DE-INDUSTRIALISATION

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1. Introduction.

From time to time, and in various guises, the issue of de-industrialisation is raised. Sometimes the central concern is the dereliction of a once staple industry, sometimes the effect on UK trade, sometimes the decline of the proportion of GNP related to manufacturing, sometimes a discussion of whether industry matters so much when the rapidly developing sector is now services.

These discussions tend not to start at the beginning, which is assumed, naturally, to be largely known. The terms of the discussion, such as output and productivity, are thus used as if their meanings were perfectly clear. They are not, of course, but no purpose would normally be served by continually rehearsing this, as long as the subject is year to year economic development. When the period concerned is decades and centuries, it is necessary to be more explicit.

2. Background.

Perhaps the first point to clarify is a self-evident one, but, since it runs counter to usual perceptions, one that is easily lost sight of. This is simply that the producer and the associated technology are primary. The monarch, priest, warrior, scholar, administrator, merchant and shopkeeper are secondary. The fundamental difference between the first civilised societies and primitive societies, was not the cultural and structural notions we associate with civilisation but the less interesting fact of agriculture. It required millenia of technical progress by producers to free gradually a small fraction of the population, finally perhaps one fifth, from the necessity of production, to lead, think and serve. The paradox that the more esteemed is also the less important will appear several times in this paper.

In the same way, the essential difference between the society of Adam Smith and that of today is not the vast expansion of services, but the advances in technology which have reduced agricultural effort from 80% to 5%, and led to the situation where another 25% produce most of the things we need, liberating the majority to lead, think, and serve.

The pre-historic agricultural revolution was just as explosive as the industrial revolution. They are both parts of one continuous process of innovation, albeit one with accelerative phases separated by several millenia. The essential basis for each was the use of solar energy, the first directly to raise crops and animals, the second indirectly by releasing the stored solar energy in fossil fuels. A consequence of this single continuous process has been the increasing liberation, at varying rates, of labour from the needs of production.

The producers have thus shrunk from nearly 100% in the primitive society to 30% or less today. As the productive force dwindles numerically, it is little wonder that it may begin to seem that it is of less importance, when in fact it is the continuing sine qua non of modern society.

3. Productivity.

The numerical decrease of the productive labour force while production increases can be described as an increase in productivity. There is no difficulty in this change of vocabulary, except that the objective ring of the word can obscure the fact that any attempt to quantify it, especially as a function of time, is fraught with difficulties. Indeed, the compilation of tables of numbers denoting, say, annual increase in labour productivity, is useful only when considering a limited region of space and time. Rigorous quantification is, in general terms, impossible. There is no objective way of comparing the productivity of a medieval shipbuilder with that of a present day shipbuilder, still less with that of a spaceship builder. All we know is that a modern worker is vastly more productive.

A further problem is that the ratio denoted by this word, namely items produced over labour involved, is subject to wholly arbitrary decisions as to the definitions of both its numerator and its denominator. A computer systems analyst is by no means a service worker in the sense of a barber or a nurse, but the item he produces, and the scale by which he can be said to be producing more items today than yesterday, are not easy to define. Similarly, in an industrial enterprise, the size of the work force to which the productivity gains are to be ascribed is not a matter for objective assessment. Secretaries, personnel staff and so on may or may not be included, or the staff of such outside consultants as may be employed.

What has this to do with the problem of de-industrialisation? Well, in discussing de-industrialisation, we must constantly be aware that there are difficulties in knowing or objectively measuring what we are talking about, and still more in assigning an importance to it. These are not just difficulties in the sense that a lot of care and effort is needed to surmount them. They are in principle insurmountable. There is thus a lot of room for undeclared pre-judgement and emotion to be felt to be fact, and presented as such.

4. Numerical illustration - preamble

In order to pursue the matter further, a numerical illustration will be given. But first some necessary remarks will be given on productivity, wages, and prices.
Since the output of a given group of people, measured in current money terms, is simply the sum of their incomes, and since across the various activities of society people by and large have comparable incomes, it follows that productivity, measured in value-added current money terms, is about equal for every type of activity. Also it changes from year to year only in so far as real GNP per worker changes (but note that the quantification of GNP, and of real GNP, suffers from exactly the same difficulties as those mentioned above for productivity). If this basic reality seems surprising, it is

only because economists and commentators stress the detailed departures from this general picture. Money and success for individuals (or enterprises, or nations) are obtained by momentarily taking advantage of an advance, that is an increase in productivity, before its fruits diffuse throughout society. The fact that, level for level, incomes in all spheres of activity, the traditional as well as the innovative, are roughly equal, demonstrates the reality of this diffusion. A person is paid as a person, irrespective of his product, so his productivity in current money terms is essentially his wage, and his wage is more or less the same as everyone else's. The productivities in real or volume terms that are tabulated for different activities at different times may be obtained by performing an anachronistic calculation, i.e., by pricing the worker's output today at yesterday's prices. In principle, productivity can be measured just as well by the change in price as by the change in volume. If it can be said that the average worker's yearly wage can today buy 4 small cars, whereas 30 years ago it could buy only one, then a car worker's productivity has increased about four-fold (car workers being understood to mean all persons involved in the final product). The fact that the small (how small?) car of today is not at all comparable with the small car of that time is one of the insuperable difficulties already referred to, which ensure that the answer to a question on productivity gain over a long period is more defensibly "a lot", or, "various experts would, with many qualifications, obtain results around 4", than, say, "a factor of 4.27".

Cases of the latter essentially spurious precision can be found (and must be found, since there is no computational alternative) in any compilation of relevant statistics. For example, in an invaluable and rightly esteemed work, on the second page of the text, and without caveat, may be found lists of numbers which imply that the GDP/head in real terms of the UK in 1989 is 12.94 times that of Austria in 1820. Another universally ocurring example is the fact that official statistics of GNP at current, or constant (anachronistically calculated), prices are given to an absurd number of significant figures, in the case of Italy to an apparent precision of one in a million. This is a number which in its relation to reality, however defined, might be defensibly given to a precision of 1 in 10, or at best, 1 in 1000.

In the numerical example given below, the radical simplification is made that the products do not change with time. Only the technology does. In this way, the wholly unquantifiable element of changing quality (the extreme form of which is complete novelty) is eliminated. This means that productivity, so long as it is confined to one good, has a precise meaning. Every person is paid the same wage, receiving his/her equal share of the total product. As explained above, this is not as unrealistic as it sounds, and in any case could equally well be understood to refer to average wage in each sector of activity.

Economic activity is assumed to be divided between two sectors, one capable of a high rate of increase of productivity, the other not. These are called the primary and secondary sectors. The first may be visualised as embracing agriculture and industry, the second services, but it is the rate of change of productivity which is the essential distinction between them, not the nature of the activity. The economy consists of one unchanging primary product and one unchanging secondary product - say golf balls and haircuts. In order to avoid the repetition of clumsy phrases like "wages are so many currency units per unit time and unit of labour", or the invention of new name

for a fictitious currency unit, the units used here will be pounds, years, persons, and "items" of the two goods involved. To simplify the numbers, the state consists of one person, although this can be thought of as one million or one billion if wished. The person is always employed, or, what is the same thing, any idleness is incorporated in the value of the productivity. The starting conditions begin with setting the wage at one pound per year. This defines the currency. At this starting point we are free to define what is meant by an item of each good, and we define it as the production of one person in one year. Therefore, at the datum point, the productivity in both sectors is one item per person and year. The price of the item is the wage of the person, so it is one pound per item in both sectors. GNP per year, wage per person and year, and price per item are all equal to one pound. To summarise, a pound buys a primary or secondary item which initially takes one person-year to produce, the wage of course being also one pound.

As long as one deals with one good of fixed quality, there is no problem in principle or in practice. The above definiton of currency or of an item is arbitrary but not subject to any conceivable objection. However, the above has implicitly introduced the notion of value, because, in assigning a price of one pound to each item, it is arbitrarily fixing that one item of an primary good is of equal value to one item of a secondary good.

As explained above, there is no objective way whatever of justifying this. Whether the value of 1 kg. of water is less than, equal to, or more than, that of 1 kg. of gold depends entirely on the circumstances in which the question is posed. One can only assign the values which pertain by chance at one point in time, in our case the datum time, and stick to this, anachronistically as said above, at all later (or earlier) time. This is what official statisticians do, and must do, only they move the datum time forward from time to time, as the differences in quality (which are not present in the present formulation) and distribution (which are present) of goods become too great for the process to remain credible. It is important to acknowledge, and keep constantly in mind, that this process, no matter how dedicated the practitioners, is fundamentally not science. It is a modus operandi.

The GNP at later times, is shared equally among workers. The wage of the worker in the more productive sector therefore reflects the mean productivity of the economy, is in fact the GNP/head, so the price of items (wage costs divided by the number of items) in this sector continuously falls. In current terms, the primary fraction of GNP is simply the labour fraction, which is numerically the same as the item output costed at current prices. In real terms , however, the primary fraction of GNP is the output costed at datum prices. "Real" is used here equivalently to its normal use in the context of economic statistics, but, as explained, the basis for its quantification is in no sense real, but depends on an entirely arbitrary choice of datum time.

5. Numerical example - formulation.

The formulation, given data, and starting conditions are given in the appendix. The algebra gave some indispensible insights, but the text can be read without a study of it.

6. Numerical illustration - results.

It is assumed that primary productivity rises at 5% per year, while secondary productivity grows at only 0.5% per year. In order to determine the evolution of the primary and secondary work forces, it will be assumed that some circumstance constrains GNP growth to 2.5% per year. So the factors of growth per year are

p(p)=1.05
p(s)=1.005
g =1.025

where p and g denote the productivity and GNP growth rates referred to above. The actual productivities and GNP are denoted by P and G.

Since the GNP is simply related to the labour forces and productivity, it is found that at all times apart from T=0
the primary fraction of the labour force is

$$L(p)=(G-P(s))/(P(p)-P(s)).$$

At datum time (year 0), G(0), P(p,0), and P(s,0) are all set at unity, so L(p,0) is indeterminate from the above formula. It can be verified, however, that at this point (and only at this point), L(p,0) is given by the same formula, with the G and P's replaced by their rates of growth

$$L(p,0)=(g-p(s))/(p(p)-p(s)).$$

The given rates result in L(p,0)=0.44.

Thus, with G and the P's being given at all times by the starting values combined with the growth rates, all prices and outputs can be calculated for the datum and any later or earlier year, using the simple algorithms given in the appendix. The results are given in Table 1.

A line by line commentary for the 200-year period -100 to +100 will be given, in order to explain the formulation and at the same time the results.

The primary labour force, line 2, diminishes, while the secondary one rises at a rate of the order of 1% per year (line 3). In absolute terms, of course, the rates for any given time are equal and of opposite sign. The productivities, line 4, grow at 5% and 0.5% per year as defined. The output in items, line 5, is the product of these two elements of data. The items are valued at the datum (year 0) price of one pound, so the GNP by volume of product, line 6, is numerically the same as the number of items, the total GNP (column 3) being that imposed by the given growth rate. It is here, of course, that the arbitrary process of adding apples and pears takes place, reflected later on line 12.

Table 1

Simple Economy: Evolution of Various Parameters with Time

Primary Sector Growth rate of productivity 5% per year

	Year	-100	-50	0	10	30	50	100
2	Labour force	0.87	0.71	0.44	0.40	0.30	0.21	0.08
3	Deind rate (%/y)	-0.26	-0.62	-1.20	-1.33	-1.57	-1.79	-2.15
4	Productivity *	0.01	0.09	1.00	1.63	4.32	11.47	131.50
5	Output (items)	0.01	0.06	0.44	0.65	1.28	2.43	10.30
6	Volume (money) **	0.01	0.06	0.44	0.65	1.28	2.43	10.30
7	Wage (money)	0.08	0.29	1.00	1.28	2.10	3.44	11.81
8	Price (money)	11.13	3.34	1.00	0.79	0.49	0.30	0.09
9	Infl(T) (%/y)	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41	-2.41
10	GNP (money)	0.07	0.21	0.44	0.51	0.62	0.73	0.92
11	GNP-fract	0.87	0.71	0.44	0.40	0.30	0.21	0.08
12	Vol-fract	0.08	0.21	0.44	0.50	0.61	0.71	0.87

Secondary Sector Growth rate of productivity 0.5% per year

	Year	-100	-50	0	10	30	50	100
2	Labour force	0.13	0.29	0.56	0.60	0.70	0.79	0.92
3	Deind rate (%/y)	1.79	1.49	0.99	0.87	0.66	0.48	0.18
4	Productivity *	0.61	0.78	1.00	1.05	1.16	1.28	1.65
5	Output (items)	0.08	0.23	0.56	0.63	0.82	1.01	1.52
6	Volume (money) **	0.08	0.23	0.56	0.63	0.82	1.01	1.52
7	Wage (money)	0.08	0.29	1.00	1.28	2.10	3.44	11.81
8	Price (money)	0.14	0.37	1.00	1.22	1.81	2.68	7.17
9	Infl(T) (%/y)	1.97	1.97	1.97	1.97	1.97	1.97	1.97
10	GNP (money)	0.01	0.09	0.56	0.77	1.48	2.71	10.89
11	GNP-fract	0.13	0.29	0.56	0.60	0.70	0.79	0.92
12	Vol-fract	0.92	0.79	0.56	0.50	0.39	0.29	0.13

Totals/Averages Growth rate of GNP 2.5% per year

	Year	-100	-50	0	10	30	50	100

2	Labour force *	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3	Deind rate (%/y)							
4	Productivity							
5	Output (items)							
6	Volume (money) *	0.08	0.29	1.00	1.28	2.10	3.44	11.81
7	Wage (money)							
8	Price (money)							
9	Infl(T) (%/y)	-1.82	-1.10	0.01	0.25	0.69	1.06	1.64
10	GNP (money) *	0.08	0.29	1.00	1.28	2.10	3.44	11.81
11	GNP-fract	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	Vol-fract	1.00	1.00	1.00	1.00	1.00	1.00	1.00

* "given" data
** at base (year 0) item prices

The wage, line 7, is by definition the same as the total GNP, since there is one person and the GNP is shared equally between the workforce in the two sectors. The wage thus increases at 2.5% per year. The price per primary item, line 8, steadily decreases. In fact, since
it is the wage divided by the productivity (the labour content cancelling), it must diminish at a rate which is roughly the difference between the growth rates of these two parameters, or -2.5% per year (the exact value is -2.41%). Similarly, the price of secondary items increases at approximately 2% per year (exact value 1.97%). It is a consequence of the definition of the currency unit that the average (or item-weighted) price per item is always one pound, i.e., in this economy, there is zero inflation.

There is, however, a small apparent inflation of prices. In the real world, inflation of prices is, by definition, calculated by comparing today's prices with yesterday's. Of necessity, this can only be done by costing a certain basket of goods at the two sets of prices. As discussed generally above, this means that there is unavoidable anachronism in the sense that today's basket is different from that of yesterday. In the real world there are differences both in the distribution of goods (i.e., how many of each sort), and in the quality (i.e., some may be improved, some wholly novel), so that an objective and accurate calculation is in principle impossible. In the simplified world of the above table, the goods are supposed to be unaltered in quality, but the distribution changes. Inflation of prices in each sector separately are constant and can be calculated precisely, as already described above. The overall inflation rate is calculated by pricing yesterday's basket at today's prices. (It has been explained above that the synchronistic inflation rate is zero - today's or yesterday's basket, costed at, respectively, today's or yesterday's prices, always has an average item price of one pound.) The apparent inflation rate can be calculated according to the basket of last year or of any time in the past. Numerically, it makes little difference what datum is chosen. The value shown in the table (line 9, 3rd section) relative to one year is the instantaneous value at the given year. This over-estimation of the inflation rate due to the use of an anachronistic basket in the calculation well known. Since generally inflation rates are calculated against a basket defined up to 10 years earlier, the appropriate degree of overestimation in the model is about one quarter of one percent. In the real world, small or radical innovations result in continual improvements in quality, i.e., the golf ball becomes not only cheaper but also better. This is ignored both in the present formulation and in official calculations.

The GNP by income, line 10, is simply the wages of the labour force, totalling, of course, to the same value as the GNP by volume of produce. This identity follows from the fact that the wage is by definition the GNP, i.e., in this one-person state, the GNP/head.

Lines 11 and 12 show the fraction of GNP represented by each sector, discussed further in the next section.

7. De-industrialisation

Lines 10 and 11 show that the fraction of GNP represented by the primary or secondary sector is very different when calculated by volume and by income. When

alarm is expressed at de-industrialisation, it is usually in terms of the fraction of GNP at today's prices, or by income in the sector in terms used above, or by fraction of the labour force employed. These are all approximately equivalent in the real world, and exactly so in the formulation used here. The table shows that de-industrialisation of GNP and employment can proceed apace while the real situation is that well-being is being more and more assured by a growing volume of primary goods. At the end of the 100-year period relative to the datum year, the primary sector has shrunk to only 10% of the GNP or the work force, but, by the standards of 100 years earlier, primary goods account for 90% of total well-being. In other words, although the primary labour force has diminished by a factor of 5, primary goods have increased by a factor of 20, while, on the other hand, a near-doubling of the work force in the secondary sector has expanded secondary goods by only a factor of three. The increase in total GNP, and the current level of GNP at T=100, are accounted for almost entirely by primary activity.

If one takes a 200-year span (here it is necessary to re-state that the "year" is a mythical year), the primary labour force diminishes by a factor of 9, while primary output rises by a factor of 1500.

It will be remembered that any statement above referring only to one sector is, within the terms of the formulation, exact, while any reference to total well-being or GNP or sector share are to be evaluated with all the caveats made above. That is, the phrases "by the standards of 100 years earlier" and "90% of total well-being" are quantitatively virtually meaningless (and similar statements about the real world even more so), except, and that only to some extent, by reference to the modus operandi lying behind it.

The picture presented suggests, with all due reservations, that de-industrialisation is not the doom-laden process sometimes portrayed, with images of derelict factories, and scenarios of Britain leading the way downwards, but an inevitable and universal consequence of the fact that the motor of progress, by the very fact that it is the motor of progress, works people, whether farm or factory workers, out of a job, or, in an alternative formulation, frees them for better things.

8. The bias of language

De-industrialisation is a very poor word for this process, at least for the discussion of economics as opposed to sociology, since it suggests that industry, after a period of going up, is now on its way down. This no doubt is due to the contemplation of the fact that unemployment is going up while the industrial labour force, which once went up in the process known as industrialisation, is now coming down. The fairer picture, it is suggested, is that the primary sector, including food-gathering, hunting, and agriculture, as well as ancient and modern manufacture, has always been in decline in terms of the fraction of the labour force employed, albeit at an accelerating rate, and this decline is the essential counterpart, indeed the cause, of the rise of civilisation. It adds to the confusion and paradox that the process of decline has, in real terms, been one of stupendous advance. It is only due to it ("de-agriculturalisation" at that time)

that Plato was enabled to spend his life in thinking, teaching and writing instead of in hunting small animals or picking berries.

While the complete phrase "de-industrialisation of employment" is a reasonably clear and neutral expression, the fact that it is almost always shortened to "de-industrialisation", and then loaded with negative images and qualifications, conveying that it is in fact the opposite of industrialisation, and mainly or entirely a problem, means that the word should be avoided altogether. This applies even more strongly to "post-industrial", which is often used in the same contexts, and for which there is no possible defence.

As illustrated copiously above, language has its own dynamic. A bottle can be half full or half empty. The same process, which freed Plato for teaching, freed the farm labourer for the city slums, and frees the factory worker for the dole queue. Alternatively they, or quite realistically their children, have been freed to become today's script writers and financial consultants. In any case, it seems that the using of negative language like "decline" or de-"anything" to discuss a process which is not only a facet of progress, but is synonymous with everything one has ever understood by progress, is a wrong turning which should be rectified.

9. Public services and taxes.

The public services, that is, services provided through taxation, are in great part activities which have a tendency to be in areas less susceptible to high productivity gains. Assuming that people generally are just as keen to have better public services (such as health and education) as private ones (such as banking), it follows that de-industrialisation, or progress as it might be better called, must be accompanied by a growth in the fraction of GNP represented by public services, in line with services in general. For example, if in year 0, public services were half of all services, and so 25% of GNP, then by year 100, if they improved in line with all services, they would represent 45% of GNP. The consequence would be that if public provision of these services was still desired, taxation would need to rise from 25% to 45% of GNP, and hence of incomes. Ignoring details, this must indicate a tendency, at least, for related taxation to rise, as a fraction of income, from the mere fact that the services provided by taxation have less room for productivity gains than the average for all economic activity. The alternative to tax rises could only be a privatisation of some services which are at present provided collectively. Whichever way is chosen, to say, as is currently fashionable, that we cannot afford to pay an ever increasing fraction of income for these services, is just as absurd as to say that we cannot afford to pay an ever increasing fraction of income for better banking and leisure services.

10. Diffusion of productivity gains.

One of the striking elements in the above analysis is the equalisation of the benefits of high productivity throughout the population. Give or take a few inequalities, this reflects an observable reality. The benefits, which originate with the innovator and

are mediated by the capitalist and machine operator, are transferred virtually instantaneously to the barber and banker. However, the equalisation tends to stop at certain frontiers. Even small natural barriers, like the Irish Sea, seem historically to have obstructed the process of equalisation. This must partly be due to the geographical range within which services can be delivered, e.g., the factory worker necessarily transfers his money to the nearby barber, and partly to the mobility of labour, e.g., the barber would become a factory worker if his income would thereby be greatly improved. Clearly, goods are relatively mobile, and services tend not to be. If, somehow, a UK primary worker could conveniently have had his hair cut in Bangladesh, and the Bangladeshi barber could somehow not conveniently take the UK worker's job, and this could have been true of all services, the workers within the high productivity gain sector would have been able to keep the fruits of their productivity. The fact that this convenience is not available presumably explains the rather mysterious contrast between the rapidity of diffusion of prosperity in certain geographical areas, compared with persistence of inequalities between those areas and others. It is as if the populations of the advanced countries had managed to keep the fruits of advanced technology, not to the workers in those advanced fields, but to a boundary defined essentially by distance measured in terms of transport costs, and by linguistic, cultural and administrative features.

One may speculate that the likely globalistion of culture and communications may well have the effect of globalising incomes in the same way that national incomes have been internally diffused. In that case, for many, the equalisation could be, at least for a prolonged period, downwards.

11. Full employment.

In the above formulation, the transition rate between primary and secondary activities amounts to something of the order of one half of one percent of the labour force per year. Any imperfection in this transition would be of little explanatory value in the scale of existing real unemployment rates of 10% and over. However, there is no doubt that lay-offs are often perceived as being due to productivity gains, in the sense that they are often not accompanied by corresponding falls of production.

The formulation, involving only two productivities, is a poor representation of the real situation where the mean productivity of a sector covers a wide variation within it, so that the real situation is one of labour being, as it were, decanted down a cascade of sub-sectors of decreasing rates of productivity gain, and thus with more scope for mis-match than in the formulation. Moreover, it is quite imaginable that in good times, industries might tend to carry their labour force unchanged, while in bad times, they might be forced, or given an excuse, to identify and squeeze out redundant labour all at once, rather than in a continuous way.

It is not suggested that this might be the specific mechanism giving rise to the current wide-spread rise in unemployment, but it might be a factor superimposed on others. In any case, it does suggest that unemployment is an unacceptable way to impede the equalisation of incomes. It represents an anomaly in a system which in general rapidly spreads the fruits of innovation from the innovators to the non-innovators. It

would point to an additional injustice that the people who, albeit through no merit of their own, mediate the implementation of innovation, should be those most at risk of suffering through transitional mis-matches, while service workers, equally or even more undeserving, enjoy the rewards of this innovation. Although it is logical that those who have the highest rate of productivity gain are those who most quickly work themselves out of a job, it is surely unjust.

Insofar as this is a correct perception, it would follow that a permanent cure for socially unsustainable levels of unemployment is not to be sought in regaining or increasing the rate of growth of GNP, but in administrative measures to regulate and brake the rate of lay-offs. This would automatically entail a slow down in the rise of wages of those in work. Assuming that this process could be adjusted merely to prevent people becoming permanently unemployed, and not to prevent transition to other employment, perhaps via temporary unemployment, it would have no effect on money measures of productivity and competitiveness. Its only effect would be to reduce the number of unemployed, and the mean level of wages per employed person. It is not suggested that this solution would be in practice easy to implement. It would tend to promote inflation, at least in cultures where social cohesion is low. But others might be even more difficult, and even less sure in their outcome.

12. Differential growth between regions

Table 1 can be used to illustrate remarks on the consequences of differential growth between regions. Let it be supposed that two regions with higher and lower productivity growth rates, called, say, Utopia and Subtopia respectively, have at one point in time a common economic situation as defined at year zero in the table, and that the difference in the rate of growth of productivities in the two regions is such that when Utopia reaches the year=50 state, Subtopia has arrived only at the situation shown for year=30 (numerically, this implies that for Subtopia p(p)=1.030, p(s)=1.003, and g=1.015).

Wages in Utopia are much higher than in Subtopia, but the price of primary goods is lower, while secondary goods are more expensive.

Clearly the two regions cannot be part of one country, since no one would buy primary goods from Subtopia, while on the other hand, all new Utopian factories would be located in Subtopia to benefit from the lower wage rates. In other words, the within-country diffusion process described in previous sections makes marked and sustained productivity differentials impossible.

Let it be supposed, then, that the regions are two separate countries, but that they still have the same currency. Subtopia would have to protect its primary sector from Utopian imports by imposing a duty of at least 63% on primary goods, and Utopia might have to restrain exports of capital and tourist expenditure to Subtopia, attracted by low wage rates and low prices of secondary goods. It will be recalled that although both economies have zero inflation, Subtopia appears to Utopians as a low price area, relative to their expenditure basket.

An alternative for Subtopia (this is mentioned only because it happens in reality - it would otherwise not come to mind) would be to conclude that its already low wage rates are too high for international competitivity, and to deflate the economy in order to introduce discipline into the labour market. This means trying to cure too low output by decreasing it further.

Now let it be assumed that the currencies, identical at year=0, are allowed to float, and that administrative constraints are abandoned. Although both economies are at all times inflation-free, their currencies are forced to diverge. Otherwise Subtopians would import their primary goods from Utopia instead of buying their own. If trade is predominantly in primary goods, the Subtopian pound must become lighter than the Utopian one. Indeed, it can be seen that to the extent that trade is not entirely in primary goods, the Subtopian pound must be overvalued for primary trade and undervalued for secondary trade. Subtopia will then tend to have a negative balance of trade for primary goods and a positive one for secondary goods, while for Utopia the opposite obtains.

Suppose finally that Utopia and Subtopia were amalgamated so that their differences in productivity growth could be counterbalanced neither by constantly adjusted administrative measures nor by constant changes in currency exchange rate. What would happen? If the imbalance were as great as shown in the table, the answer appears to be that there would be severe social problems, unless there were vigorous and successful efforts to cure the regional imbalance accompanied by internal administrative measures of regional protection.

It would appear from this simple analysis, that once the geographically localised industrial (productivity) revolution started, the world had a choice between, on the one hand a single currency (gold/silver) plus protection or force, or, on the other hand, locally administered paper currencies plus free trade. This choice presumably lies behind the eventual abandonment of the Gold Standard and the subsequent unprecedented world inflation, in terms of paper currencies, since 1945.

Insofar as the above is correct, it would seem curious that the criteria for convergence, as pre-conditions for monetary union, set out in the (Maastricht) Treaty on European Union (1992), omit any reference to the absolute level of development, since it has been indicated above that even countries with zero inflation rate could not easily have a single currency, if their absolute level of development were too far apart. However, in the period 1980-90, when exchange rate discipline was largely in force, only Greece among the poorer countries failed to narrow the gap between their GNP per head (in units adjusted for purchasing power) and the Community average (Eurostat, 1993). This may possibly indicate that Community policies of regional protection are more effective than is often assumed, and that these, aided by an increased rate of diffusion (in the sense used above) fostered by co-operative measures, including disciplined exchange rates, more than make up for the negative elements regarding competitivity.

13. Relation to previous work

An account of the historical primacy of production can be found in many works, for example that of Renfrew (1987), an archaeologist commenting on linguistics, but incidentally summarising the impact of agriculture, to which cause he attributes the spread of Indo-European speech, rather than to the more exciting hypotheses involving warriors, horses and weapons. Adam Smith (1776), of course, makes several relevant remarks. For example, on his first page, he describes the starting point of history when productive labour is 100%: "Among the savage nations of hunters and fishers, every individual who is able to work, is more or less employed in useful labour, and endeavours to provide, as well as he can, the necessities and conveniences of life, for himself or such of his family or tribe who are too old or too young to go a hunting and fishing". And later he notes (Book 1, XI, Part II): "by the improvement and cultivation of land ... the labour of half the society becomes sufficient to provide food for the whole. The other half, therefore ... can be employed in providing ... clothing, lodging, household furniture and what is called Equipage".

Maddison (1991, p. 32) estimates that the fraction of the total labour force in the UK which was devoted to productive activity diminished in the series 78%, 72%, 60%, and 31% in the years 1700, 1820, 1890, and 1989, demonstrating the tail end of what is presented here as a monotonic diminution stretching, albeit at varying and generally much reduced speed, from the beginning of history.

The following is the result of a literature search originating from the bibliography given by Crafts (1993).

Sir William Petty is credited by Clark (1957) with noting in 1691 that labour is progressively transferred from agriculture to manufacture, and thence to merchandise. Marshall in 1873, cited by Bell (1973), seemed clearly to anticipate that workers would become completely de-industrialised when he said, "the question is ... whether progress may not go on steadily, if slowly, till, by occupation at least, every man is a gentleman. I hold ... that it will". Baumol (1967) noticed that taxes in US cities had to go up because of the inherently inferior productivity, hence rising costs, of municipally provided services. Bell (1973), the sociologist inventor of the term "post-industrial", quotes James O'Connor as naming this process "the fiscal crisis of the state".

Baumol (1967), Skolka (1976), and Rowthorn and Wells (1987), present algebraic formulations similar to that used here. Skolka credits Baumol (1967) and Fabricant (1972) with the notion, used here, of dividing the economy into sectors by productivity level rather than by the type of activity. Figures 1.2 (a to e) in Rowthorn and Wells show results similar to those in Table 1. They differ principally in that it is assumed there that the real output of the service sector is a constant fraction of total output, a constraint which here is replaced by the imposed growth rate of GNP.

Baumol and Skolka both state conclusions derived from their formulations (for example that the economy will in time cease to grow) rather as if they necessarily followed from the fact of differential productivity, without making it clear that they flow simply from their chosen constraints. The constraint of constant GNP growth seems to the author of the present paper more realistic and less arbitrary than the imposition of equal real growth rate in each sector, and gives a result less reminiscent

of "the end of history" in that there is steady growth indefinitely, in both sectors. Also, these authors express the view that certain services and entertainments might price themselves out of existence. This is not so, since prices must go up less than wages.

Cairncross in Blackaby (1979) says that, "the share of manufacturing in GDP at constant prices was on a fairly upward trend from the late 1950's right up to 1973, although at current prices the trend was downward." Similarly, Ginzberg in his introduction to Stanback (1979) says, "his analysis points up beyond challenge that there has not been any significant tilting of the economy in terms of the value of the output from goods to services", and again, "when output is measured in constant dollars there has been little shift from goods to services."

In his introduction to Bailey and Hubert (1980), Sir John Greenborough confirms one of the themes of this paper, namely that, "productivity is one of the most elusive commodities and one which we are at a loss to know not only how to define but how to measure satisfactorily". Nevertheless, a few lines later, and without much further ado, he compares productivity increases for 7 leading countries ranging from 27% to 100%, thus illustrating the unavoidable difficulty of quantitative discussion based on concepts which are not rigorously definable. Crafts (1993) says in his introduction, "the data are, of course, estimates rather than facts". However he adds, without offering evidence, "but they can bear the weight of the interpretation placed on them". In reading Broadberry (1992) on what was essentially a failure to reconcile the evolution of US, German and UK manufacturing productivities with the greater convergence of GNP per worker, one wonders whether the explanation might not lie in the fact that both sets of numbers are attempts at quantifying the unquantifiable, useful within limits in their own sphere, but not necessarily reconcilable.

Chapter 1 of Rowthorn and Wells (1987), in its account of what is called (p. 5) "positive de-industrialisation" (it may be noted in passing that UK literature is often concerned with what are seen as specifically UK problems of negative or morbid types of de-industrialisation), contains remarks relating to nearly everything of substance which is in this paper, and indeed, nearly the same might be said of Skolka. For example, Rowthorn and Wells clearly state the basic notion (p.15) that, "with a given pattern of output, differential productivity growth will always cause the pattern of employment to shift away from the most dynamic sectors towards those in which productivity is rising more slowly", and mentions (p. 5) that this happens "despite increasing output" in the manufacturing sector.

A common feature of the literature is that agriculture is treated as a mere repository for a supply of labour for the industrial revolution. Rowthorn and Wells adopt a fairly representative stance when they say (p. 8),

"when modern economic growth first gets under way in earnest, the share of agriculture in total employment falls rapidly and there is an enormous expansion in both the proportion and the number of people engaged in non-agricultural pursuits ... new industries ... commercial, administrative activities ... community services ..."

and again (p. 11),

"de-industrialisation ... is merely the logical culmination of two basic trends ... (1) the decline of agriculture as a source of employment and (2) the growth of services. As agriculture declines and services rise, it is only a matter of time before the share of industry in total employment begins to fall. At first, services grow at the expense of agriculture and later, when this is no longer possible, they grow at the expense of industry. This is the essence of the argument."

The penultimate sentence clearly pictures services as the primary and in some way autonomous driving force of the evolution of labour structure, draining first agriculture and then industry of their labour forces, and this process is at the expense of these latter sectors. That this phrase is not a neutral, but a pejorative formulation is shown by the fact that it is used several times, and indeed the whole tone of the discussion in most of the literature is in this sense. de-industrialisation is not just a process, not even just a process of change which gives rise to problems of adjustment; it is in itself the problem, for which solutions are needed.

In the author's view, this perception differs radically from the viewpoint formulated in this paper, in three ways.

The first is that agriculture is, implicitly at least, presented as something old, pre-existing, while industry is something new, created by the industrial revolution, and of an entirely different logical nature. In reality, agriculture and industry have co-existed and co-developed for thousands of years, and are logically similar (for the purpose of considering de-industrialisation) apart from the fact that one is done in the fields and the other in workshops. Both make things, one things for eating, the other things for wearing, sheltering in, tilling the soil with, or fighting with. Agriculture involved the first massive exploitation of solar energy, and later the power of draught animals. From the beginning, it involved huge increases in productivity. Later, when modern industry arrived, agriculture did not just passively have labour poached from it. Like other types of pre-existing productive industry it was itself fully involved in innovation, the use of machinery, energy and chemicals, as part of the industrial revolution, and not just as a convenient source of labour for it. Of course, there were shifts of labour within this total primary sector. One does not want an infinite supply of potatoes any more than of television sets. The conventional mis-perception of agriculture is further illustrated by Broadberry (1992) who remarks that, "the reduction of employment in low productivity agriculture is important in explaining the extent to which Germany caught up" (with the UK). Statistics of the Statistisches Bundesamt (1991), however, show that between 1960 and 1985, for example, German agricultural output increased by 50% while the labour force fell by 60%, implying a rate of increase of productivity of 5 or 6% per year.

The second is that agriculture and industry are viewed, it may be guessed, with a habit of mind conditioned by the important strand of sociological/political thought which has opposed the ideas of country, peasant, conservative, to those of town, worker, progressive. This habit of mind leads directly to what is, in the present author's view, the mis-perception of industry as being successively in pre-mature, mature and post mature phases, maturity being defined as the point where industrial employment

reaches a maximum. In the view presented here, there is no point of maturity. Employment in the primary or productive sector is in continuous diminution, although all kinds of sub-sectors within it, including as a mere (economic) detail that of agriculture, may rise and fall, in terms of employment, of output, or of both.

The third is that services take labour from the agricultural and industrial sectors at their expense, thus making it seem that the service sector is the active, aggressive, primary agent, whose growth harms the other sectors, like the growing of a cancer, and that the process is to be deplored. Naturally, since people are more interesting than things, the sector which is growing in terms of people may tend to be thought of as the active agent compared with the "declining" sector, or even worse, the sector which is "in decline". What is really happening however is not that an embattled industrial sector is left with the people that a dynamic services sector has not (yet) taken, but that the services sector is left to absorb the people whom the dynamic primary sector, due to the use of fossil fuel energy and to technological advance, no longer needs, even as its output is expanding.

The most striking discrepancy in emphasis between the literature and the viewpoint presented here, however, is that since the authors are nearly always proceeding from their initial theoretical reflections to the discussion and solution of a perceived problem (city taxes, industrial dereliction in the sociological sense, structural unemployment, UK balance of trade), there is almost total neglect, often complete omission, sometimes outright denial, of the fact that industrial output is rising in spite of everything. Even Crafts (1993), who, in view of the title and general stance of his booklet, might have been expected to give prominence to this, devotes only 7 lines of text to commentary on his Table 9, which gives growth rates in manufacturing output, all positive, for 5 leading countries, including the UK, from 1950 to 1989. The commentary is concerned entirely with the position of the UK in the merit-order, and to the fact that the UK avoided last place only in the period of 1979 to 1989. Surely, however, the message from this table is that while much of the industrial world is experiencing de-industrialisation, industrial output is bounding upwards.

Much of the gloom in the literature is due to factors specific to the UK, and often expressed in the most emphatic terms. For example, Martin and Rowthorn (1986), in their preface, referring to a relative and absolute decline in (among other things) manufacturing output, say: "Since the late 1960's, and especially since the early 1970's, British manufacturing has become caught in a process of progressive and accelerating contraction." However, the more recent data cited by Crafts show that, despite periods of contraction, the long term trend was upwards. This appears to continue. OECD (1992, 1993) figures for 1985 to 1992, a period encompassing a severe UK recession, show a calculated trend line for UK industrial output which implies a rise of 14% in this period. This compares with 18% for the European Community and 23% for OECD. No trend line is given for UK manufacturing output but the unadjusted annual data for this show a similar rise.

What is notable about the UK situation is the remarkable fall in manufacturing employment, but Crafts shows in his Table 8 that from 1973 to 1989, the UK manufacturing employment ratio moved from a very high to a more representative value, Germany and Japan being the significant countries left with high and outlying

values. This exceptional rate of reduction of manufacturing employment may be continuing, since the OECD data already cited shows a 12% fall from 1988 to 1992, but it seems more likely that this temporarily reflects the full force of the UK recession.

14. Conclusions.

The main conclusions are listed in brief form, with the warning that brevity gives a false air of certitude.

- the production of things is paramount or primary
- this activity has most scope for productivity gains
- it therefore occupies ever decreasing human resources, but with ever increasing output
- this process has proceeded since the beginning of the human race
- by freeing people's time from the needs of production, it is the sine qua non of all ancient, modern and future civilisation
- it is based on learning to use solar energy, first directly, then accumulated stocks - nuclear energy is a recent addition
- it will continue as long as energy per head is sufficient
- quantification of the above is not rigorously possible
- agriculture and industry are logically one - they have co-existed from the beginning - the "industrial" was more properly the "primary" revolution.
- terms like de-industrialisation, post-industrial, declining, in decline, post-mature, in relation to the primary sector, are inappropriate
- a few related reflections:
- taxes must tend to go up in relation to GNP
- hardly anyone merits the fruits of innovation which they receive - no one merits being denied both fruits and work
- a single currency goes with protection, floating currencies with free trade
- this paper does not address specifically UK problems, with which much of the literature is concerned
- it does however draw attention to the fact that, whatever the problems, UK primary output is in long-term upward trend
- this paper essentially supports those who have argued for the importance of manufacturing - the primary sector, of which it is a major part, is not only important, it is of absolute and primordial importance.

Appendix

Nomenclature

Time lapse from year 0 in years		T
GNP (pounds per year) in current and real terms		GC, GR
Total GNP (pounds per year)		G
Factor of increase of GNP in one year		g
Labour force (fraction of)	L	
Factor of increase of labour force in one year		l
Wage per person and year		W
Productivity (items per person and year)		P
Factor of increase of productivity in one year		p
Number of items per year	N	
Price in pounds per item	PR	
Average apparent yearly inflation of prices using basket of items appropriate to year T-1		pr(T)

"Suffices" (given in brackets)

primary	(p)
secondary	(s)
total	(t)
datum time	(0)
current time	(T)

Assumptions, derived quantities, identities

Note: * means "multiplied by" ** means "to the power"

At datum time (year 0):

W(0) = G(0) = PR(p,0) = PR(s,0) = 1
P(p,0) = P(s,0) = 1

Given data, constant in time:

p(p)=1.05
p(s)=1.005
g =1.025

The following is valid at year 0:

L(p,0)=(g-p(s))/(p(p)-p(s))

The following are valid at all times:

P(p)=p(p)**T (This is approximately e**((p(p)-1)*T)) P(s)=p(s)**T
G=g**T
W = G
L(p)=(G-P(s))/(P(p)-P(s)).
L(s) = L(t)-L(p) = 1-(p)
l(p)=1+(L(p,T+0.5)-L(p,T-0.5))/L(p,T)
N=L*P
GR(p) = N(p)*PR(p,0) = N(p)
GR(s) = N(s)*PR(s,0) = N(s)
PR = W*L/N = W/P = G/P
Item weighted average price (pounds) per item = 1
Real price inflation rate is zero at all times.
pr(T) is calculated using N(T-0.5)-weighted current prices PR(T+0.5), compared with N(T-0.5)-weighted past prices PR(T-0.5):
pr(T) =N(p,T-0.5)*PR(p,T+0.5)+N(s,T-0.5)*PR(s,T+0.5)
GC(p) = L(p)*W GC(p)/G = L(p)
GC(s) = L(s)*W GC(s)/G = L(s)
G = GC(t) = GC(p)+GC(s) = GR(t) = GR(p)+GR(s)

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