:

- Entropy law of thermodynamics
- Ecological resilience

The basis for the conceptualization offered in this slide and the next can be found in:
My text with Jack Sinden (OUP 2013) and 2 peer reviewed papers



Origins of the Production Function

Income Approach to National Accounts (IANA) is is based on the following identity

Y ≡ OPERATING SURPLUS (OS) + COMPENSATION OF EMPLOYEES (CE)

Payments accruing to KM

Payments accruing to L

Therefore the IANA can be used to illustrate the standard Cobb-Douglas (C-D) function that is used in most texts as point estimates

$$Y = \alpha(KM)^{\theta}(L)^{\lambda}$$

θ = [OS/Y]

λ = [CE/Y]

We need to define Y = g(KM, L, KN)

- By recourse to study of entropy and factor utilization, it is possible to establish the basis for a function including KN as:

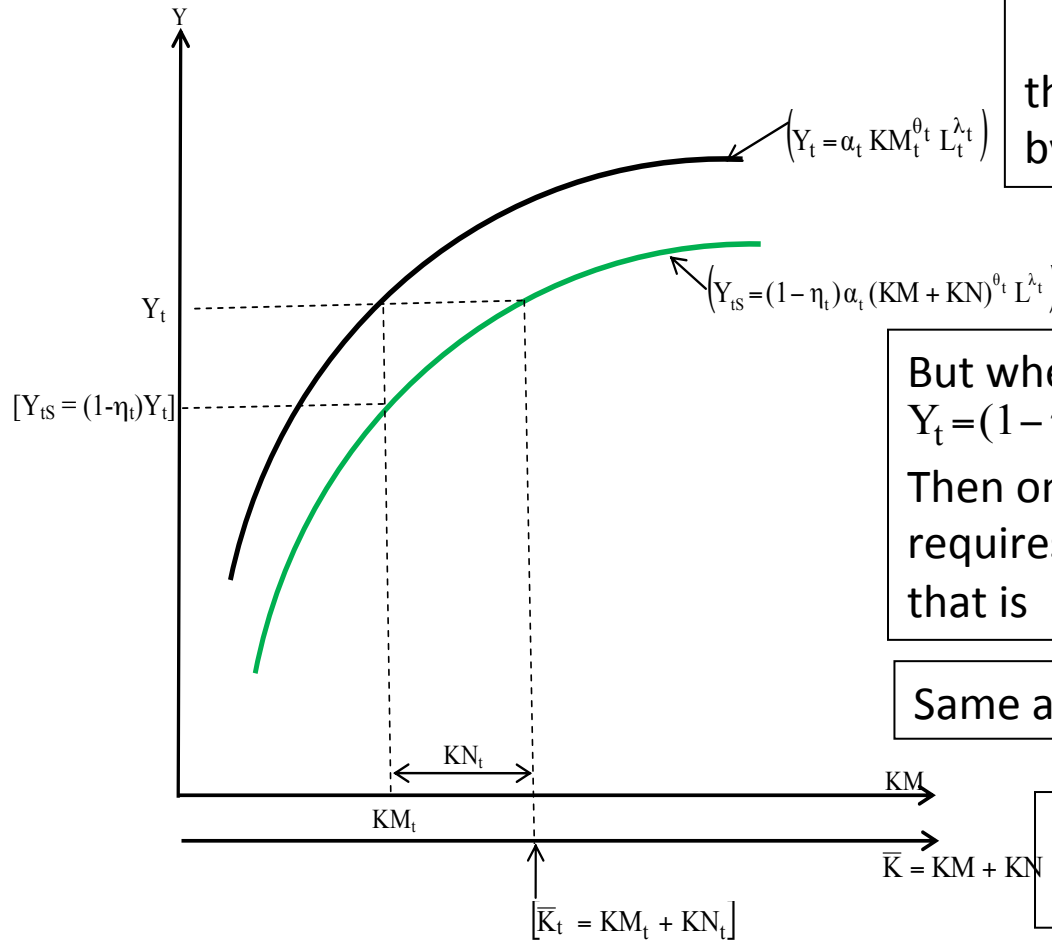
Y = g[(KM+KN), L)]

- We must also ensure that on the basis of Environmental Accounting, g[(KM+KN), L)] conforms to ($Y - D_{KN}$) or ($GDP - D_{KN}$)
- So, if in a given year/time D_{KN} is a proportion η of GDP [that is, $\eta = (D_{KN}/GDP)$], then we can write C-D function as

$$Y_t = (1-\eta_t)\,\alpha_t\,(KM_t + KN_t)^{\theta_t} L_t^{\lambda_t}$$

- Note that in the formulation offered above, D_{KN} is cost of depleting (depreciating) KN. Hence, should we not deplete KN; that is ($KN_t \rightarrow 0$), then ($\eta_t \rightarrow 0$), and the definition of factor-utilization, would tend towards

$$Y = \alpha(KM)^{\theta t}(L)^{\lambda t}$$



The Conceptual Basis for the Estimation of KN

In this sketch, if one were to recognize only

$$Y_t = \alpha_t KM_t^{\theta_t} L_t^{\lambda_t}$$

then, one would conclude that Y_t is explained by KM_t

But when the recognition extends to

$$Y_t = (1-\eta_t)\alpha_t (KM_t + KN_t)^{\theta_t} L_t^{\lambda_t}$$

Then one recognizes that the explanation of Y_t requires not only KM_t but also KN_t;
that is $(KM_t + KN_t)$

Same amount of Yt is explained by 2 equations

Size of KN Utilized can be derived by dividing equation (1) by equation (2)

$$KN_t = \left[\left(\frac{1}{(1-\eta)} \right)^{\frac{1}{\theta}} - 1 \right] \cdot KM_t$$

EMPIRICAL ILLUSTRATIONS – Australia and South Korea:
KN is assumed to be the AIRSHED
D_{KN} was approximated to the cost of air pollution abatement
Given the availability of Total Green House Gas emissions as point estimates for (1970 to 2015). D_{KN} was estimated for each year using a constant 2006 price of $130 (AUD) based on the Stern Report
Using the Income Accounts it was possible to get point estimates for:
θ, λ, and η; and then display both

$$Y_t = \alpha_t \, KM_t^{\theta_t} \, L_t^{\lambda_t}$$

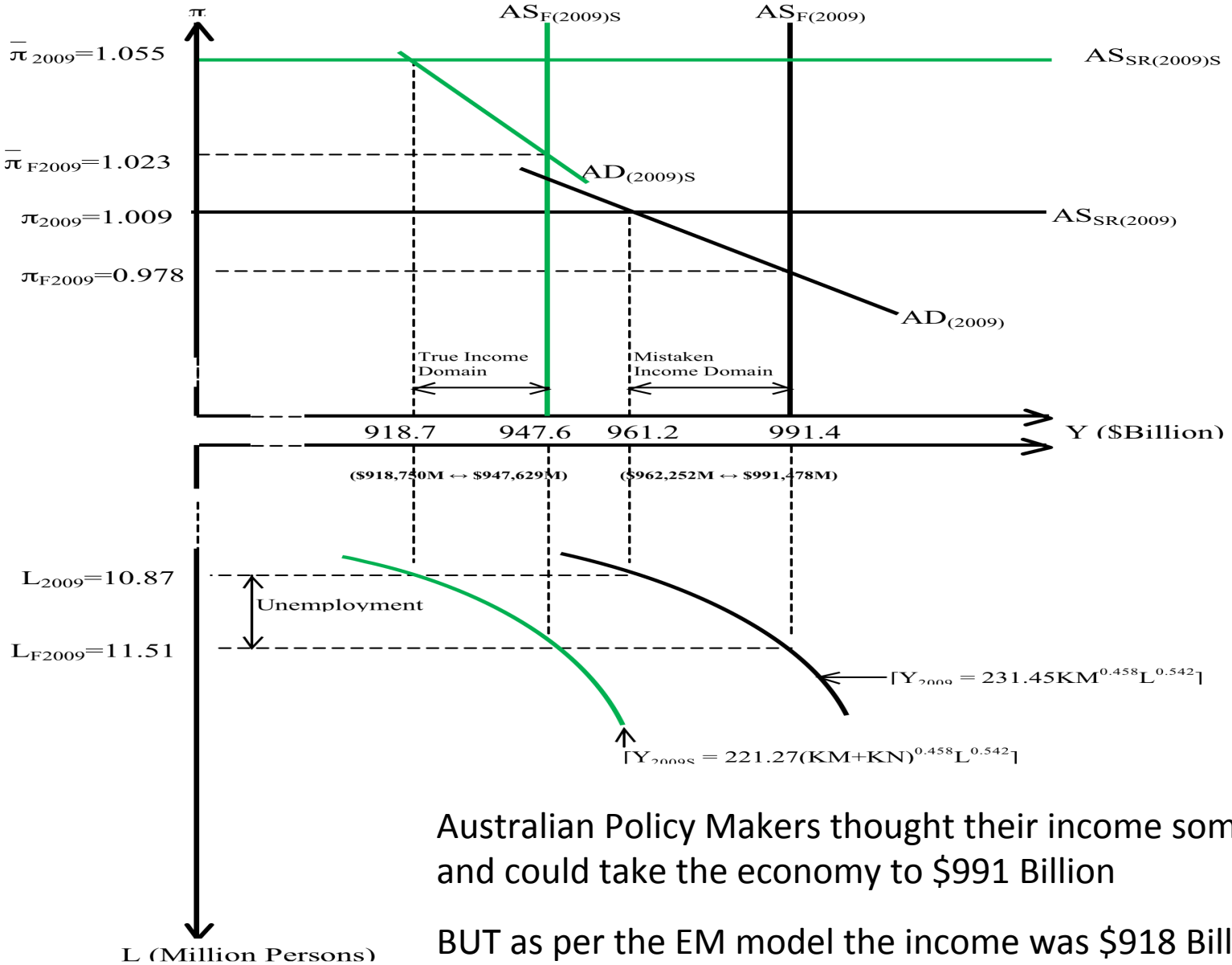
$$Y_t = (1 - \eta_t)\, \alpha_t \, (KM_t + KN_t)^{\theta_t} L_t^{\lambda_t}$$

Use the revised production function to revise:

- Short-run stabilization models (Aggregate Demand – Aggregate Supply)
- Harrod – Domar Model
- Swan – Solow Model
- Romer (endogenous) Model

Main result is a highly reduced growth trajectory

This is shown with Swan-Solow framework (next slide)

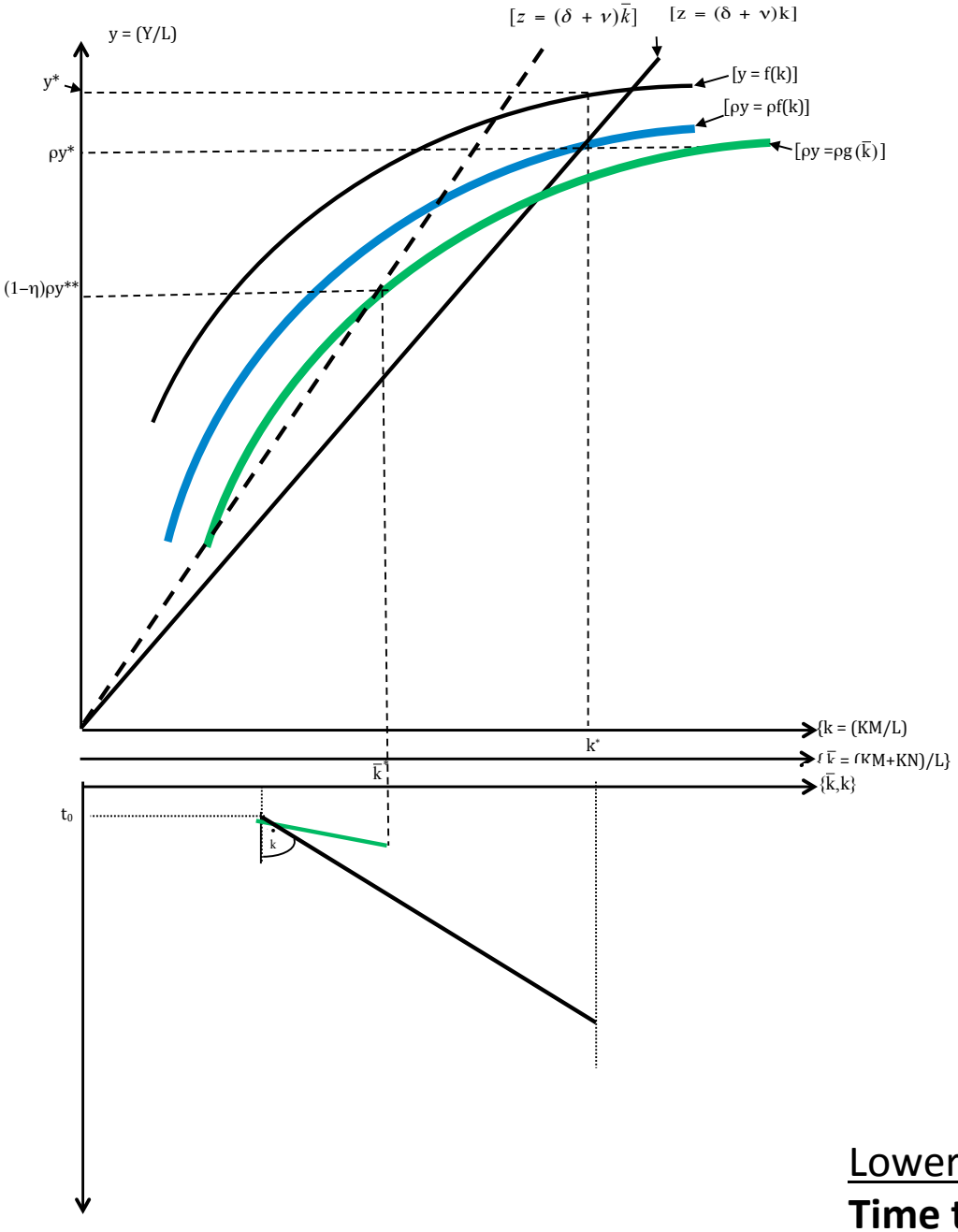


Australian Policy Makers thought their income some $960 Billion and could take the economy to $991 Billion

BUT as per the EM model the income was $918 Billion and capacity was $947 Billion

Australia was operating beyond its true capacity

AUSTRALIAN ECONOMY Aggregate Demand – Aggregate Supply (Snap-Shot for 2009)



Reworking the Swan-Solow Model

Rate of economic growth is governed by the **equilibrium** between:
Savings per worker &
The needs to offset depreciation and growth of the workforce

This equilibrium is **the Steady-State Equilibrium (SSE)**

Upper Panel:

Bold Blue Curve describes savings per worker in standard model

Bold Green Curve curve describes savings per worker in EM model

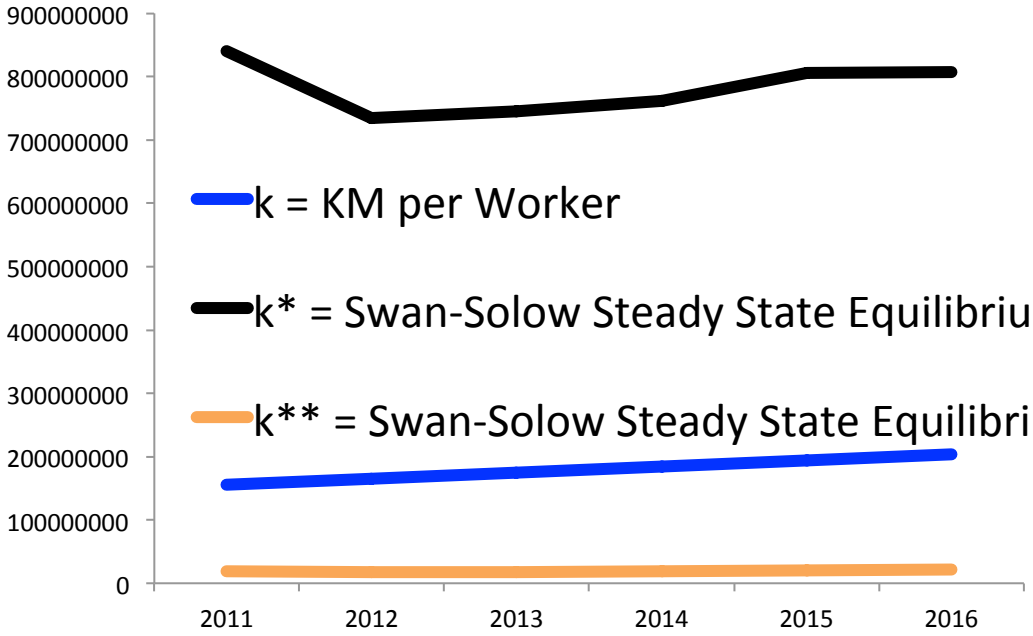
Thin Black straight line describes rate of KM depreciation and entry of new workers in standard model

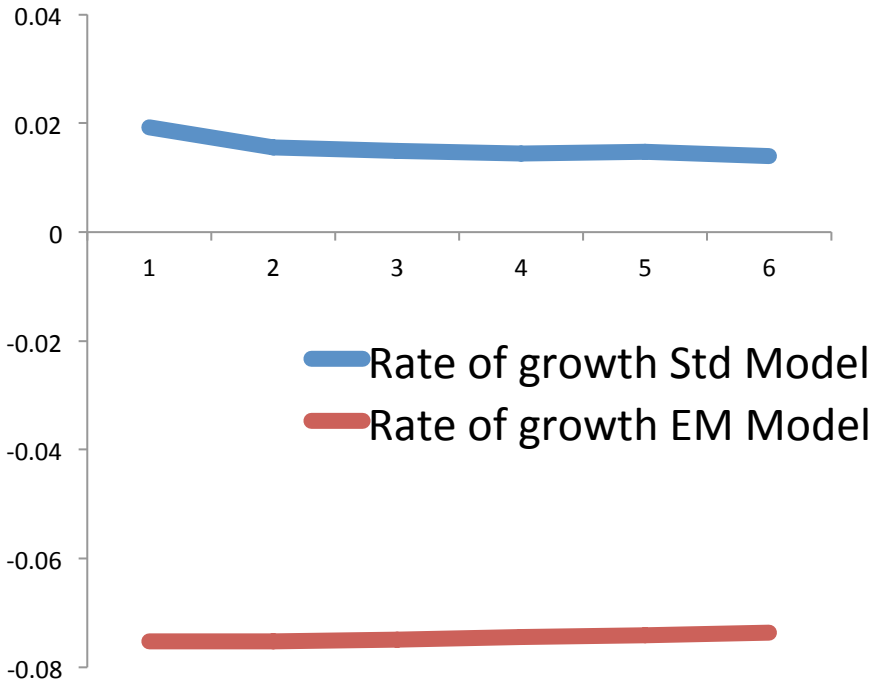
Thin Dashed line describes rate of KM depreciation and entry of new workers in EM model

Lower Panel:

Time taken to reach SSE is much shorter in EM model compared to standard model

South Korea (2011-16)





Peter Victor – York U Toronto:
Managing without Growth

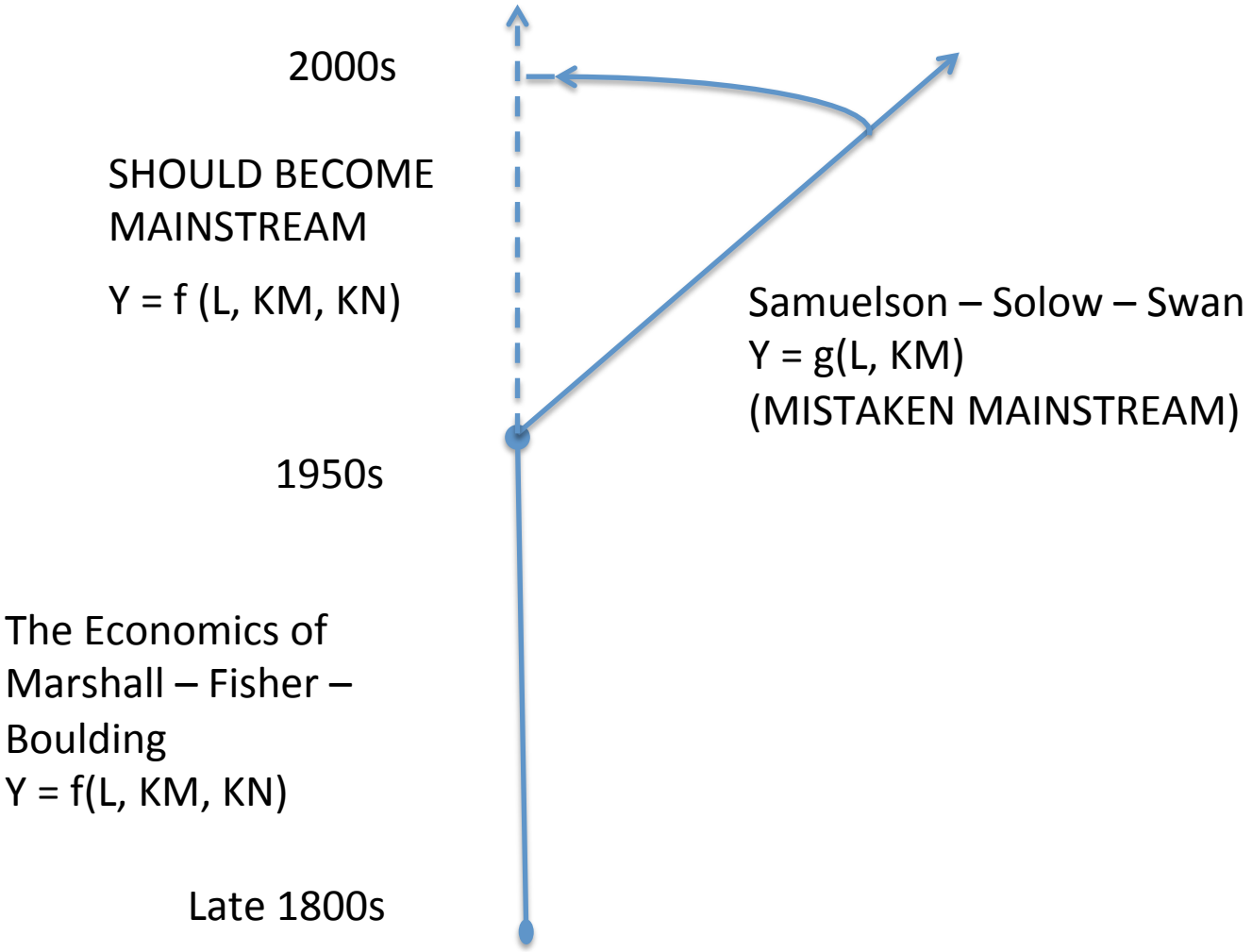
Makes a case for Zero Growth and De-growth

Policy Implications

Primarily measures to reduce the depreciation of KN

- INNOVATIONS and TECHNOLOGIES – environmental technologies – associated with the shift to renewable energy – Some outstanding Australian innovations (Edward Linacre @ Swinburne U)
- Closed-Production Systems – Restructuring the Economy
- Fiscal Measures – Resource Rent Tax – Differential Taxes
- Monetary Measures – Differential Interest Rates – Higher interest rates on resource incentive activities
- Lifestyle changes – Make consumption less necessary (Kenneth Boulding (1945)): "Any discovery which renders consumption less necessary to the pursuit of living is as much an economic gain as a discovery which improves our skills of production …."

Implications for Curriculum Development



Mankiw (2004, 2009):
“Although natural resources can be important, they are not necessary for an economy to be highly productive in producing goods and services. Japan, for instance, is one of the richest countries in the world, despite having few natural resources….".

(Japan is in fact exporting environmental damage)

Lawrence Summers (as chief economist of World Bank – December 1991)
“I think the economic logic behind dumping a load of toxic waste in the lowest-wage country is impeccable and we should face up to that.” …….“I’ve always thought that **under-populated countries in Africa are vastly under polluted**.”

These Harvard professors are part of the mistaken mainstream and are propagating moral hazard or information asymmetry

We have lost Macroeconomics to the so called theoretical purists and the econometricians!

Paul Krugman (2009): Most macroeconomics of the past 30 years was "spectacularly useless at best, and positively harmful at worst".
http://www.economist.com/node/14030288

But Krugman has not heard of Environmental Macroeconomics!