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Adam Smith's Economic Growth Model

Dr Ian St John

Economics Department

istjohn@habselstree.org.uk

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Abstract

Adam Smith's *Wealth of Nations* (1776) was concerned with explaining the total flow of income or output of an economy and what causes that total to change over time – questions we now study under the headings of economic growth and development. Institutionally, Smith saw a system of 'natural liberty', where each individual enjoyed security of property and was free to pursue their own gain by maximising the value of their output, as most conducive to economic development. Yet he also articulated a model of the growth process itself. While many will be familiar with the importance Smith attached to the division of labour in generating increased productivity, for Smith the underlying driver of economic expansion was capital accumulation. It was capital accumulation (or net investment) that made possible the employment of labour, while also embodying improved technology and causing wages to rise above subsistence level, so fuelling population increase. This paper outlines Smith's model of growth through capital accumulation as well as the potential limits to this process – notably, the tendency to diminishing returns in agriculture and the prospect of a stationary state. Unlike most classical economists, however, Smith was fundamentally optimistic regarding the potential for future progress under the capitalist market system since various positive feedback effects from investment promised to postpone or offset any tendency to economic stagnation.

What explains the total output of an economy? This is the chief question Adam Smith addresses in his *An Inquiry into the Nature and Causes of the Wealth of Nations* (1776). Although Smith talks of the 'wealth' of nations, which is a stock concept, he means by wealth the *flow* of output per period of time – which is to say, income or output. As Smith remarks, the subject of the first four books of his work is to 'explain in what has consisted the revenue of the great body of the people … which in different

ages and nations, have supplied their annual consumption …'[1] The *Wealth of Nations* can thus best be considered an attempt to explain the size and growth of Gross Domestic Product. And the greater is this GDP relative to the population, the higher is per capita GDP or the standard of living:

> The annual labour of every nation is the fund which originally supplies it with all the necessaries and conveniences of life which it annually consumes … According, therefore, as this produce, or what is purchased with it, bears a greater or smaller proportion to the number of those who are to consume it, the nation will be better or worse supplied with all the necessaries or conveniences for which it has occasion.[2]

The whole of the *Wealth of Nations* is concerned with answering the question of what better or worse supplies a nation with the necessaries of life.

Smith gave two, interlinked, answers to this question – an institutional one and a more narrowly economic one. In terms of institutions, Smith contended that a nation will prosper and experience 'opulence' if it enjoys a condition of 'natural liberty', where responsible and self-interested individuals are permitted to advance their own interests to the best of their ability, the advancement of each amounting to the collective progress of all.

> Every individual is continually exerting himself to find out the most advantageous employment for whatever capital he can command. It is his own advantage, indeed, and not that of society, which he has in view. But the study of his own advantage naturally, or rather necessarily, leads him to prefer that employment which is most advantageous to the society.[3]

It was for this reason that Smith deprecated attempts by governments or monopolistic institutions to regulate individual profit-seeking behaviour, since market competition would ensure that in endeavouring to advance their own interests, each individual would, as if guided by an 'invisible hand', bring the greatest benefit to society as a whole. It is for this advocacy of *laissez-faire* policy as opposed to mercantilist government intervention that Smith is best remembered.

However, within the pages of his work there resides a more formal model of the economic growth process. This model is at times explicit, at others implicit, and is wrapped up within passages that are capable of contradictory meanings. For this reason, Smith's work has generated a cottage industry of competing attempts to formulate his underlying growth model. Notable examples are provided by J.J. Spengler, 'Adam Smith's Theory of Economic Growth' (1959), H. Barkai, 'A Formal Outline of a Smithian Growth Model' (1969), A. Anspach, 'Smith's Growth Paradigm', W. Eltis, *The Classical Theory of Economic Growth* (1984), and G. Reid, *Classical Economic Growth* (1989). The exposition which follows largely follows Barkai, whose

[1] A. Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations* (Edited by E. Cannan, Methuen and Company, London, 1930), Volume I., p. 3.
[2] *Ibid*., p. 1.
[3] *Ibid*., p. 419.

article is not only expressed with admirable clarity, but offers the chance to explore several important aspects of Smith's ideas along the way.[1]

The Total Product Function

The Total Product function relates the output of the economy to the inputs required to produce it. Barkai gives the function as:

Y = Y[K, L, T]

where:

Y = Total output (GDP)

K = Stock of capital – made up of fixed capital (machines, tools, buildings) and circulating capital (raw materials and wages of productive workers)

L = Number of productive workers

T = State of technology

Productive labour consists of those workers engaged in work that creates tangible products and useful services that *could* be used as inputs into the production process. Unproductive labour is work which produces things that expire at the point of their realisation and which does not add to the resources potentially available for future production – the labour of 'churchmen, lawyers, physicians, men of letters of all kinds; players, buffoons, musicians, opera-singers, opera-dancers, etc.' – and, we might now add, Tik-Tok influencers.[2] 'A man grows rich,' Smith remarks, 'by employing a multitude of manufacturers: he grows poor, by maintaining a multitude of menial servants.'[3] Whether teachers are productive or unproductive workers we leave for the reader to decide. The supply of productive labour depends on the total population and the share of that population engaged in productive work; i.e.

$L = \alpha P$

where:

P = Total population

α = Share of population engaged in productive work

For a given productive labour share (α), the rate of growth of the productive labour supply will be equal to the rate of growth of population. Smith believed that in a

[1] H. Barkai, 'A Formal Outline of a Smithian Growth Model', *The Quarterly Journal of Economics*, Vol. 83, August 1969, pp. 396-414.
[2] Smith, *Wealth of Nations*, Vol. I., p. 314.
[3] *Ibid*., p. 313.

growing economy, population would be increasing. This was because economic growth would cause a rising demand for labour, which would in turn cause wages to rise above subsistence levels. A subsistence wage is that wage just necessary to feed and sustain a worker and a given size of family. In a growing economy with high levels of capital accumulation, demand for labour increases relative to supply, pulling up wages above subsistence levels. 'It is not', says Smith, 'the actual greatness of national wealth' which 'occasions a rise in the wages of labour' but 'its continued increase …'[1] When wages rise above subsistence level then workers would have more children and more of these children would survive to adulthood, meaning total population would increase. In itself, a rising population and labour supply would tend to depress wages back towards subsistence, but continued economic growth would prevent this happening by raising demand for labour further, with the result that market wages might remain above subsistence wages and population will continue to grow over time. This was the case in Britain, where Smith observed that 'the wages of labour seem, in present times, to be evidently more than what is precisely necessary to enable the labourer to bring up a family.'[2] As further evidence for this argument, Smith noted that wages were highest where demand for labour was rising fastest – higher in America than in England, higher in towns than in the countryside, and so on.

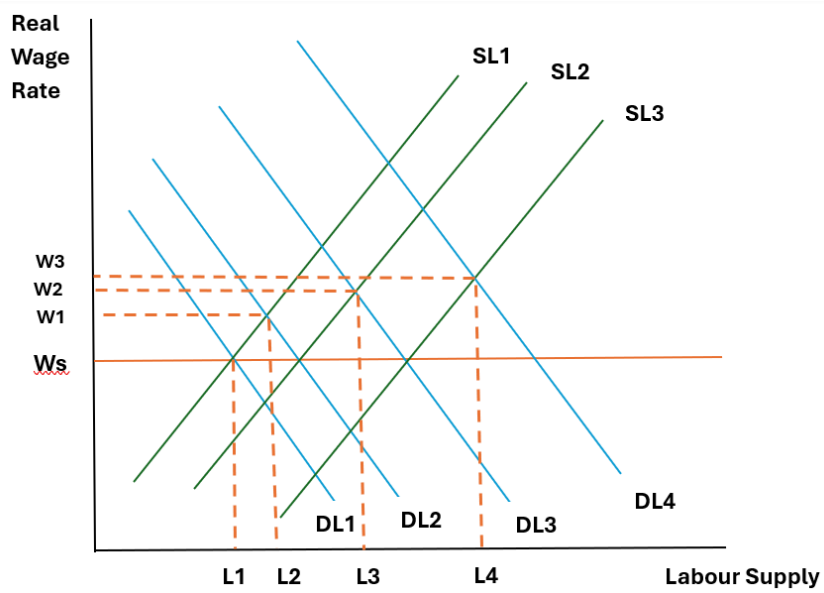

Figure 1. Determination of Wages with Economic Growth

This diagram illustrates the likely trajectory of real wages within the Smithian growth model. Initially, the demand for labour is DL1 and the supply SL1, with an equilibrium wage of Ws, which is the subsistence wage – just sufficient to maintain a given level of population. A rising demand for labour due to capital accumulation causes the demand for labour to rise to DL2. The initial effect is a rise in real wages to W1. This

[1] *Ibid*., p. 71.
[2] *Ibid*., p. 75.

rise in real wages above the subsistence wage leads to an increase in population, and the supply of labour line shifts out to SL2. By itself, this increased labour supply will push the equilibrium wage back towards the subsistence wage – which was the 'classical' pessimistic assumption of Malthus and Ricardo. But Smith did not believe that wages would always tend towards subsistence. This is because continued capital accumulation and growth will cause the demand for labour to increase again to DL3, further drawing the equilibrium wage above subsistence levels (W2 in this case). Population increases again and the supply of labour shifts to SL3. Yet again this will not lead to wages declining to subsistence levels if economic growth continues to raise the demand for labour. So long as economic growth exceeds population growth, real wages will remain above subsistence levels and may even trend upwards.[1] Only when economic growth stalls and declines towards a stationary state will wages trend down to subsistence levels – something Smith believed had happened in China. Although China had long been 'one of the richest … most fertile, best cultivated, most industrious, and most populous countries in the world', by the eighteenth century its economy had ceased to grow, with the result that the 'poverty of the lower ranks of people in China far surpasses that of the most beggarly nations in Europe.'[2] In Britain and North America, by contrast, wages were above subsistence and rising.

Characteristics of the Total Product Function

Total output is a positive function of each of the inputs. That is, the partial derivates of output with respect to each factor input are all positive:

$$\frac{\partial Y}{\partial K} > 0$$

$$\frac{\partial Y}{\partial L} > 0$$

$$\frac{\partial Y}{\partial T} > 0$$

Thus, the marginal products of capital, labour, and technology are all positive. However, if one input is increased while all others remain constant, there will be diminishing marginal returns:

$$\frac{\partial^2 Y}{\partial K^2} < 0$$

$$\frac{\partial^2 Y}{\partial L^2} < 0$$

[1] C.f. M. Blaug, *Economic Theory in Retrospect* (Fourth Edition, Cambridge University Press, Cambridge, 1985), pp. 44-45.
[2] Smith, *Wealth of Nations*, Vol. I., pp. 73-74.

$\frac{\partial^2 Y}{\partial T^2} < 0$

If, for example, we increase capital inputs while holding all other inputs constant, the total product function can be depicted as follows.

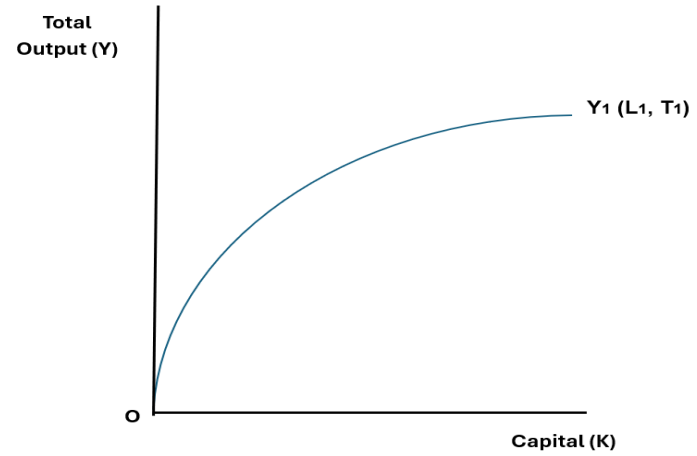

Figure 2. Relationship between Total Output and Capital Inputs

This curve shows that total output is a positive function of the capital stock. As the quantity of capital increases, holding labour supply and technology constant, total output increases ($\partial Y/\partial K > 0$) but at a decreasing rate due to diminishing returns ($\partial^2 Y/\partial K^2 < 0$). This function is drawn for given levels of productive labour supply and technology. If either increases, then output from any given capital stock will increase and the curve will shift upwards.

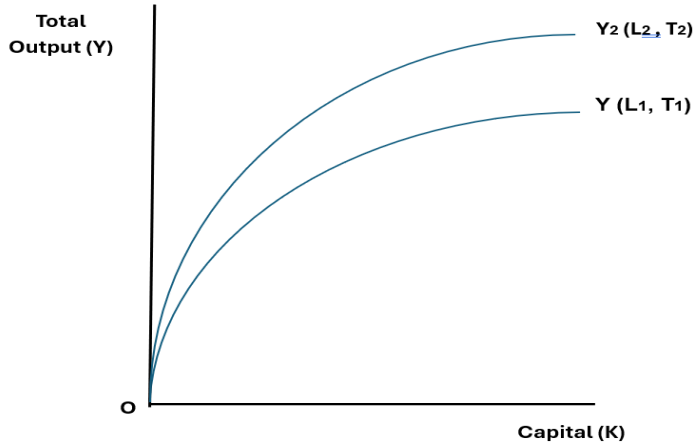

Figure 3. Effect on Total Output Function of Increase in Labour and/or Technology

Accounting for Economic Growth

Given that:

Y = Y[K, L, T]

a change in Y must be due to a change in K, L, or T. That is:

$$dY = \frac{\partial Y}{\partial K}dk + \frac{\partial Y}{\partial L}dL + \frac{\partial Y}{\partial T}dT$$

What explains the behaviour of these variables?

L, as we have noted, refers to the total productive labour force. The productive labour force is a function of the total population and the share of the population which is engaged in productive labour (αP). The productive labour force will increase if population is rising and the share of the population engaged in productive labour is constant or rising. Population increases so long as the actual wage is above the subsistence wage ($W_A > W_S$).

Now consider technology or technical efficiency (T). Technical efficiency is assumed to be a function of the extent of the market and the productivity of capital. Thus:

$$T = T(m, t)$$

where:

m = extent of the market

t = technical efficiency of capital

Assuming a closed economy, m is the size of the domestic market available and this depends on the total income of those within the country, which is Y. As the economy grows and income rises, so does m. In other words:

$$m = m(Y) \qquad \text{where } \partial m/\partial Y > 0.$$

The growth in the market increases productivity due to the division of labour. When workers specialise in particular trades (so rather than a farmer also making his own shoes and tools he specialises in farming and buys his shoes from a shoe maker and his tools from a toolmaker), and within those trades workers specialise in particular tasks (so a shoe maker doesn't make an entire shoe himself, but divides the task between people who make the soles, people who make the uppers, and others who join the two together and so on), then they become more proficient and more productive. Such division of labour boosts output through what we now call *learning by doing.* The more we do something the better we get at doing it – which means inputs per unit of output decline.

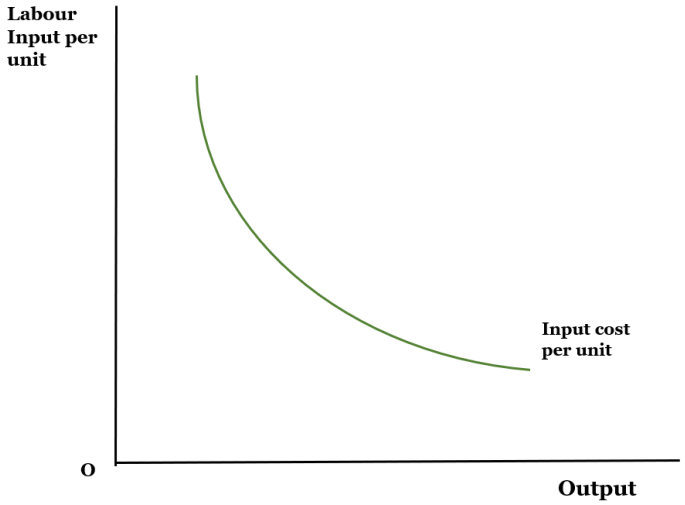

Figure 4. Learning by Doing

Smith attached considerable importance to the division of labour as a source or economic growth and prosperity. As he wrote in the opening chapter of *The Wealth of Nations*

> The greatest improvement in the productive powers of labour, and the greater part of the skill, dexterity, and judgement, with which it is anywhere directed, or applied, seem to have been the effects of the division of labour … The division of labour … occasions, in every art, a proportionable increase in the productive powers of labour … It is the great multiplication of the productions of all the different arts, in consequence of the division of labour, which occasions, in a well-governed society, that universal opulence which extends itself to the lowest ranks of the people.[1]

The extent of the division of labour, Smith famously remarked, is 'limited by the extent of the market.'[2] If it is to be worthwhile building a factory with lots of workers doing specialised tasks, it needs to be possible to *sell* the finished product at a profit. If the available market is small (say, a country is poor or transport costs limit sales to a small town) then an extensive division of labour is impossible. Thus, the larger is an economy and the better-off are its residents, the larger the potential market and the greater the division of labour. This is why m is a positive function of Y.

The level of technical efficiency, t, depends on the degree to which machines and sophisticated production processes are employed. Such technical efficiency will require more fixed capital per worker and also more 'round-about' or longer production processes which mean the employer needs to advance more circulating capital to pay wages and for raw materials. Hence, Barkai expresses the level of productive technology as a function of the amount of capital were worker:

[1] *Ibid*., pp. 5, 7, 12.
[2] *Ibid*., p. 19.

$$t = t\left(\frac{K}{L}\right) \qquad \text{where } \partial t/\partial(K/L) > 0$$

So, technical progress is a positive function of the capital-labour ratio: as the amount of capital deployed per worker rises, so will the technical productivity of the production process.

It is, however, 'capital accumulation' or investment which is the chief source of growth in Smith's growth theory. Although he begins the *Wealth of Nations* by highlighting the role of the division of labour, it is actually the accumulation of capital which drives the growth process. As H. Landreth and D. Colander write:

> Capital is the chief determinant of the wealth of nations. Smith stated that the rate of economic growth depends in large measure on the division of the total output of the economy between consumer goods and capital accumulation. The larger the proportion of capital accumulation to total output, the greater the rate of economic growth.[1]

Net capital investment which increases the total capital stock will:

a) Raise output (Y) directly since Y is a function of K.
b) Increase the extent of the market (*via* Y), promoting the division of labour.
c) Increase the productive labour force by putting more labour to work (increasing employment).
d) Provide the increased wages that causes population to increase and with it the productive labour force.
e) Increase fixed capital per worker and so the capital-labour ratio.

Joseph Spengler summarises:

> Capital accumulation played a major role in Smith's theory of economic development, serving to augment employment, to provide workers with better equipment, and, above all, to make possible extension of division of labour; it thus served to increase both output per worker and total output.[2]

Capital investment is the engine of economic development. Put simply:

$$Y = f(K)$$

[1] H. Landreth and D. Colander, *History of Economic Thought* (Houghton Mifflin Company, Boston, Third Edition, 1994), pp. 79-80.
[2] J.J. Spengler, 'Adam Smith's Theory of Economic Growth – Part I', *The Southern Economic Journal*, Vol. XXV (April 1959), p. 405.

What Determines Capital Investment?

Capital investment depends on two things: saving (S) and the rate of return on investment (π). That is:

$$I = I(S, \pi)$$

The relationship between investment and saving is most important. Smith assumed that saving always leads to investment:

$$S \equiv I$$

Saving is that part of income that is not consumed. When a person saves, says Smith, they do not leave that saving to sit idly – that would be pointless, and they might as well consume it. Rather, they save to invest at a rate of return. 'That portion of his revenue which a rich man … annually saves … is immediately employed as capital …'[1] Workers do not save – saving is done by capitalists chiefly, but also by some landowners. For Smith, saving is a function of income:

$$S = S(Y)$$

This relationship is familiar to students of Keynes. Other things being equal, the more income someone has the more they will save:

$$S = \alpha Y$$

where α is the Average Propensity to Save (which is equal to the Marginal Propensity to Save). What determines α are cultural norms. When peoples are frugal and careful with their income they save a high share; when they are profligate or like to keep a large retinue of servants, they save a small share. 'Capitals are increased', he writes, 'by parsimony, and diminished by prodigality and misconduct.'[2] This indicates how, in Smith's analysis, institutions, cultural attitudes, and the distribution of income all help to determine saving and hence investment. A country which is stable, where property rights are secure, thrift is encouraged, taxes are low, and most income (after deducting for wages) goes to capitalists, will save and invest more and experience a higher rate of economic growth. A country which is politically unstable, where property rights are not secure, spending is encouraged, taxes are high, and where a higher portion of total income goes to workers and landlords, will have lower rates of saving, investment, and growth.

However, capital investment by itself does not guarantee sustained economic growth. As we have seen, increasing capital inputs relative to labour and technology yields

[1] Smith, *Wealth of Nations*, Vol. I., p. 320.
[2] *Ibid*.

diminishing marginal returns – or, as Smith puts it, capital accumulation tends to cause profit-rates to decline.

Capital Accumulation and the Rate of Profit

Smith was clear that, as capital accumulation proceeds, the rate of profit on investment (π) will decline. 'The increase of stock', he writes, 'tends to lower profit.'[1]

$$\pi = \pi(K) \qquad \text{where } \partial\pi/\partial K < 0$$

Smith believed this had historically been the case, citing the long-run downward trend of interest rates in developed countries. Since the rate of interest someone was prepared to pay on a loan reflected the rate of return they expected to derive from investing it, the fact that interest rates had fallen since the sixteenth century (in Britain and in other European countries) stood as *prima facie* evidence that rates of return on investment had declined. In North America, for example, 'both the legal and the market rate of interest have been considerably reduced during the course of the present century. As riches, improvement, and population, have increased, interest has declined.'[2] Why was this? Smith gives various explanations, but the simplest is that it is due to diminishing returns. As more capital is invested, the most productive and profitable opportunities are exploited first. With capital stock rising, less profitable outlets are pursued, and so the rate of return on capital and hence the interest rate declines. 'As capitals increase in any country, the profits which can be made by employing them necessarily diminish. It becomes gradually more and more difficult to find within the country a profitable method of employing any new capital.'[3] Since the marginal productivity of new capital declines, the growth rate declines – since remember, capital is the engine of growth. New investment grows more slowly for two reasons. First, as income growth slows, so will the growth of saving, and saving is the source of investment. And second, as the rate of return on investment (and hence saving) falls, those with income will have less reason to save and the Average Propensity to Save will decline. And as the growth in the capital stock falls, total output growth slows. This continues until a stationary state is reached. With rates of return on investment just equal to that return necessary to cover risk, no net-investment occurs and the capital stock stops growing. Income and saving stop growing also. And with no additions to the capital stock, the demand for labour stops growing and population growth causes wages to fall back to the subsistence level, at which point population and labour supply also cease to increase. Smith considered that this was

[1] *Ibid*., p. 89.
[2] *Ibid*., p. 94.
[3] *Ibid*., p. 335. Though Smith then confuses matters by attributing falling profits to upward pressure on wages as capital accumulation proceeds. While rising demand for labour might squeeze profits in the short run, it could not explain a secular decline in profit rates over time since higher wages lead to higher population and labour supply: there cannot be a permanent labour shortage.

the condition China had attained in the eighteenth century, with stagnant output and wages at subsistence level. **Figure 5** illustrates this outcome.

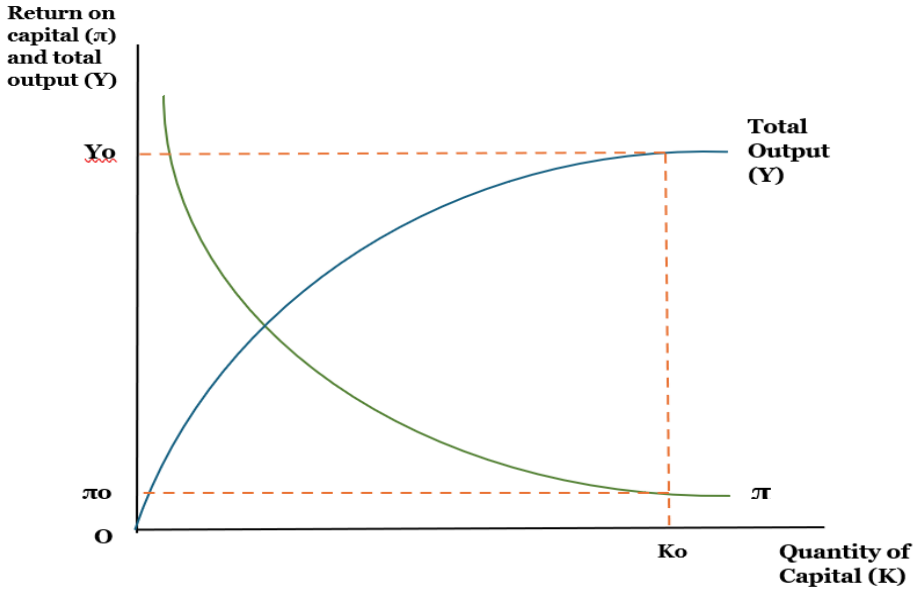

Figure 5. The Declining Rate of Profit and the Stationary State

This diagram shows how, as the capital stock increases, the rate of return on capital declines until at Ko the rate of return, πo, is just sufficient to cover the risk of investment. At this point further capital accumulation ceases and total output (Y) also ceases to increase. Output, capital stock, and population all cease to grow and the stationary state is attained.

Sustained Growth: How to Avoid a Stationary State

Contrary to later Classical theorists like Ricardo and Mill, Smith's *Wealth of Nations* is not governed by expectations of a future stationary state. Smith was fundamentally optimistic, and believed that, for Britain, economic growth could be sustained, with rising capital accumulation, increasing output, and improving living standards. Several aspects of his system suggest such a positive prognosis.

The central factor promoting growth is, as we have seen, capital accumulation. Although the accumulation of capital exerts a downward pressure on profit rates, a series of endogenous growth-effects off-set this tendency.

1) First, capital accumulation generates growth and rising output (income). This, in turn, expands the available market for goods, and this extension of the market increases the scope for the division of labour. Rising Y causes m to increase, which in turn raises the technical efficiency of capital. As a result, the total product line shifts up for any given level of capital stock, raising the rate of return on investment and counteracting the falling rate of profit.

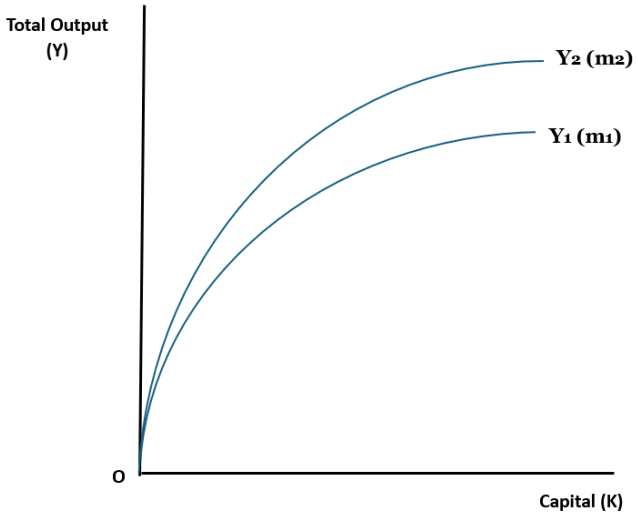

Figure 6. Increased productivity of Capital due to Extended Division of Labour

Thus, as the division of labour extends, the output associated with any given level of capital input will increase

2) So long as capital accumulation exceeds the rate of growth of population, capital per worker (K/L) will rise. Rising capital per worker will permit greater use of technology, and this, too, will shift upwards the total product function and raise the rate of profit.

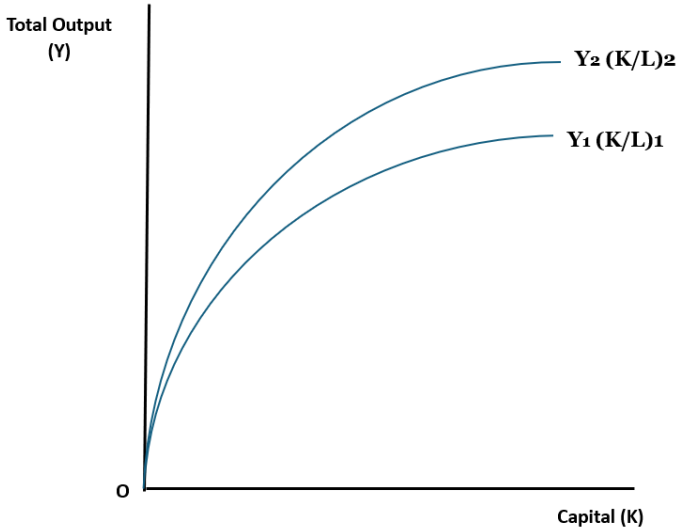

Figure 7. Increased productivity of Capital due to Technical Progress

3) Capital accumulation increases the demand for labour which keeps wages above subsistence levels, ensuring labour (L) supply grows, providing more workers and more consumers.

4) Rising incomes mean increased saving, helping to keep capital accumulation positive.

The net effect of these positive-feedback processes is to cause the total product curve to shift upwards, which means that the output for any given level of capital stock will rise.

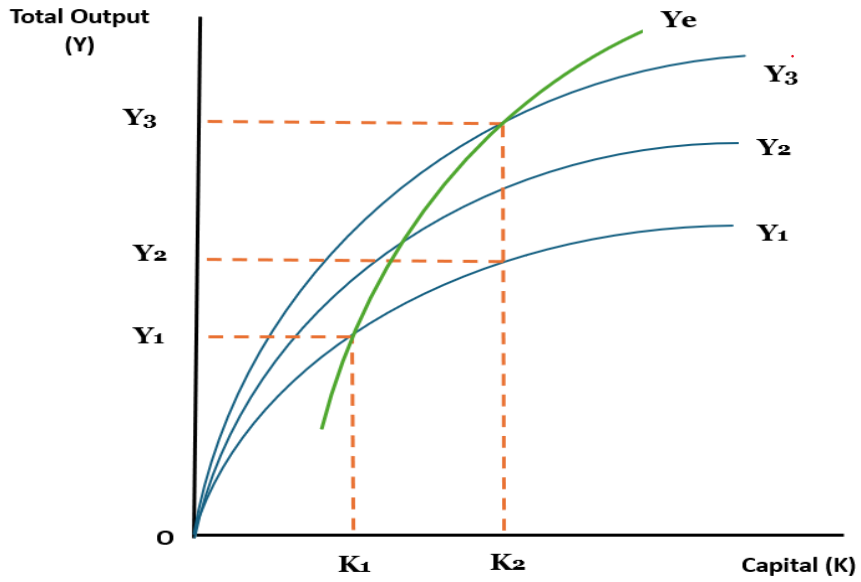

Figure 8. How Capital Accumulation Raises the Long-Run Growth Trajectory of the Economy

In this diagram, an initial increase in capital stock from K1 to K2 generates successive increases in the income-capital line due to greater division of labour and greater technical progress. The increase in capital inputs K2 – K1 causes an increase in total output Y3-Y1, of which Y3-Y2 is due to induced increases in productivity. Ye is thus the long-run growth path of the economy.

Thus, Smith saw capital accumulation, in which manufacturers advance wages and raw materials to workers (circulating capital) and supply tools and machinery (fixed capital) as the key to sustained economic growth. It promised to raise productivity *via* division of labour and technical progress and thus off-set the effect of diminishing marginal returns. To promote such capital accumulation a society needed to be abstemious and save a significant share of its total product. A society with a high propensity to consume and low propensity to save would invest less and its dynamic growth prospects would be diminished. Smith saw high saving rates as determined primarily by cultural factors: society's promoting saving, prudence, and self-restraint would save and invest more than those associated with profligacy and a preference for consumption. They also reflected stable institutional structures which rendered investments secure and returns predictable. Hence, protection of property rights, freedom to invest, and open access to trade all promised to yield an advancing economy with rising productivity and living standards.

Threats to Sustained Growth

But sustained growth was not guaranteed. China, as we have noted, provided an example of a once prosperous country which had arrived, by the eighteenth century, at a stationary state. What things could bring a stationary state about?

a) *One was diminishing returns in agriculture*. Barkai's model does not include land as a factor input, which is a limitation. Several economists have noted that land is a significant constraint in Smith's model. The availability of good land is limited, and thus as population and demand for grows, along with demand for raw materials, the real price of primary products rises as recourse must be made to lower-productivity (and thus higher-cost) land. As a result, the price of raw materials rises as will wages as the price of foodstuffs increases. Diminishing returns in agriculture thus represent a drag in Smith's growth system, especially since Smith believed that the division of labour was much less practicable in farming. Walter Eltis has developed a Smithian model in which long-term growth requires that economies of scale arising out of the division of labour and technical progress in the manufacturing sector more than outweigh diminishing returns in the primary goods sector. So long as it does, the rate of capital accumulation will remain positive and capital stock continue to increase. If it does not, then the rate of profit and rate of capital accumulation will decline over time, resulting in a stationary state.[1]

b) *An increasing unproductive labour force*. Output is positively correlated with an increasing supply of productive labour. If the share of labour that is used unproductively increases (more servants, entertainers, social media influencers, sportspeople) then this will slow the growth of capital and output. Smith saw the retinues of unproductive labour maintained by kings and aristocrats through history as hindering growth, and the relative decline of such spending on unproductive labour had contributed to the greater opulence of the eighteenth century: 'We are more industrious than our forefathers; because in the present times the funds destined for the maintenance of industry, are much greater in proportion to those which are likely to be employed in the maintenance of idleness, than they were two or three centuries ago.'[2] Smith would have been unlikely to take a favourable view of the expansion of the unproductive population since 1945.

c) *Taxation*. Our model contains no government. One effect of government is to introduce taxation as a deduction from the total product, which will reduce the resources available for saving and investment. Of course, the state may invest productively. But if (as Smith assumed) its spending was largely unproductive –

[1] For Eltis's model, see W. Eltis, *The Classical Theory of Economic Growth* (Macmillan, London, 1984), pp. 91-96.
[2] Smith, *Wealth of Nations*, Vol. I., p. 318.

especially if it used taxation to make transfer payments to unproductive individuals – then an expanding state can be expected to slow growth. Again, such a growth in unproductive state spending has been a feature of post-war economies and in itself will bring forward the stationary state.

Smith wrote at a time when the prognoses for growth were positive: trade and the division of labour was expanding, technical progress accelerating, unproductive court expenditure was diminishing, tax rates were low, and the emerging entrepreneurial class professed a protestant religion which deprecated conspicuous consumption and advocated thrift. Hence he looked forward to continuing economic growth and generalised opulence – a distinctly more optimistic vision than that of his classical economic followers such as Malthus, Ricardo, and Marx, for whom subsistence wages and an end to growth seemed more imminent prospects.