INDUSTRIAL REVOLUTION IN ENGLAND AND FRANCE: SOME THOUGHTS ON THE QUESTION, 'WHY WAS ENGLAND FIRST?'

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I.

A major concern of economic historians since World War II has been to interpret the process of industrialisation in now developed countries. Anglo-American economic historians have formulated a major part of their inquiry in the following way.

> "... the Industrial Revolution poses two problems:
> (1) why did this first breakthrough to a modern industrial system take place in Western Europe? and
> (2) why, within this European experience, did change occur when and where it did?" (1)

Indeed Hartwell has severely criticised an earlier generation of writers for being too preoccupied with matters of equity and the quality of life during industrialisation at the expense of explaining England's primacy;

> "The most lively literature has been concerned with the way of life and the standard of living during industrialisation, i.e. with the consequences of the industrial revolution, and the important problem of determining why the revolution occurred at all, and why it occurred in England, i.e. with the causes of the industrial revolution, has not received its warranted attention."(2)

A sizeable number of authors have recently examined an even more specific question, namely 'why did England experience the onset of the industrial revolution before France?' Thus Davis defines his central issues as follows:

> "In examining development in the middle decades of the eighteenth century, the questions must be asked whether it exhibits features that explain the great discontinuity of the Industrial Revolution that was about to occur; and whether it reveals the reasons why the Industrial Revolution came to Britain and not to France."(3)

Crouzet goes on to argue that this method of inquiry is a fruitful one in terms of yielding insights into the process of economic growth:

> "The economic historian interested in the key problem of growth is bound to find the comparative approach particularly fruitful. A systematic comparison of the eighteenth-century English economy with that of another country - and France as the leading Continental power at that time seems the obvious choice - should bring out more clearly what factors were peculiar to England and might have determined what is a unique phenomenon, the English Industrial Revolution of the eighteenth century."(4)

There is by now an extensive literature offerring a wide variety of answers to these questions. To cite just a couple of examples from the very many explanations for England's primacy we find views as diverse as those of Kemp,

> "... if one overriding reason can be given for the slower transformation of the continent ... it must be the continued prevalence of the traditional agrarian structures."(5)

and Hagen,

> "... differences in personality rather than differential circumstances are the central explanation of Britain's primacy ... the Industrial Revolution occurred first in England and Wales ... because British people were inwardly different from those of the continent."(6)

However, there has been an increasing tendency in the literature to abandon the search for a single crucial reason for the occurrence of the industrial revolution in England in the eighteenth century. For example Milward and Saul maintain,

> "All these attempts to isolate single factors which can explain the fact that the first industrial revolution occurred where it did ... tend to break down before the enormous diversity of the continental economies. The more their history in the eighteenth century is considered, the greater appears the difficulty of finding one single factor in the British economy not present in some continental economies."(7)

In reaction against the single factor explanation two positions have commonly been adopted. One is to regard the English industrial revolution as the result of a previous period of general economic growth; thus Hartwell argues

> "... do we need an explanation of the industrial revolution? Could it not be the culmination of a most unspectacular process, the consequence of a long period of slow economic growth? ... Cannot the industrial revolution be explained more plausibly as the outcome of a process of balanced growth?"(8)

The other is to list a large number of favourable factors, as, for example, does Kranzberg,

> "In short, there was no single factor which can account for Britain's leadership in the Industrial Revolution. Instead, it was a multiplicity of factors - technological, social, economic, political, and cultural - which came together in the mid-18th century to provide the stimulus for industrial advance. In all these factors, Britain had a slight advantage over France. But the advantage was qualitative rather than quantitative."(9)

Neither of these positions is very satisfactory and Milward and Saul attacked them also in their recent book. On the former they point out that

> "... most recent research into the French economy in the eighteenth century has demonstrated that the increase in industrial output per head in the eighteenth century was probably faster than that in Britain ... [so that] this general explanation no longer seems valid."(10)

The latter type of approach they view as

> "... too tautological to be of much value."(11)

Furthermore in two as yet unpublished papers O'Brien and Keyder(12) and Roehl(13) have argued for a major re-interpretation of French economic performance, suggesting that the comparative economic historians have been led astray by their inappropriate use of English experience as a 'norm' with which to compare France. Roehl sums up one of his main arguments as follows:

> "The French industrialisation process resembles (without being identical with) that of Britain because they both commence at a very early stage, and proceed more or less apace, of course with some important differences in detail ... Economic history has, I believe, so long mis-interpreted French industrialisation because it has for so long been accustomed to looking at modern economic growth through the prism of the English experience ... industrialisation proceeded differently in the two countries."(14)

Both Roehl and O'Brien and Keyder are arguing that the economic history of France, in English at least, has been seriously distorted by the general adoption, epitomised in particular by Landes and Rostow, of an erroneous perspective of a uniform path of industrialisation with England as the front runner and the other countries following behind on the same course.

The present paper advances four propositions.

(i) The standard question 'why was England first?' cannot be answered.

(ii) It is in any case one which is misconceived.

(iii) The posing of the standard question may be quite largely responsible for perpetuating the 'old-orthodox' views on French industrialisation now coming under fire.

(iv) The question 'why was England first?' should be distinguished from the separate question 'why did the industrial revolution occur in the eighteenth century?'. Failure to do so may be the source of some of the difficulties encountered in the review of the literature.

The fundamental line of argument underlying all these propositions is that economic development in general and technological progress in particular in eighteenth century Europe should be regarded as stochastic processes.

II.

To aid our examination of the difficulties of the explanation of England's primacy the question will be put in the more specific form found in the literature, 'why did the onset of the industrial revolution occur in England and not France?'. 'Industrial revolution' will be understood as a period of rapid structural change in the economy, involving a rapid rise in industrial output, the share of output in manufacturing and factory based activity, (implying a different kind of economy), based on major technological innovations.

For present purposes we can adopt a narrow definition of the explicandum. It is a commonplace to give the cotton textile industry the leading role in precipitating industrial revolution, although not the whole

growth process.[15] Landes does so because it met the following specifications;

> "On the one hand, industrial revolution required machines which not only replaced hand labour but compelled the concentration of production in factories - in other words, machines whose appetite for energy was too large for domestic sources of power and whose mechanical superiority was sufficient to break down the resistance of the older forms of hand production. On the other hand, it required a big industry producing a commodity of wide and elastic demand, such that (1) the mechanisation of any one if its processes of manufacture would create serious strains in the others, and (2) the impact of improvements in this industry would be felt throughout the economy."[16]

Rostow concurs and sees a lack of other contenders, hypothesising

> "... sooner or later the forces at work would have yielded a take-off elsewhere in Europe (or in the United States), if Britain had not led the way. It probably would not have been long delayed, and cotton textiles would have been the leading sector, as it was in Britain."[17]

This leads to a reformulation of the question in the terms adopted by Davis,

> "The Industrial Revolution had its immediate beginning in the cotton industry ... The events that were decisive were two in number; the invention of the spinning jenny by Hargreaves, and of the water frame by Arkwright ... why ... did the decisive inventions take place in England?"[18]

Davis, as was pointed out earlier, put the question specifically in the context of trying to explain why England and not France.

It is as well to make explicit the counterfactual envisaged in choosing to work with this form of the question popularised by the recent comparative historians, namely that if the 'decisive innovations' had occurred first in France rather than Britain, France would have had the

first industrial revolution. The appropriateness of this counterfactual will be discussed later for it would evidently be rejected by some writers, despite its prominence in some of the comparative literature. It should be noted, however, that this formulation does not regard 'industrial revolution' and achievement of 'modern economic growth' as synonymous, nor does it deny that in practice France followed a different route to industrialisation, an 'unobtrustive' one,[19] the first industrial revolution having occurred. This industrialisation was largely carried out after the Napoleonic Wars in the context of England's by then large technological lead with its implications for the possibilities of imitation, comparative advantage and French policy responses.

III.

In the light of the criticisms of current attempts to explain England's primacy and the timing of England's industrial revolution which were briefly surveyed in Section I two important problems emerge; the danger of perpetrating post hoc ergo propter hoc fallacies and the need to try and assess the relative magnitudes of the impacts of the putative causal factors. There is a need to take into account the ceteris paribus and estimate the partial effects of the supposed independent variables.

This might suggest one of two approaches. Firstly it might be sought to invoke a universally applicable 'covering law' of the type 'whenever A then B', (i.e. A is a set of conditions necessary and sufficient for B). Rostow's stage theory approach might be thought of as a (bold but unsuccessful) attempt to proceed this way by making such a 'lawlike statment '.[20] However, solving the problem of the causes of the first industrial revolution in this way is impossible as it is the outcome of an uncontrolled experiment and a unique event at that. Furthermore economists

do not in general claim to have discovered such universal laws in the social as opposed to natural science situations they confront; as far as historians are concerned it has been stated by Walsh that

> "... no-one has yet produced a reputable example of an historical law."(21)

The second method would be to make inductive generalisations by looking for empirical associations between various features of economic life and the timing of the 'decisive innovations'. This would be rather similar to Kuznets methodology in his examination of modern economic growth. A natural way to proceed would be to run a multiple regression, $Y = \alpha + \beta_1 X_1 \ldots \beta_n X_n + e$, where Y, the dependent variable, would be the timing of the 'decisive innovations', the Xs the proposed 'causal factors' and e represents an error term. This way of doing things would be less ambitious than the former and would be concerned by estimating the regression coefficients to be able to talk about sufficiency and hence, for example, to try to say what changes in conditions in France would have sufficed, ceteris paribus, to give France the first industrial revolution. Obviously this approach is also impossible because we have only one observation. Even if we were prepared to include the imitative follower cases of the nineteenth century we could still expect insuperable problems of interpretation, multicollinearity and insufficient degrees of freedom.(22)

However, it is helpful to formulate the problem in this way. First it serves to remind us that some of the βs, (the partial derivatives), could be negative; putting it in the context of England's primacy it could be that some of the features of the English economy cited as favourable to industrialisation because they were present in England could actually have been retardative.

Second it draws attention to the error term; its presence implies that for given values of the Xs there are probability distributions of values of Y. With only one observation this precludes the use of the result that England was first to infer the favourability of particular conditions of the English economy.

There are two different ways of looking at the error term, based on two quite different philosphical positions with regard to the notion of 'chance'. One reaction would be to consider it as the reflection of the difficulty of accounting for a complex event, essentially as an expression of ignorance in a situation where there exists a deterministic relationship between the factors $X_1 \ldots X_n$ plus a further unspecified group of factors $X_{n+1} \ldots X_q$ and Y, which in principle would be knowable but in practice is not. A version of this position appears to be held generally by economic historians; that is to say that they believe that the observed result that England had the 'decisive innovations' and the first industrial revolution justifies the contention that the English economy was superior to the others in Europe, including France, even though at present they are unsure exactly how. This would seem to be the position of, for example, Milward and Saul, who are among the sternest critics of existing attempts to explain England's primacy. They suggest a new direction for search and argue that

> "Previous centuries of development <u>determined</u> that the industrial revolution happened, not in Europe's wealthiest, most populous, most powerful and most productive country, France, but in an island off its shores.", (italics added).(23)

Unfortunately, given the difficulty of dealing with the unique event, it may be that this contention that the result demonstrates the superiority has led, as Hagen puts it, to a situation where

> "... explanations of Britain's primacy ... consist mainly of a not very convincing sort of 'retrospective inference' ('something must have caused Britain's primacy in time, so presumably the earlier conditions overtly observable did') ..."(24)

In other words the favourability of certain conditions in England has been inferred from the result with the likelihood that entails of the post hoc ergo propter hoc fallacy.

A different reaction would be to argue that the relationships between the independent variables and the dependent variable were genuinely stochastic in the sense that randomness rather than ignorance is involved and that the independent variables are related to the dependent variable probabilistically in the true structure. This would imply that even with all the relevant explanatory variables, $X_1 \ldots X_q$ present in the regression there would still be an error term, representing the 'irreducible random'. This view seems to have no supporters at all in the recent debate over the causes of the industrial revolution. As Davis, one of the few to have contemplated such a view, says,

> "It could be argued that no explanation is needed. The events that were decisive were two in number; the invention of the spinning jenny by Hargreaves, and of the water frame by Arkwright ... These two isolated events may have been fortuitous; the chance of personalities and their good fortune in seeking along the right lines. But the economic historians instinctively recoils from such explanations."(25)

Perhaps this is partly because at first sight the idea of randomness has connotations of 'lottery' and the abandonment of the idea that there were any functional relationships, i.e. in terms of the regression model this would mean that all the βs were zero and there would be only 'noise'. This, of course, is not implied by making the

second reaction. All that need be maintained is that there are probability distributions of values of Y for given values of any X and that the probability distributions of Y are different for different values of X. That is to say that the β coefficients would be non-zero and could be interpreted as giving information about the partial effect of an independent variable on the expected waiting time to the 'decisive innovations'.

Such a view of history in general has recently been proposed by Leff;

> "To any practising historian it must be the first principle from which he begins that events happen which need not happen and which could frequently have happened differently. Their contingency varies from sheer chance and accident such as Barbarossa's death by drowing to a precarious equilibrium between forces ..."(26)

If this is how the industrial revolution is looked at, then the following warning by Leff must be heeded;

> "To read back ... from the outcome of a sequence of events causal antecedents into it is the most vulgar of all historical errors ..."(27)

So this second view would maintain that it may be, but need not be, that England was superior (inferior) to France in terms of the probability of achieving the 'decisive innovations' in the eighteenth century; i.e. that the result does not reveal the ex ante probability of England's winning the race, the result would only be one of a distribution which we can conceptualise but never observe. An analogy would perhaps be to ask if Walsall's 2 - 0 defeat of Arsenal in their 1932 F.A. Cup tie would justify the inference that Walsall was the better team in the sense that they would have emerged victorious a majority of times in a

large sample of games.

In brief the arguments of this Section have been that in trying to explain England's primacy there are no 'covering laws' to be used and that the best we could do would be to formulate explanatory generalisations with an error term, but where unfortunately tools of statistical inference could not be used to deal with the explanation of the timing of the decisive innovations because the event in question is unique. To that extent at least it can be claimed that the standard question is unanswerable, (proposition 1 of Section 1). This contention is in sharp contrast with the hopes expressed by authors such as Couzet.[28] Our interpretations would then appear to be at a humbler level and one might follow Leff,

> "The nature of historical explanation ... is by means of giving an account of events not of forming general propositions about them."[29]

It was further pointed out that it is important whether the industrial revolution is thought of as the result of a deterministic or a stochastic process. If the latter position is adopted then the question 'why was England first?' is misconceived insofar as the observed result need not imply that there was anything superior about the English economy, (proposition 2 above). The question 'why was the industrial revolution begun in the eighteenth century?' may still be useful in the sense that ex ante in, say, 1700 it might be argued that the probability of the 'decisive innovations' being made somewhere was high enough that the cumulative probability of their occurring before, say, 1800 was virtually 1, but even then the precise timing would be of no very great significance.

To clarify these arguments and to gain some idea of their possible relevance the next section looks at theories of inventive activity

and innovation in eighteenth century England and France.

IV.

There are, of course, a wide range of hypotheses purporting to 'explain' inventive activity. At one extreme is the 'great man' approach. In Usher's words this holds that

> "The novelties that constitute the basis of social growth and development are attributed to the inspiration of genius ... Such avenues to truth and social change do not admit of explanation or analysis."(30)

For an economist this would normally be characterised as an 'autonomous supply' argument; it can presumably be taken either as deterministic, (the will of God), or stochastic, (the accident of birth). At the other extreme are 'social determinist' views which see invention, and particularly innovation, as an inevitable result of necessity with

> "... the individual ... merely an instrument or expression of cosmic forces."

More modestly there are hypotheses which see innovation and/or invention as induced by the economic environment via the profit motive, for example, Schmookler who emphasised the role of favourable demand conditions.(31) A third variant tends to accept the importance of economic stimuli but stresses the (supply-side) factors which affect the ability of economies to respond to stimuli, such as sociological influences on the quality of entrepreneutship or the development of science.

Most of these positions are reflected in the literature on the industrial revolution as the basis of explanations for England's primacy

and/or the timing of the events. The 'heroic' view has fallen out of favour with modern writers, however.(32) There are several reasons but among the most powerful are the demonstration by Merton and others(33) of a large number of multiples in scientific discovery in general, which has led to the widespread abandonment of the notion that particular individuals are necessary to particular inventions, and the simplicity of the 'decisive innovations'. As Lilley puts it,

> "This is not a story of sophisticated inventions breaking through some technological barrier, and so creating the conditions for expansion. Developments that were technically so simple can only be responses to social and economic conditions that offered widening opportunities for self advancement through innovation."(34)

Economic inducements are represented by the hypotheses that the 'decisive innovations' were the result of the greater pressure of the growth of demand and 'factor scarcities' in England than on the continent. Thus Habakkuk maintains that

> "Most of the economically important inventions of the Industrial Revolution period can more plausibly be ascribed to the pressure of increasing demand than to the random operation of the human instinct of contrivance, changes in factor prices, or the Schumpeterian innovator ... Both in the primary iron industry and in cotton there were exceptionally strong stimuli to the adoption of new methods: in the former, shortage of timber and the consequent dependence on foreign supplies for a large part of a munition of war, wrought iron; in the latter the lack of balance between the spinning and weaving sections ... These seems to me the main reaons why the Industrial Revolution happened in England rather than in for example, France."(35)

Other authors have disagreed and emphasised a superior response to economic stimuli; for example, Rostow argues that

> "What distinguished Britain from the rest as the eighteenth century wore on was the scale of the inventive effort that went into the breaking of crucial technical bottlenecks, and the scale of the entrepreneurial corps which introduced them as the century moved towards its close."(36)

In the promotion of a vigorous response writers such as McClelland(37) have stressed sociological factors, whilst others such as Musson and Robinson(38) emphasise the role of science.

However, if the socio-economic theories are regarded as deterministic and examined as to their ability to cope with all the events in the eighteenth century innovation they appear to be far from satisfactory. Musson has recently mounted a strong critique from this perspective. He suggests that such theories

> "... completely [ignore] the realities of individual achievement, sustained effort, and the mixture of motives involved."(39)

and continues, with reference to a number of eighteenth century improvements,

> "If these inventions were simply products of pressing economic and social forces, why was there such a long time lag before their widespread application? Surely, if they were sociologically or economically 'determined', 'inevitable' and 'necessary', they should have been brought into widespread use immediately."(40)

Similarly it is hard not to sympathise with the point of the following quotation from Hook;

> "Writing in 1880, William James banteringly asked Herbert Spencer whether he believed that if William Shakespeare had not been born at Stratford-on-Avon on April 26 1564, the convergence of social and economic forces would have produced him elsewhere; and whether if Shakespeare had died in infancy, another mother in Stratford-on-Avon would have delivered 'a duplicate copy' of him?"(41)

Musson concludes from his survey of the literature that

> "... there certainly does not exist anything like an agreed general theory, integrating science and technology into the older theories of economic growth."(42)

This proposition, which seemingly would command universal acceptance, means there is no 'covering law' to which we can turn to explain England's primacy in achieving the 'decisive innovations'. Indeed we find a foremost authority in the area expressing

> "... the extreme agnosticism to which one is led on the subject of technological change by recent theorising."(43)

As far as economic theory is concerned it is in fact difficult using neo-classical assumptions to derive predictions about the rate of technological progress in general or even to support the assertions of writers such as Crouzet, Landes and Habakkuk of the beneficial effect of the 'shortages' experienced by the British economy in the first half of the eighteenth century.

At the macro level neoclassical growth theory has traditionally relied on the assumption of an exogenously given natural rate of growth, taking technological progress as exogenous, a path which new economic history seems to be following.(44) It is hard not to agree with Wright's

observation,

> "I am not hopeful in general that competition and Cobb-Douglas will take us very far in unravelling the mysteries of the industrial revolution."(45)

Moreover, if we adopt competitive assumptions and the neoclassical distinction between factor substitution and innovation, (moves along as opposed to shifts of the production function), we have to accept David's summing up;

> "For a firm in a competitive market setting which has arrived at a minimum-cost equilibrium with regard to the disposition of its factors of production, all inputs are equally 'dear' and 'productive' at the margin."(46)

This would imply, for example, no support for the labour shortages theories of the industrial revolution of Crouzet, Landes and others.(47) Nor can this type of rationale of England's primacy be saved by reference to Kennedy's notion of an innovation possibility frontier.(48) Its raison d'être seems to be as a mechanism to generate Harrod-neutral technological progress and since, as David points out,

> "The shape and position of the IPF are not really accounted for by the theory ..."(49)

it is useful neither for explaining the rate of innovation nor the role of 'shortages' in promoting the first appearance of particular resource/factor saving innovations in England rather than France, say.

However, if we look closely amongst all this apparent chaos in the literature the situation may not be quite as unpromising as the preceding review suggests at first sight. There is in fact some agreement among

many authors who hold such apparently widely divergent views. That is to say they all treat technological progress as a stochastic process. The writers concerned can all be interpreted as sharing a vision of innovations emerging from a search process which is highly uncertain in terms both of the nature and timing of its outcome and which is conditioned as to its intensity and direction by social and economic variables and as to its chances of making particular discoveries by scientific knowledge and existing technology.

Thus we find Musson in his stern criticism of existing theories related to the 'decisive innovations' arguing on the one hand that

> "There seems little doubt ... innovators or entrepreneurs were certainly very much influenced by economic factors, such as relative factor prices, market possibilities, and profit prospects."(50)

On the other hand he remarks"

> "... there is danger of easy historical hindsights: we know that certain inventions were made during the Industrial Revolution, and it is easy to produce arguments as to their 'inevitability', though they certainly did not seem 'inevitable' to the contemporaries concerned.";(51)

and that

> "... if one studies at first-hand the detailed contemporary evidence - revealing the prolonged thought, experiments, disappointments, and innumerable practical problems involved in producing an invention, from the first original idea to eventual industrial application, not forgetting also the countless failures and bankruptices - then a theory of 'inevitability' appears ludicrous ..."(52)

Yet, if we examine the modern version of the 'sociological determinism', about which Musson is so scathing, we find it is actually a probabilistic theory apparently not so very antagonistic to Musson's own point of view. Merton's view can be summarised in his own words as follows;

> "... innovations became virtually inevitable as certain kinds of knowledge accumulated in the cultural heritage and as social developments directed the attention of investigators to particular problems."(53)

But Merton takes pains to stress that

> "... I do not imply that all discoveries are inevitable in the sense that, come what may, they will be made, at the time and the place, if not by the individuals who in fact made them. there are, of course, cases of scientific discoveries which could have been made generations, even centuries, before they were actually made, in the sense that the principal ingredients were long present in the culture."(54)

He goes on to point out what he sees as the

> "... recurrent fact of long-delayed discovery ..."(55)

The common theme is taken up by Rosenberg, who acknowledges the importance of economic stimuli to invention, but points out that

> "Many important categories of human wants have long gone either unsatisfied or very badly catered for in spite of a well established demand ... a great potential demand existed for improvements in the healing arts generally, but ... Progress in medicine had to await the development of the science of bacteriology in the second half of the nineteenth century."(56)

Elsewhere he argues that

> "... the developed countries never solve more than a small fraction of the problems which happen to be formulated and actively pursued."(57)

In the historical context we have been examining we find a statment of similar sentiment from Landes,

> "From the 1730's on British forgemasters devoted great effort and expense to finding a shorter, surer technique [of making wrought iron] that would use mineral rather than vegetable fuel. The search took half a century."(58)

Many more examples could be given of similar positions being adopted. Until recently, however, this view of technological progress had not been reflected in the efforts of economic model builders. Recently, though, Nelson and Winter have proposed a model which embodies an evolutionary, conditioned search approach similar to that envisaged by the writers cited above and entailing the abandonment of a neoclassical position. They describe the heart of their model as follows

> "... the model is a Markov process in a set of "industry states" ... Changes in the industry state are generated by applying transition rules, independently, to the individual firms states. Technique changes by individual firms are governed, first of all, by a satisficing mechanism. If the firm's rate of return on capital exceeds a target level, the firm retains it with probability one. Otherwise a probabilistic search process generates a possible alternative technique. The probability distribution governing search outcomes is constructed in a manner that reflects the influence of 'closeness' and of 'imitation' ... Finally a test is applied to determine if the technique turned up by the search process is actually less costly, at the prevailing wage rate, than the one the firm currently uses. If the answer is yes, the firm changes technique."(59)

The authors point out that unlike neoclassical theories

> "... there was no production function - only a set of physically possible activities ... The exploration of the set was treated as an historical incremental process ..."(60)

in this model.

This particular model would not be appropriate but this general way of looking at things, in terms of seeing innovation as the result of stochastic search processes in which both economic inducements and scientific supply-side considerations play a part appears to have several advantages in the context of our historical concern. (It should be noted that Nelson and Winter's model was successful in 'accounting for' twentieth century U.S. economic growth.) Such a view of the world, which appears to be implicit in or at least not inconsistent with the work of Merton, Musson, Rosenberg and many others, need not be troubled by a number of the difficulties which have been found with the putative explanations of eighteenth century innovative behaviour. It could accommodate the appearance of inventions which were not used straightaway and also Merton's evidence of a distribution of lags in discoveries which subsequently turned out to be multiples of Cavendish's, at the time unpublished, work.(61) Moreover a response to resource 'shortages' reflected in changed relative factor prices would be expected and presents no difficulty since the distinction between factor substitution and innovation is blurred in this vision. However, the supply of search inputs need only be an increasing function of economic inducements, not exclusively related to them, and the results in terms of innovative outputs would be generally but by no means always related to economic incentives.

We are in no position to specify such a model and that is not

the present purpose. What is important here is not the details of such a model but the implications of viewing economic history in this way, where the path of the economy could be thought of perhaps as the working out of a Markov process in which the economy's state at any point in time is the evolutionary outcome of a contingent sequence of probabilistic events. This is in fact the nature of the Nelson and Winter model. Two points in particular seem worth emphasising in relation to the question 'why was England first,'

(i) In the stochastic world which this view of technological progress embraces an economy with a lower likelihood ex ante of achieving the 'decisive innovations', or where some features of the economy tended to lessen the chance of achieving them first, may be observed as the winner in a two country 'race' to achieve the 'decisive innovations' that is run just once, much as, for example, in a Monte Carlo model of human reproduction the less fecund woman of two married at the same age may have the first child at a younger age.(62)

(ii) Although at the outset one economy may have a lesser chance of success it is the nature of the process envisaged that if it is 'lucky' early on it could evolve into a position with much the higher chance of subsequent success; for example, making a 'decisive innovation' first may vastly raise the probability of subsequent innovations being made.

Put in the context of England's primacy in achieving the 'decisive innovations' the upshot of these points is that being 'more advanced' in 1790 and then having a much superior likelihood of further progress in the glamour industries of the period than France does not of itself necessarily imply that Britain ex ante in, say 1740 had the greater probability of achieving the first industrial revolution or that one should feel obliged to seek reasons for Britain's inevitable primacy going far back into her history. This position would be in stark contrast with that adopted by the contributors to the debate over why England was first which was reviewed earlier and, if we follow Davis, apparently goes against the grain for economic historians in general.(63)

This would be a partial rehabiliation of the role of chance by conceding it played some part in events which were nevertheless much influenced by the factors stressed in the conventional economic history literature. It would mean acceptance of the point that from the unique observed result we cannot infer anything about the probability beforehand of England's being the first to have the industrial revolution rather than France in the years prior to the 'decisive innovations'. It then appears otiose to pose the question 'why was England first?' with the hope à la Crouzet of gaining insights in general into growth from

> "A systematic comparison of the eighteenth century English economy with that of ... France ..."(64)

Indeed, if one could construct a simulation model of development during the period embodying stochastic technological progress one would expect to observe from many runs for each economy a distribution of times for the 'decisive innovations'. Should one then worry about accounting for one result out of a distribution (unobserved) with a general theory or rather go for humbler accounts? Just as, to return to our earlier example, a

good journalist might set about giving a convincing account of how on a particular day in 1932 it happened that Walsall beat Arsenal.

It is held then that the discussion of this Section has ended with a strong case for accepting propositions (i) and (ii) of Section I. Also this suggests that the automatic inference of a 'superior' ex ante English economy, or particular features of it, from the fact of her primacy be resisted, especially since statistical tests of the null hypotheses are infeasible, even though it is the economic historian's natural instinct in reviewing the events of the eighteenth century and it pervades the literature.

V.

Two questions immediately arise from the outlining of such a position.

(i) Does resisting this 'automatic inference' seem absurd in the sense that the British economy was self-evidently superior to the French in, say, the mid eighteenth century?

(ii) How has the superiority inference been justified?

The answer to the first of these questions would seem to be a resounding no. In fact the theme of similarities between the French and England economies has been one which from time to time has found a number of friends. For example, Nef, writing in the 1940's says,

> "According to the popular misconception, English, or at any rate British, industrial development was in sharp contrast to Continental throughout the eighteenth century, and not simply at the very end of it. But, as we shall see, the rate of industrial change from about 1735 to 1785 was no more rapid in Great Britain

> than in France, a far larger country with nearly three times as many people. What is striking in eighteenth century economic history is less the contrasts than the resemblances between Great Britain and the Continent, both in the rate of economic development and in the directions that development was taking."(65)

A rather similar chord has been struck by Rostow in his recent work. His comment on the figures reproduced here as Table 1 is that,

> "There is ... some ambiguity about why Britain and not France was the first nation to move into take-off."(66)

TABLE I

	France		Britain	
	1700	1780	1700	1780
Population (mn.)	19.2	25.6	6.9	9.0
Urban Popn. (mn.)	3.3	5.7	1.2	2.2
Foreign Trade (£m)	9	22	13	23
Iron Output (000tns.)	22	135	15	60
Cotton Consn. (mn.lbs.)	0.5	11	1.1	7.4
Agricultural Output (1700=100)	100	155	100	126
Industrial Output (1700=100)	100	454	100	197
Total Production (1700=100)	100	169	100	167
Income/Head (1700=100)	100	127	100	129

Source: W. W. Rostow, How It All Began, (New York, 1975) in which the derivation and sources of data are discussed.

Furthermore the recent work on income levels by O'Brien and Keyder[67] finds fairly little difference between the two economies and Roehl has seen fit to argue that France was perhaps the first economy to enter on modern economic growth.[68]

With regard to French innovative potential Mathias states unequivocally that

> "The French record of scientific growth and invention in the eighteenth century was a formidable one".[69]

We learn from McCloy[70] that in the first half of the eighteenth century there weremore patents granted in France than England despite a legal situation making it likely that patent statistics understate French relative to English inventiveness. It also becomes clear from a reading of McCloy that the French came very close to preempting Hargreaves' invention on at least two occations in the 1740's and 1750's.[71] In retrospect it would hardly seem a great shock if France had succeeded in view of the simplicity of the 'decisive innovations', French inventive ability and the fact that search was evidently taking place. If so, as Rostow puts it,

> "... the French market, with its absolutely larger urban population, was not so poor as to rule out an ample domestic as well as a foreign market for cheap cotton textiles, if French industry had produced them first ..."[72]

The answer to the second question is as would be expected under the circumstances of the absence of 'covering laws' and the possibility of using tools of statistical inference. Namely it would appear that the superiority of the economy as a whole, or key features of it, has been inferred from the result of Britain's primacy on the (deterministic)

presumption that it indicates that something or other about the preceding conditions was superior. A couple of recent examples will suffice, both from authors who are sceptical of the standard textbook presumption of wide differences between the two economies. Thus Davis, having found fault with the standard 'explanations', concludes,

> "The safest thing to say, perhaps, is that although the need for innovation was strong in France as in England, French society offered a less congenial climate to innovation than did English, and the accident of these innovations being made in France rather than in England did not occur."(73)

Likewise Crouzet

> "... the explanation for Britain's superior inventiveness ... [is that] ... the conditions for innovation seem to have been more favourable than in France ... [There was] a 'critical mass', a piling up of various factors favouring England's growth which triggered off a chain reaction - the Industrial Revolution. In France, on the other hand, there was no such critical mass, which is why France did not spontaneously start an Industrial Revolution."(74)

One is put in mind of Gerschenkron's comment on Rostow;

> "The question was what made growth start. Rostow would answer that it did so because the preconditions were completed. When one asked how this was known, the further answer was that growth had started."(75)

Not surprisingly in the circumstances we find vigorous disagreement over the validity of the assertions of the superiority of particular key features, for example, O'Brien and Keyder would reject Habakkuk's claim of faster growth of demand,(76) Davis rejects Crouzet's diagnosis of labour shortages,(77) and Kemp dismisses Landes' claim of greater technical skill and ingenuity.(78)

An alternative is to take information from the late eighteenth and early nineteenth century progress of the French economy to suggest the French were less innovative and also to adopt new methods.[79] This is possibly rather more convincing but is still open to several objections.

(i) It can be argued that many innovations then made in England should be thought of as the consequences of the 'decisive innovations'.

(ii) French development took place under the handicaps of an English lead and wartime disruption and does not therefore reveal reliable information concerning the ex ante potential of the French economy.

(iii) The determinants of diffusion are not necessarily the same as those of initial development, particularly where international diffusion is concerned.

(iv) Even if France had had the 'decisive innovations' first and even though there would seem a strong case for arguing that in that event she was capable of exploiting them to have an industrial revolution, nonetheless considerations of comparative advantage domestic to France would presumably have led to a somewhat different, (not inferior), end product.

If these arguments that the superiority inference be regarded as non-proved, (not as refuted), were accepted and a stochastic view of technological progress adopted,it is interesting to examine a few features of the historiography of the comparative economic history of England and

France with a view to providing some speculative justification for propositions (iii) and (iv) of Section I.

It seems possible to reconstruct one powerful current in the literature as follows. During the retreat from the cataclysmic/exogenous view of the Industrial Revolution[80] economic historians correctly perceived the need to examine the build up of conditions in the economy over the long run which were promotive of the Industrial Revolution. For example, reaction against the earlier cataclysmic history and stress on the importance of the long view is a major theme in Ashton.[81] An extension of this was to take the step that if the first industrial revolution was a distinctive feature of the English experience and itself related to prior trends in the economy, then the previous experience of the economy in England must have been more favourable and it could be assumed, (particularly in the absence of quantitative work), that development up to that point had been much different. This led both to the presumption of English superiority and attempts to find by comparison with other economies favourable features in England, a move seen in Habakkuk's work amongst others.[82] At least in the English language France was in any case generally seen in the context of developments in England.[83] With the 'inferiority' of the French economy established by virtue of England's primacy,[84] these unfavourable features of the French economy were taken as responsible for nineteenth century 'failure', and as indicators of it, that 'failure' itself being used to reinforce the belief in eighteenth century 'inferiority'.

This kind of process of thought is instanced in Kemp's recent book. He argues as follows.

> "Until the latter part of the eighteenth century ... there was nothing unique about the rate or even the character of the economic development which took place in Britain ... [but] it had undergone a structural transformation which in retrospect, (italics

> added), seems to be the necessary groundwork for industrialisation."(85)

Also

> "... if one overriding reason can be given for the slower transformation of the Continent ... it must be the continued prevalence of the traditional agrarian structures"(86)

and

> "The advantages which enabled British entrepreneurs ... to be first in the field persisted for a long time."(87)

This method of argument does not seem very safe in view of the points made in Sections II through IV.

If we dropped this deterministic position we might view both the eighteenth century and French economic history differently. An appropriate question to ask when it was perceived that the long view was important in understanding English developments would have been 'were there factors which made the probability of the onset of the industrial revolution high in eighteenth century England?' rather than asking 'what made France inferior?' When the question is put in the new form, and when the achievements of the French economy in the eighteenth century are taken into account, it no longer seems obvious that taking the long view should imply seeking reasons for French inferiority. Indeed one might also ask 'were there factors which made the probability of an industrial revolution high in eighteenth century France?', and not presume the probability was necessarily higher in England just because England was first.

Of course these questions also are not susceptible of anything more than, at best a 'convincing case', lower level answer beset by difficulties of the ceteris paribus. However, the adoption of a stochastic view of the development of the two economies naturally leads to the separation of the two questions 'why in the eighteenth century?' and 'why in England?'. Looking at things this way would surely have mitigated against both the 'unfair' treatment of France in the literature which O'Brien and Keyder and Roehl[88] protest about and also the rushing into post hoc argo propter hoc fallacies which permeate so much of the literature.

VI.

It remains to point out a couple of things this paper is not striving to maintain. First it is not arguing that the industrial revolution in England was an entirely fortuitous event. Second it is not arguing that the French economy was more likely than the English to have an industrial revolution in the eighteenth century, simple that the English economy, or particular features of it, is not proven to be superior in that regard. Essentially the warning the paper seeks to give is against expecting too much from comparative economic history. Whilst Landes argues that,

> "... if history is the laboratory of the social sciences, the economic evolution of Europe should provide the data for some rewarding experiments,"[89]

it is unfortunately the case that some of the uncontrolled experiments history performed were unique, non repeatable events.

Footnotes

(1) D. S. Landes, The Unbound Prometheus (Cambridge, 1969), p.12.

(2) R. M. Hartwell, "The Causes of the Industrial Revolution: An Essay in Methodology", Economic History Review 2nd ser. XVIII (1965) reprinted in R. M. Hartwell (ed.) The Causes of the Industrial Revolution in England (London, 1967), p.54.

(3) R. Davis, The Rise of the Atlantic Economies (Ithaca, 1973), p.289.

(4) F. Crouzet, "England and France in the Eighteenth Century: A Comparative Analysis of Two Economic Growths", in R. M. Hartwell (ed.), The Causes ... , p.139.

(5) T. Kemp, Industrialisation in Nineteenth Century Europe (London, 1969), p.8.

(6) E. E. Hagen, "British Personality and the Industrial Revolution: The Historical Evidence", in T. Burns and S. B. Saul (eds.), Social Theory and Economic Change (London, 1967), p.37.

(7) A. S. Milward and S. B. Saul, The Economic Development of Continental Europe 1780-1870 vol. 1 (London, 1973), pp. 32-33.

(8) R. M. Hartwell, "... Essay in Methodology", p.78.

(9) M. Kranzberg, "Prerequisites for Industrialisation", in M. Kranzberg and C. W. Pursell (jr.), (eds.), Technology in Western Civilisation vol. 1 (New York, 1967), p.229.

(10) A. S. Milward and S. B. Saul, The Economic Development ..., p. 31.

(11) Ibid. p.33.

(12) P. K. O'Brien and C. Keyder, "Economic Growth in Britain and France from the Revolution to the First World War", (mimeo, Oxford, 1975).

(13) R. Roehl, "French Industrialisation: A Reconsideration", (mimeo, 1975).

(14) Ibid., pp.63-65.

(15) Despite the very high proportional growth rates attained by the cotton textiles sector in late eighteenth century Britain, it is nonetheless true that the sector accounted for only a small fraction of value added in the economy as a whole.

(16) D. S. Landes, The Unbound ..., p.81.

(17) W. W. Rostow, "The Beginnings of Modern Economic Growth in Europe: An Essay in Synthesis", Journal of Economic History XXXIII (1973), p.574.

(18) R. Davis, The Rise ..., pp.311-313; (original word order slightly amended, but sense same.)

(19) This term originates with K. E. Berrill, "Historical Experience: The Problem of Economic 'Take-Off'", in idem., Economic Development with Reference to Asia (1965).

(20) W. W. Rostow, The Stages of Economic Growth (Cambridge, 1960).

(21) W. H. Walsh, "'Meaning' in History", in P. Gardiner, (ed.), Theories of History (New York 1959, p.303, quoted in G. Leff, History and Social Theory (London, 1969).

(22) It is noticeable that Kuznets has been able to come up with remarkably little in the way of powerful generalisation about the timing of the onset of modern economic growth as is witnessed by the very brief remarks at the end of his recent Economic Growth of Nations (Harvard, 1971).

(23) A. S. Milward and S. B. Saul, The Economic Development ..., p.38.

(24) E. E. Hagen, "British Personality... ", p.37.

(25) R. Davis, The Rise..., pp.312-313.

(26) G. Leff, History..., p.52.

(27) Ibid., pp.67-68.

(28) See above p.1.

(29) G. Leff, History..., p.93.

(30) A. P. Usher, A History of Mechanical Inventions (London, 1954), p.60.

(31) J. Schmookler, Invention and Economic Growth (Cambridge, Mass., 1966).

(32) In notable contrast with the writers of an earlier generation, as seen, for example by reading the account of the agricultural revolution in Lord Ernle, English Farming Past and Present, (London, 6th ed., 1961).

(33) R. K. Merton, The Sociology of Science, (Chicago, 1973) and references therein.

(34) S. Lilley, "Technological Progress and the Industrial Revolution 1700-1914", in C.M. Cipolla, (ed.), The Fontana Economic History of Europe, vol. 3 (London, 1973), p.195.

(35) H. J. Habakkuk, "The Historical Experience on the Basic Conditions of Economic Progress", in L. Dupriez, (ed.) Economic Progress (Louvain, 1955), p.154.

(36) W. W. Rostow, "The Beginnings...," p.570.

(37) D. C. McClelland, The Achieving Society (Princeton, 1961), Ch. 5.

(38) A. E. Musson and E. Robinson, Science and Technology in the Industrial Revolution (Manchester, 1969).

(39) A. E. Musson, "Introduction", in A.E. Musson (ed.), Science, Technology and Economic Growth in the Eighteenth Century (London, 1972), p.49.

(40) Ibid., pp.52-53.

(41) I. S. Hook, "The Hero in History", reprinted in R. H. Nash, (ed.) Ideas of History (New York, 1969), vol. 2, p.311.

(42) A. E. Musson, "Introduction", p.38.

(43) N. Rosenberg, "The Direction of Technological Change: Inducement Mechanisms and Focusing Devices", Economic Development and Cultural Change XVIII (1969), p.1.

(44) As is illustrated by a glance at a couple of recent articles; D. N. McCloskey, "Did Victorian Britain Fail?" Economic History Review 2nd ser. XXIII (1970), pp.446-459 and J. G. Williamson, "Late Nineteenth Century American Retardation: A Neoclassical Analysis", Journal of Economic History XXXIII (1973), pp.581-607.

(45) G. Wright, "Econometric Studies of History", in M. D. Intrilligator (ed.), Frontiers of Quantitative Economics, (Amsterdam, 1971), p.449.

(46) P. David, Technical Choice, Innovation and Economic Growth, (Cambridge, 1975), p.34.

(47) F. Crouzet, "England and France...", pp.168-173 passim; D. S. Landes, The Unbound..., p.60, ii6-117 and passim.

(48) C. Kennedy, "Induced Bias in Innovation and the Theory of Distribution," Economic Journal, LXXIV (1964).

(49) P. David, Technical Choice..., p.52.

(50) A. E. Musson, "Introduction", p.53.

(51) Ibid., p.46.

(52) Ibid., p.49.

(53) R. K. Merton, The Sociology..., p.352.

(54) Ibid., p.369.

(55) Ibid., p.369.

(56) N. Rosenberg, "Science, Invention and Economic Growth", Economic Journal LXXXIV (1974),p.97.

(57) N. Rosenberg, "The Direction...", p.1.

(58) D. S. Landes, The Unbound..., p.91.

(59) R. R. Nelson and S. G. Winter, "Neoclassical vs. Evolutionary Theories of Economic Growth: Critique and Prospectus", Economic Journal LXXXIV (1974), p.895.

(60) Ibid., p.902.

(61) R. K. Merton, The Sociology..., p.364.

(62) For an example of such a model see J. C. Ridley and M. C. Sheps, "An analytic Simulation Model of Human Reproduction with Demographic and Biological Components," Population Studies XIX (1966), pp.297-310.

(63) See above, p.8.

(64) F. Crouzet, "England and France...", p.139.

(65) J. U. Nef, "The Industrial Revolution Reconsidered", Journal of Economic History III (1943), p.5.

(66) W. W. Rostow, "The Beginnings...", p.547.

(67) P. K. O'Brien and C. Keyder, "Economic Growth...", p.36.

(68) R. Roehl, "French...", passim.

(69) P. Mathias, "Who Unbound Prometheus? Science and Technical Change, 1600-1800", in A. E. Musson (ed.), Science..., p.81.

(70) S. T. McCloy, French Inventions of the Eighteenth Century (Lexington, 1952), Ch. 12.

(71) Ibid., pp.89-93.

(72) W. W. Rostow, "The Beginnings...," p.570.

(73) R. David, The Rise..., p.313.

(74) F. Crouzet, England and France...", p.172-173.

(75) A. Gerschenkron, "Discussion", p.367 in W. W. Rostow, (ed.) The Economics of Take Off into Sustained Economic Growth, (New York, 1965).

(76) P. K. O'Brien and C. Keyder, "Economic Growth...," p.31.; H. J. Habakkuk, "The Historical Experience...", p.154.

(77) R. Davis, The Rise..., p.312.; F. Crouzet, "England and France..." p.168.

(78) T. Kemp, Industrialisation..., p.17.; D. S. Landes, The Unbound..., p.61.

(79) For example, D. S. Landes, The Unbound..., p.63.

(80) See M. W. Flinn, Origins of the Industrial Revolution (London, 1967), Ch. 1 for this expression and a discussion of the relevant historiography.

(81) T. S. Ashton, The Industrial Revolution, 1760-1830 (London, 1948).

(82) H. J. Habakkuk, "The Historical Experience...", passim.

(83) See R. Roehl, "French...", passim, for a development of this point and bibliographic references.

(84) Ibid., p.7, for a similar view.

(85) T. Kemp, Industrialisation..., p.8.

(86) Ibid., p.14.

(87) Ibid., p.3.

(88) This view of French economic development is, of course, fairly sympathetic to that of Roehl. However, in at least one respect it is antithetical to his approach; much of his paper uses the device of inverting the Gerschenkron typology to establish France as a forerunner in entering modern economic growth. The view of the world adopted in this paper makes that procedure illegitimate in the sense that the associations predicted by Gerschenkron would only be assumed to account for part of the variance, there would also be an error term. In effect Gerschenkron himself argues this in Economic Backwardness in Historical Perspective (Harvard, 1966), Ch. 1, 2 and postscript. It also makes it unnecessary as a move to erase the 'inferiority label', which is possibly an advantage in that on occasions the effort to fit England and France into Gerschenkron's boxes, which were designed for the late nineteenth century industrialisers primarily, gets arguably rather strained.

(89) D. S. Landes, The Unbound..., p.39.