Economic Growth

So far we have only talked about how natural GDP can be altered through supply shocks (Gordon, Chapter 9). We have not yet addressed the issue of long-term growth in the natural level of output (Y) and productivity (roughly Y/N). The two central goals of this chapter are:

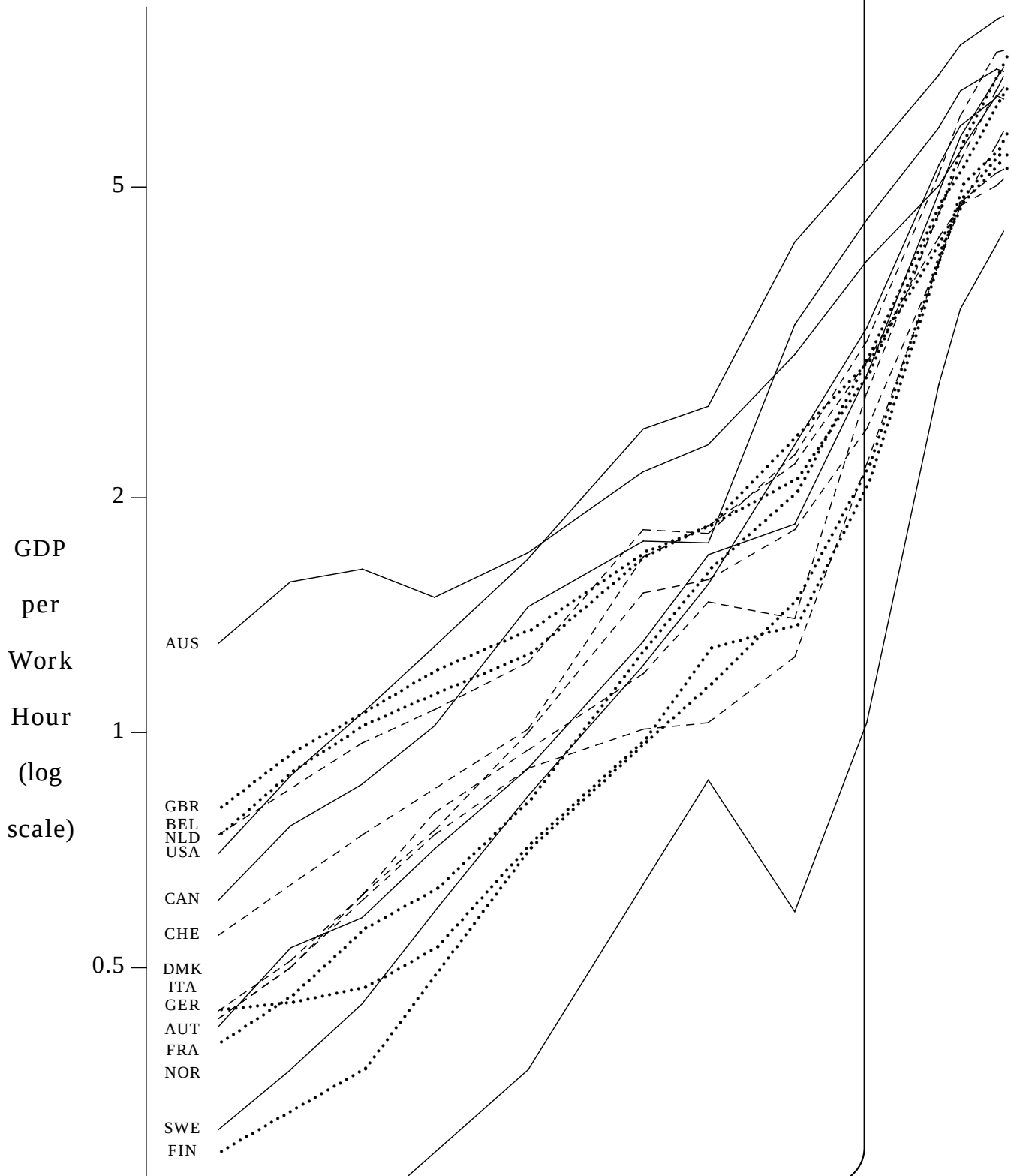
- What determines economic growth? ($\dot{Y}/Y$)
- How can this be applied to explain the recent downturn in productivity?

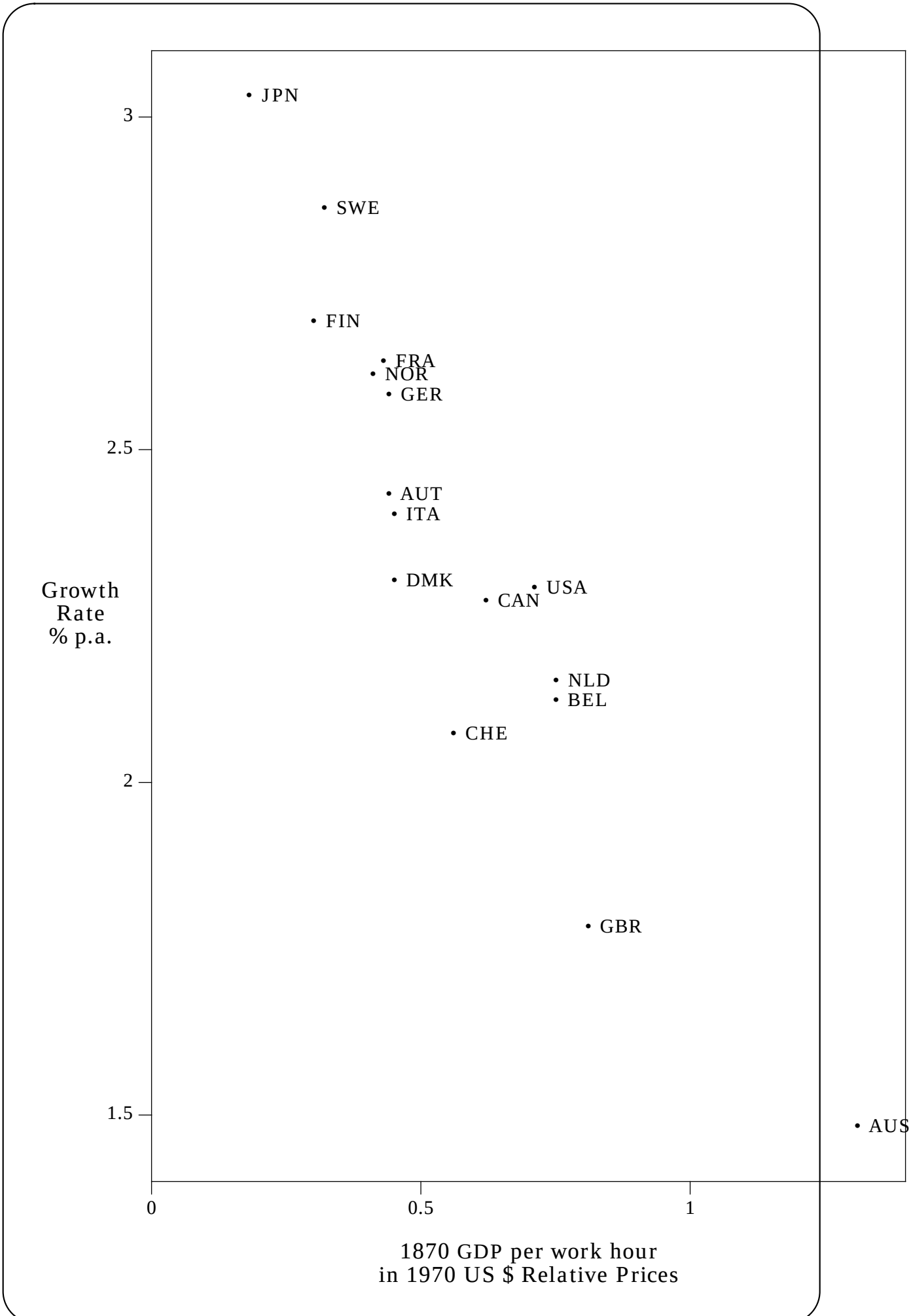
1. Standard of Living and Economic Growth

Economic growth is the main factor determining the standard of living in a country. Growth in the standard of living depends not on total real GDP, but on real per-capita GDP.

2. Long-Term Growth by Country

The recent slowdown in growth is not limited to the USA: growth in real GDP per capita has decelerated almost everywhere (and growth in real GDP per hour has slowed down even more sharply).

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Growth Rate % p.a.
1870 GDP per work hour in 1970 US $ Relative Prices

3. The Sources of Economic Growth

The basic definitional relationships implied by the production function and national income accounting identity are presented separately. Each of these relationships is applied as the theory is developed (Gordon, Chapter 12).

The aggregate production function is a function of labour (N), capital (K), and an "autonomous factor" (A). The principal advantage of this formulation is that it divides economic growth into:

1. the growth of factor inputs (N and K), and
2. the growth in output *relative* to growth in factor inputs (A).

When this specification is converted into a "per-person" or per-capita production function (by dividing through by N), the important concept of the capital–labour ratio (K/N) is introduced. This ratio is one of the central concepts in economic growth theory.

Since all individuals in the economy are assumed to be employed, there is no distinction between the per-person capital stock and the capital–labour ratio.

The simple national income identity which equates saving with investment directly relates national saving to the growth rate of capital and capital depreciation (Gordon, equations 12.3 and 12.5). National saving here refers to the total saving of households, businesses, and the government.

4. The Swan–Solow Model

So far we have only rewritten relationships which are true by definition: we have not yet presented a theory. The main concept of economic growth theory is the idea of a *steady state* where the growth rates of capital, labour, and real output are constant.

The capital–labour ratio (K/N) is only constant (at its steady state level) when the growth rate of capital stock ($k \equiv \dot{K}/K$) is identical to the growth rate of labour ($n \equiv \dot{N}/N$), since K/N rises if $k > n$ and falls if $k < n$.

By combining this steady-state condition ($k = n$) with the national income accounting relationship, we arrive at the Harrod–Domar result that in the steady state, saving per unit of capital should equal the sum of the population growth rate (n) and the capital depreciation rate (d):

$$s\,\frac{Y}{K} = n + d$$

But the major problem with this theory is that it didn't specify the underlying forces by which the economy adjusted to the steady state, and that the steady-state condition appeared to link completely unrelated activities. Because of this, many described the Harrod–Domar model as having "knife-edge" stability: if this seemingly arbitrary condition didn't hold, the economy would be completely unstable, with growth rate exploding or imploding indefinitely.

The major contribution of the Swan[1]–Solow growth theory is that it combines the Harrod–Domar model with the per-capita production function. The steady state now requires that the difference between total national saving per capita and steady-state investment per-capita be equal to zero:

$$sY = (n + d)K$$

or

$$s\frac{Y}{N} - (n + d)\frac{K}{N} \equiv \Delta\left[\frac{K}{N}\right] = 0$$

This approach solves the Harrod–Domar problem by explicitly recognising that a capital–labour ratio (K/N) growing at a faster rate than the output–labour ratio (Y/N) would imply that the capital requirement is in excess of total savings, so that the amount of capital available to each worker will have to fall until the capital–labour ratio stops changing, and the steady-state condition is satisfied.

As the output–capital ratio starts out below (above) the steady-state level, the resulting decumulation (accumulation) of capital per person with the *property of diminishing returns* will automatically raise (shrink) the output–capital ratio until the steady-state level is reached.

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1. Peter's late father, Trevor.

The most important implication of the Swan–Solow growth model is that the economy's steady-state growth rate depends only on the population growth rate and is completely unaffected by changes in the saving rate, although empirically this may be too strong.

Any increase in the saving rate will only temporarily raise the actual growth rate of per-capita output by increasing the growth rate of real output above the population growth rate. But the extra saving will only finance a higher *level* of capital stock per person so that the net effect of the higher saving rate will only increase output per person to a higher *level* instead of a higher steady-state growth *rate*.

5. Technology

But because output growth equals population growth in the steady state, the prediction of constant output per person seems inconsistent with the substantial increases in the standard of living observed in the major industrialised nations.

The Swan–Solow model introduced two types of technical change:

- *labour-augmenting technological change*, which assumes that new technology raises the efficiency of labour, and
- *neutral technological change*, which actually shifts the per-capita production function.

Labour-augmenting technological change can allow the output per *effective* labour ratio to remain constant while the actual output–labour ratio is increasing, since with this change, the actual labour-supply growth rate will be lower than the growth rate of effective labour supply.

Neutral (or "disembodied" or "residual") technological change results in growth in output relative to factor inputs. It represents "other factors" which cause output to grow relative to the growth in inputs. It is often called growth in *multifactor productivity* or *total factor productivity*. (The growth rate of output per hour of work, minus the contribution to output of the growth in the quantity of other factors of production per hour of work, notable capital, but sometimes including energy, raw materials, or other factors of

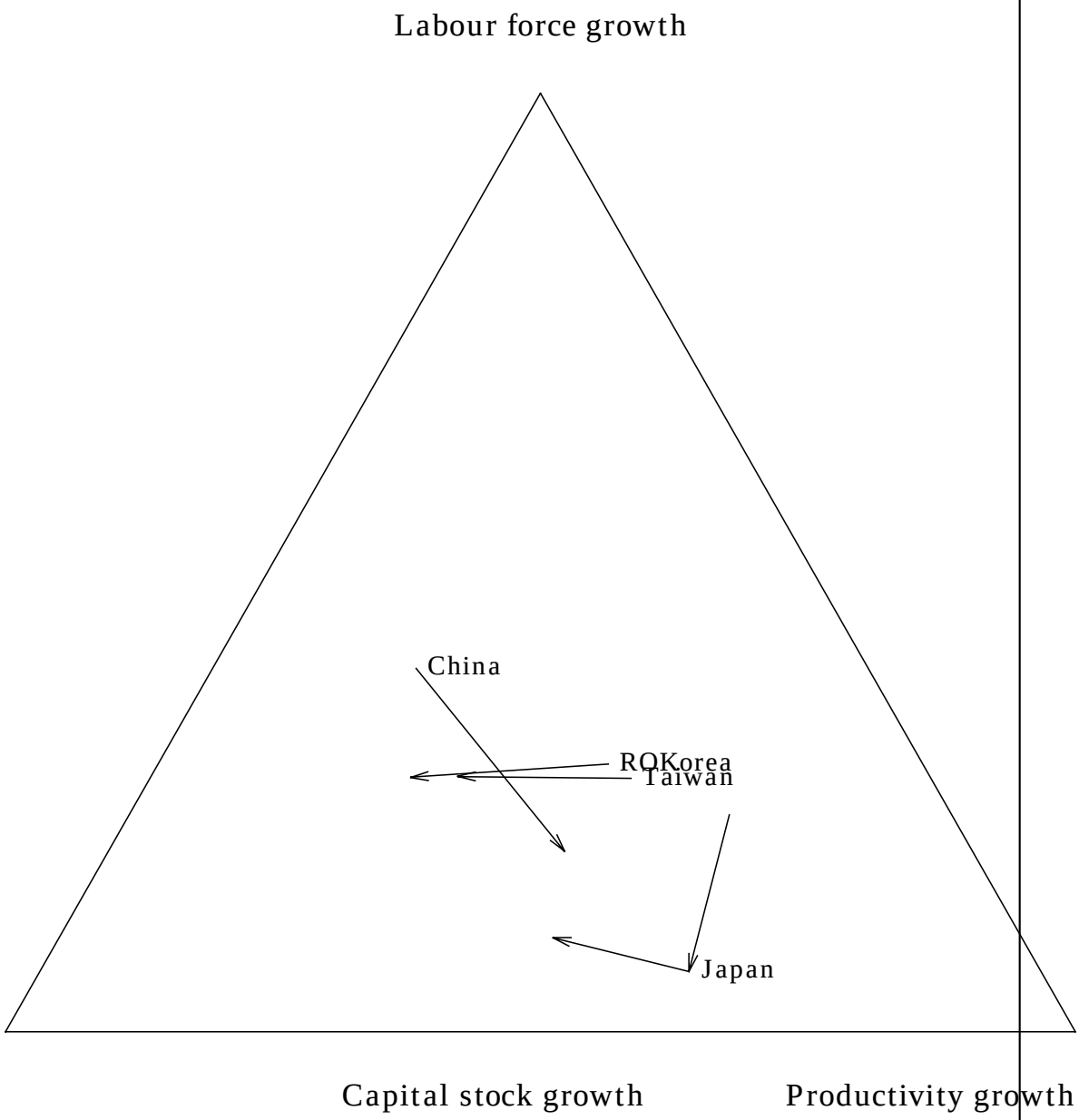

Figure: Growth Accounting
Source: Garnaut Table 2.5

China: 1953/1976–1976/1985
Japan: 1952/1959–1959/1971–1971/1985
ROKorea: 1963/1972–1972/1982
Taiwan: 1955/1970–1970/1986

production.)

Some factors which have been classified as part of the residual include:

- education
- demographic composition (age–sex)
- improvements in labour supply (quality)
- R&D
- movement from farm employment
- crime and/or environmental degradation

6. Sources of US Growth

Using the Swan–Solow theory of economic growth, Dennison decomposed output into growth in output per unit of labour, and the residual component. His main results were that about half the acceleration in US real output growth which occurred between the periods 1929–48 and 1948–73 can be attributed to "advances in knowledge" or the residual, and that almost all of the productivity (or output per capita) slowdown between the periods of 1948–73 and 1973–82 can be attributed to the residual category.

7. Competing Hypotheses

Why has productivity been so slow after 1973? Gordon concludes that the productivity slowdown, although over-hyped, continues to be a problem. While the US manufacturing sector recovered significantly in the post-1979 period — most of it because of the computer industry — the much larger non-manufacturing sector displayed no growth at all up to 1987.

Explanations include:

- the US tax system discouraged household and business saving, especially during inflationary periods (Feldstein)
- the high prices of raw materials and energy, aggravated by restrictive macroeconomic policies,
- a decline in the quality of labour
- various problems in particular industries
- running out of resources and ideas
- sklerosis of institutions (Mancur Olson)
- catch-up through technology transfer

8. Policy

Macroeconomic policies designed to promote economic growth must necessarily revolve around the role of the government budget deficit and the foreign trade deficit. Empirical studies suggest a correlation between household saving and per-capita growth rates, against the Swan–Solow model's predictions. The twin deficits directly affect the level of current saving and investment, and thus the future productive capacity of the economy.

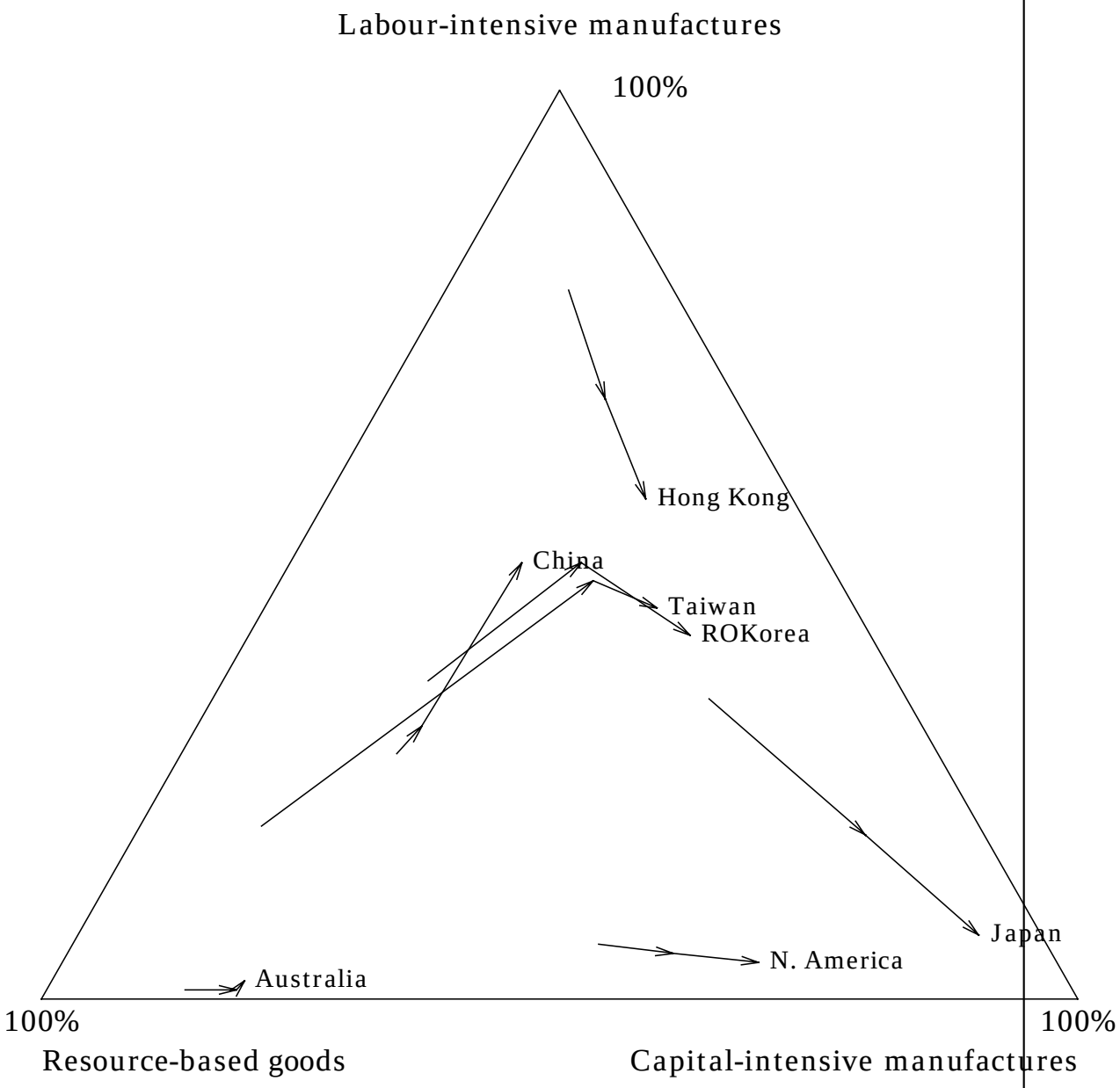

Figure: Sectoral Shares of Merchandise Exports 1965, 1977, 1987
Source: Garnaut Table 3.3

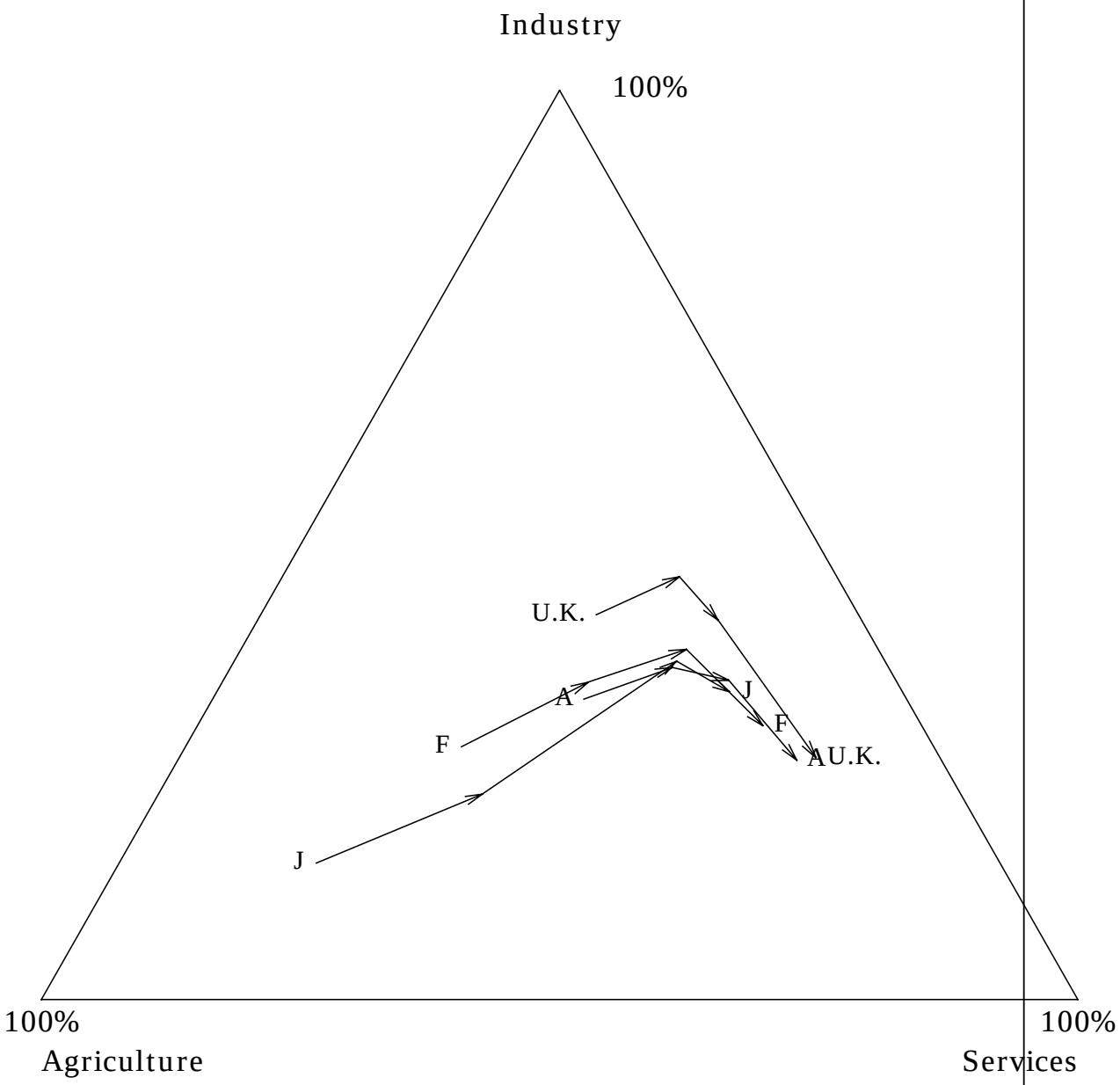

Figure: Structure of Employment 1870, 1950, 1973, 1987
Source: Maddison Table C.5

A = Australia, C = Canada, F = France, J = Japan