“History Friendly” Models of Industrial Evolution

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1. **Introduction**

"History-friendly" models (HFM) are an approach to the construction of evolutionary models based on the formalization of the essence of appreciative theories about mechanisms and factors affecting the evolution of specific industries suggested by empirical research.

The development of HFM was inspired by the reconsideration of some basic methodological principles that underlie evolutionary economics. In particular, HFM reflect the commitment to the argument that:

i) realism should be considered as an important merit of theoretical models and that the design of formal economic models ought to proceed well informed by the empirical literature on the subject matter they purport to address;

ii) formal evolutionary theory can be a major help to empirical research in economics.

iii) formal models play a crucial role for the development of more general theories that are capable to subsume diverse specific instances into a compact, broad and simple conceptual framework.

In this paper, we shall discuss first the basic methodology of HFM. Second, we shall briefly present the basic structure of a model of the evolution of the computer industry and some applications and exercises carried out on such model. In Section 4, a brief illustration of a model of the pharmaceutical industry will be used to suggest how HFM can be used in an inductive way to progress towards broader generalisations and theories. The concluding section indicates some lines for future research.

2. The Methodology of HFM

HFM are inspired by the recognition that there is often a tension between detailed-rich, empirical and historical accounts of specific phenomena and "general theories", almost always formalised in mathematical models. This is arguably the case in evolutionary economics, too. The evolutionary models " of the "first generation" attempted in general and primarily to explore the logic of evolutionary economic processes and to establish the usefulness of this new approach. In most case, these models were rather simple and abstract. They had as their empirical referent broad phenomena such as economic growth, the relationship between industrial structure and innovation, the diffusion processes, and other stylized facts about issues of industrial dynamics. Sometimes they had a very complex formal structure, but both the description of phenomena under observation and the internal structure of these models were highly simplified, as it concerns both the kind of agents that were explicitly modelled (typically only firms) and the representation of their internal structure and of their behavior was also extremely stylised. Also the demand side was not usually represented in any depth.

These models were in our assessment tremendously successful. Yet, this very successes raises a number of questions.

First, it becomes necessary to explore further the fundamental principles of evolutionary economics that are able to explain such a large variety of phenomena. This is the realm of "high theory", which ought to be as general, compact and parsimonious as possible. In other words, the task here is to identify and strengthen the "hard core" of evolutionary theory. Recent work , e.g. by Sidney Winter, Giovanni Dosi and others goes precisely in this direction (Bottazzi *et al*, 2001; Winter *et al*, 2000).

Second, in a strongly complementary way, one might try to impose a stronger empirical discipline on formal models, for at least two reasons. In some cases, especially as models progress in mathematical sophistication, their linkage with specific economic facts tends to become worringly tenuous. Moreover, and more important, sometimes the empirical phenomena that the theorist tries to explain are extremely generic and not sufficiently specified or conditioned to restrictions. Thus, they can result from very different dynamic processes. Phenomena like S-shaped curves in diffusion theory or skewed firm's size distributions are typical examples of this kind of "unconditional objects" (Brock, 1999). In these instances, it might be useful to both enrich the internal structure of the model and above all to increase the number and the kind of facts that one tries to explain at the same time. The imposition of a tighter "empirical discipline" is necessarily a more demanding test for the model.

Last, but by no means least, evolutionary economics has been developing to a large extent through the construction of empirical and historical case studies. Usually these "histories" present rich and detailed evidence and suggest powerful explanations. Actors and variables like the educational system, policies, institutions, the internal organizational structure of firms, the structure of demand play a fundamental role in these accounts. This literature is based on “appreciative theorising” (Nelson and Winter 1982), i.e. non-formal explanations of observed phenomena based on specific causal links proposed by the researcher. Nelson and Winter argued that not only appreciative theorizing is a true causal theory, but also a fundamental and unavoidable step in any process of “theory-making”. Thus, it is dangerous to downplay its methodological status, since they provide the fundamental building blocks and the understanding of the specific set of phenomena under investigation. However, it is sometimes hard to check the logical consistency of appreciative models, whether the suggested causal arguments are consistent and sufficient to provide an explanation. This is particularly the case if these appreciative models embody non linear and path-dependent processes and a variety of agents and institutions. Moreover, these accounts are usually hard to generalise. Each history is often treated as unique, because the details and the specific observed sequence of events make it difficult or controversial any claim that the particular case can be considered as an instantiation of a more general process applicable to a wider range of cases.

These remarks suggest, in our view, that in many cases there is a tension between empirical analysis of specific cases and the construction of general theories. To a large extent, this tension is unavoidable and it is a legitimate and indeed fruitful source of progress in understanding. But possibly, it might have indeed gone too far.

Against this context, HFM try to bridge this gap. In this vein, formal models should be considered first of all as attempts at checking the consistency and the robustness of the verbal arguments that constitute the appreciative theory. Hence, HFM aim to capture the essence of the appreciative theory put forth by analysts of the history of an industry or a technology, and thus to enable its logical exploration. Often, in these cases, only a simulation model can capture (at least in part) the substance of the appreciative model. But it is worth observing that a "history-friendly" model doesn't necessarily need to be based upon simulation, nor necessarily on an evolutionary approach[1].

On the other hand, HFM might contribute to the construction of more general theories in at least two ways. First, the construction of formal models of specific industries might be useful in forcing the theorist trying to apply a general model to a specific case, recognising that often the “devil is in the details” and calling both for more realism than it is sometimes the case and for stronger awareness of the distance that might exist between any “general” theory and the issue under investigation.

Second, in a more inductive attitude, building different HFM for different industries may help the development of “general theories” by prompting the analyst to clearly recognise what is similar and what is different between two or more sectors. As an example, at the very beginning of the development of a model, one must obviously identify the distinctive features of the industries under investigation. In all probability, then, a model built to deal with the computer industry should be different from a model of the pharmaceutical industry. But the deliberation about which features have to be different and which can be similar is a basic inductive exercise, which paves the way for subsequent generalizations. Thus, a "history-friendly" approach can allow us to tackle, in a dynamic setting, some general traditional questions of industrial economics, like why do industries differ, what are the relationships between innovation, demand structure and market structure, what are the determinants of processes of vertical integration and specialisation, etc..

[1] For example, the model presented by Jovanovic and MacDonald (1993) could be thought as a neoclassical antecedent of "history-friendly" models. Much of the work by Steven Klepper goes also in the direction of building models for specific industries as a basis for further generalization. See for instance, Klepper (2002)

In this sense, HFM try to impose a “double” methodological discipline on evolutionary industrial organisation theory: imposing formal discipline on appreciative theorising and empirical discipline on more abstract, general theories.

3. The model of the computer industry

The first attempt at building a HFM concerned the computer industry (Malerba *et al*. 1999). The model clearly shares the distinctive characteristics of the evolutionary approach. Agents are characterized by "bounded rationality", i.e. they don't completely understand the causal structure of the environment in which they are set and they are unable to elaborate exceedingly complex expectations about the future. Rather, firms' and consumers’ actions are assumed to be driven by routines and rules that introduce inertia in their behaviour. Agents, however, can learn and are able to improve their performance along some relevant dimensions, in particular technology.

Given earlier period's conditions, firms act and modify their performance. Specifically, profitable firms expand, and unprofitable ones shrink. Thus, the model is mainly driven by processes of learning and selection. Jointly, the actions of all agents determine aggregate industry conditions, which then define the state for the next iteration of the model.

Strong non-linearities are present in this structure. They generate a complex dynamics and prevent an analytical solution of the system. Moreover, the model does not impose equilibrium conditions: on the contrary, "ordered" dynamics emerge as result of interactions far from equilibrium.

3.1 The basic structure

The history analysed in the model begins with a number of firms engaging in efforts to design a computer, using funds provided by "venture capitalists". Computers are designed on the basis of transistor technology. Some firms exhaust their capital endowment without achieving a computer that meets a positive demand and fail. Some other firms succeed and begin to sell. This way they first break into the mainframe market. Profits are used to pay back the initial debt, to invest in R&D and in marketing. Successful firms gain market shares and grow. Over time firms come closer to the technological frontier defined by transistor technology, and technical advance becomes slower.

After some time, microprocessors become exogenously available. This shifts the technological frontier, so that it is possible to achieve better computer designs. A new group of firms tries to design new computers exploiting the new technology, in the same way it happened for transistors. Some of these firms fail. Some enter the mainframe market and compete with the incumbents. Some others open up the PC market. Incumbents may choose to adopt the new technology to achieve more powerful mainframe computers. The adoption of new technology by old firms is costly and time-consuming. After they have switched to the new technology, incumbents may decide to diversify into the PC market and compete with new PC producers.

3.2. Some features of the formal structure of the model

Computers are defined by two characteristics, "cheapness" (defined as the inverse of the price of a given computer) and "performance" which improve over time as a consequence of firms' R&D spending. Computer can be designed using two different technologies, characterized by the type of components they embody: transistors and microprocessors. These technologies become exogenously available at different periods and they define the maximum levels of the two characteristics that can be achieved by a computer design.

Computers are offered to two quite separate groups of potential customers. One group, ("large firms"), greatly values performance and wants to buy mainframes. The second group ("small users"), has less need for high performance but values cheapness. It provides a potential market for personal computers. The value that customers place on a computer design is an increasing function of its performance and its cheapness[2], which, jointly, define the "merit" of a particular computer to the eye of the customers.

[2] Markets for mainframes and for PCs consist of a large number (a parameter in the model) of independent submarkets. They are sub-groups of purchasers with identical preferences.

Consumers buy computer valuing its "merit", compared to other products. In addition, however, markets are characterized by brand-loyalty (or lock in) effects and respond to firms' marketing policies. Moreover, there is a stochastic element in consumers' choices between different computers. Without lock-in effects or marketing, demand would be similar to a standard demand curve. It would tend to converge towards the higher quality product, even if a positive probability of surviving for computers with lower design would always remain. The inclusion of brand-loyalty and bandwagon effects introduces inertia and forms of increasing returns in market dynamics.

Firms' behaviour is meant to capture elements of the theory of the firm based on "dynamic competencies" (Winter 1987, Dosi e Marengo 1993, Teece et *al*, 1996). Firms are represented by sets of technological and marketing competencies that are accumulated over time, and by rules of action. Through their R&D expenditures, firms accumulate technical capabilities and design better computers. Outcomes of R&D activities depend on the research direction each firm decides to follow (which is assumed to be firm-specific and time-invariant), on latent technological opportunities (i.e. the maximum levels of the two characteristics that can be achieved by a computer design) as well as on a probabilistic effect.

The price that firms charge on their products is obtained by adding a mark-up to production costs, which in turn are determined by the technical progress function. R&D and advertising expenditures are simply determined as constant fractions of profits (after the repayment of their debt).

An essential element of the "dynamic competence" approach to the theory of the firm concerns the cumulative nature of firms' competencies: firms tend to improve gradually following rather rigid directions. As a consequence, competence traps and lock-in phenomena are distinctive features of this approach. In the model, existing transistor-based mainframe firms are able to switch over to microprocessor technology, but this transition takes time and costs. The probability that an incumbent firm will try to switch over is a function of how much progress has been achieved by microprocessor computer designs and of the distance of a transistor firm from the frontier of technological possibilities defined by transistor technology. When adoption takes place, a firm has to pay a once and for all switchover cost. After adoption, firms have access to the new technological frontier and can innovate faster. Moreover, these companies have now the possibility to diversify, producing computers for the PC market. The incentive for diversification is a function of the size of the PC market, defined in terms of sales, as compared to the mainframe market. The old trajectory of technological progress will not be - in general - the best suited one to design PCs. As a matter of fact, IBM entered the PC market founding a completely new division. The procedures governing diversification in the model mimic the actual strategy used by IBM.

The parent company starts a new division, which inherits from the parent company a fraction of its budget and of its technical and advertising capabilities. The parent company exploits "public knowledge" in the PC market and partly imitates PC firms. Further, it picks up randomly a new technical progress trajectory. After birth, the new division behaves exactly as a new entrant, with independent products, profits and budget.

3.3. The simulation runs

The model is able to replicate the industry history. A dominant firm (IBM) emerges relatively quickly in the mainframe market and it maintains its large market share, even after the entry of the new microprocessor-based producers. IBM then diversifies into the PC market, and gains a nontrivial, but not a dominant, share.

The parameter setting reflects the basic key assumptions of the appreciative model. Specifically, the dominant position of IBM in the mainframe market was due to significant effects of brand-loyalty and consumer lock-in. This raised substantial entry barriers to new entrants. Second, by the time microprocessors became available, computer design under the old technology was reasonably advanced, and the leader, IBM, responded to the availability of the new technology pretty rapidly. Third, IBM's massive resources enabled it quickly to mount an R&D and advertising effort sufficient to catch up with the earlier entrants into the PC market. However, in PC market lock-in and brand-loyalty processes were less significant and customers were quite sensitive to the merit of the computer being offered, particularly to price.

The logic of the model has then to be tested conducting counterfactual simulation runs. Thus, a reduction of the parameter capturing brand-loyalty effects in the demand function of mainframe market lowers significantly market's concentration. Similarly, if the time of introduction of microprocessor technology is anticipated, new firms break into the market before the emergence of a dominant firm. Hence, the process of microprocessor adoption is then slower and more costly. Facing this environment, IBM is not able to achieve a significant market share in the PC market because it must compete with firms who have already a dominant position in the new segment[3].

3.3 Further exercises: diversification, industrial policies and experimental users

Being satisfied by the ability of the model to both reproduce the stylised history and to react appropriately to changes in the key parameters (as suggested by the theory), it becomes possible to explore new issues and questions. For example, a first exercise concerned whether and under what conditions a different diversification strategy by IBM had performed better (Malerba *et al*, 2001)[4].

A further issue that has been explored through the model relates to the effectiveness of public policies under conditions of dynamic increasing returns (Malerba *et al*, 2001a). According to the model, the emergence of a monopolist in the mainframe market was nearly inevitable, given the presence of two interacting sources of increasing returns that tend to reinforce each other: cumulativeness in firms' efforts to advance product and process technologies and brand-loyalty and lock-in effects on the demand side. Within this setting, a set of simulation runs examined the effects

3 Conversely, IBM becomes able to dominate also the PC market, if the parameters measuring economies of scale in R&D and brand-loyalty in the PC market are increased and when the diversification process is eased.

4 Here diversifying firms, instead of starting a totally new division, try to apply their specific "mainframe" competencies to the PC and set up a new internal division which develops PCs following the old trajectory of technological progress and begins its activities starting from the position reached by the parent company in the space of technological characteristics. This strategy may entail the disadvantage that the new division's trajectory of advance might fare relatively badly in a markets that values more cheapness rather than performance. Conversely, the strategy based on the acquisition of new knowledge from external sources can be much more expensive and, in general, the new technological strategy of the parent company might well turn to be a very bad one. Simulation results show that a "competence- driven" strategy performs relatively better if the design of PC does not require a drastic re-orientation in the competencies mix (i.e. in the trajectory of technological advance) and if the PC market were not too distant from the mainframe market.

of the timing of an intervention of an antitrust authority (AA) breaking the monopolist in two smaller companies.

Results show the fundamental relevance of the timing of the intervention in dynamic markets of timing and suggest that it is extremely difficult to contrast the tendency towards concentration typical of markets characterised by substantial dynamic increasing returns[5]. Small initial advantages tend to grow bigger and bigger over time and catching up is almost impossible. Leaders do not only have a "static" advantage: they also run faster than laggards. Thus, antitrust intervention might be effective in modifying the degree of concentration, only in the short run. Policies of the kind are somehow designed to "levelling the playing field". But this does not seem to be enough. In order to get effective and long-lasting results, some form of "positive discrimination" might be necessary. That is to say, in the presence of strong dynamic increasing returns, policies should make competitors able to run (much) faster than the monopolist, and not just remove static disadvantages. On the other hand, even if the intervention has limited effects on the mainframe market, it produces noticeable consequences on a proximate market, i.e. the PC segment, where concentration is lower than in the standard case[6].

A third set of simulations does not deal directly or solely with the computer industry, but with a more general issue, i.e. the role of experimental users and/or diverse preferences among potential users in forcing the successful introduction of radically new technology in an industry (Malerba *et al*, 2003). Typically, a new technology is inferior to the old one in its early stages and it progresses only through the R&D efforts of new entrants. But, absent customers who are prepared to buy these initially inferior products, the new firms are not likely to survive and, despite the

5 When AA intervenes very early, the market becomes concentrated again very soon, because one company will quickly gain an advantage and grow exploiting increasing returns. In the case of later intervention the emergence of a new monopolist takes more time. Finally, if the intervention occurs after 20 years, the market will be divided into two oligopolists, who won't be able to profit any longer from the possibility of gaining market leadership, because dynamic increasing returns are limited (technological opportunities are almost depleted). Similar results were obtained in the analysis of policies supporting the entry of new firms.

6 In fact, when AA intervenes early (after 1 or 5 years), both new “IBM children” are able to diversify into the PC market, thereby reducing concentration there. In case AA intervenes "late" (after 10 o 20 years), only one firm will be able to diversify, but it will be smaller and the overall concentration in the PC market will decrease.

opportunities afforded by a potentially powerful new technology, the industry will stay stuck with the old.

To explore this hypothesis, various demand contexts are analysed. In a first set of runs, the bandwagon effects in the demand equation are modified in such a way that new firms trying to introduce a new technology are unable to get any significant market share in the market. As a consequence, established leaders in the market do not have the incentive to adopt the new technology. The same result occurs, though, even when the bandwagon effect is eliminated but customers are sophisticated and preferences are homogeneous, in the sense that users always buy the "best" product currently offered in the market. Since the new technology is initially inferior to the old one, sophisticated customers continue to buy the old – currently better - designs, preventing new entrants from finding a profitable market and to develop the new technology[7].

The situation changes if a group of customers is introduced who will buy some of the products based on the new technology, simply because they are new or if there is a group of customers with very different tastes than the customers who had been buying the old products. In both cases, the new firms, and the new technology, is able to get a foothold in the industry and to grow. Established firms now are challenged by these new ones, and they change over their own practices. The result is that, down the road, products using the new technology come to dominate the market and over the long run even the old consumers may be significantly better off.

4. The model of the pharmaceutical industry

A further attempt at building a HFM concerns the pharmaceutical industry and biotechnology (Malerba and Orsenigo, 2002). The model is still largely work-in progress and therefore only some brief comments will be reported here. This case differs drastically from computers in a number of respects. Thus, beyond its intrinsic interest, the model of pharmaceuticals

[7] This result shows that, quite paradoxically, a more "competitive" market - with little inertia in consumers behaviour - can generate more concentration than a market where inertia is greater

might illustrate how HFM can be used in an inductive and "comparative" perspective to generate and test hypotheses about the determinants of market structure and its evolution.

Pharmaceuticals are traditionally a highly R&D intensive sector where, despite a series of radical technological and institutional "shocks", the core of leading innovative firms and countries has remained quite small and stable for a very long period of time. However, differently form computers, the degree of concentration has been consistently low, whatever the level of aggregation is considered.

These patterns are intimately linked to two main factors. First, the nature of the processes of drug discovery, i.e. to the properties of the space of technological opportunities and of the search procedures through which firms explore it. Specifically, innovation processes have been characterised for a very long time by low degree of cumulativeness and by "quasi-random" procedures of search (random screening). Thus, innovation in one market (a therapeutic category) does not entail higher probabilities of success in another one. Second, the fragmented nature of the relevant markets: a drug treating hypertension has no use for those suffering of Alzheimer.

In the model, a number of firms competes to discover, develop and market new drugs for a large variety of diseases. They face a large space of – at the beginning - unexplored opportunities. However, the search for new promising compounds is essentially random, because the knowledge of why a certain molecule can "cure" a particular disease and of where that particular molecule can be found is limited. Thus, firm explore randomly the "space of molecules" until they find one which might become a useful drug and patent it. After discovery, firms engage in the development of the drug, without knowing how difficult, time consuming and costly the process will be and what the quality of the new drug will be. Then, the drug is sold on the market, whose notional size is defined by the number of potential patients. Marketing expenditures allow firms to increase the number of patients they can access. At the beginning, the new drug is the only product available on that particular therapeutic class. But other firms can discover competing drugs or imitate (after patent expiration). The innovator will therefore experience a burst of growth following the introduction of the new drug, but later on its revenues and market shares will be eroded away by competitors and imitators.

The discovery of a drug in a particular therapeutic class does not entail any advantage in the discovery of another drug in a different class, except for the volume of profits they can reinvest in search and development. Moreover, the various sub-markets (therapeutic categories) that define the overall pharmaceutical industry are independent from one another also on the demand side. As a consequence, diversification into different therapeutic categories is also purely random. Hence, firms will start searching randomly again for a new product everywhere in the space of molecules. Firms' growth will then depend on the number of drugs they have discovered (i.e. in diversification into different therapeutic categories), on the size of the markets they are present in, on the number of competitors, on the relative quality and price of their drug vis-a-vis competitors. Occasionally, a firm can discover a blockbuster. But, given the large number of therapeutic categories and the absence of any form of cumulativeness in the search and development process, no firm can hope to be able to win a large market share in the overall market, but – if anything – only in specific therapeutic categories for a limited period of time. As a result, the degree of concentration in the whole market for pharmaceuticals and in any individual therapeutic category will be low. However, a few firms will grow and become large, thanks essentially to the discovery of a "blockbuster" and to diversification.

The advent of biotechnology starts to change this picture. In the model, a first, very rough, reduced form is introduced of the cognitive processes underlying drug discovery after the molecular biology revolution. In the model, scientific knowledge allows firms to focus search into particular directions (Nelson, 1982). Moreover, science makes new products potentially available.

On these bases, new science-based firms enter the market, trying to discover new drugs. Yet, these new firms are specialised in specific techniques and applications, which might prove to be dead-ends or can be successfully be applied only in particular areas. Moreover, they have little funding and – even when they succeed in discovering a new drug – they don't control the resources to developing and marketing it.

Thus, only few of the new biotechnology firms (NBFs) will succeed in discovering, developing and selling a new drug. Conversely, extant big pharmaceutical companies do not react immediately to the new opportunities and when they eventually adopt the new technologies they have to gradually "learn" the new knowledge base. However, they have plenty of financial and marketing resources. Moreover, they are able – in principle - to "screen" wider subsets of the search space: they are "generalists" rather than "specialists". Against this background, big pharmaceutical companies and NBFs may find it profitable to strike collaborative agreements, whereby NBFs complete some specific project with additional funding provided by their large partners. The drug is then developed and (if successful) marketed by the big pharma corporation, paying a royalty to the NBF. As a consequence, a network of alliances begins to emerge.

As in the model of the computer industry, firms act following very simple rules as it concerns investment in R&D and marketing. Also the basic structure of demand is quite similar to the previous model, except – of course - that now there is a large number of independent markets. The main difference concerns then the representation of the search space in which firms conduct their innovative and imitative activities: here, the discovery of a new promising drug is totally random and there is no cumulativeness in technological advances.

Results are also encouraging. The model is actually able to replicate some of the key features of the pharmaceutical industry in these periods, especially as it concerns the low level of concentration both in the overall market and to a lesser extent also in each therapeutic category. Similarly, the biotechnology revolution does not change substantially market structure, despite a significant entry of new firms. A dense network of agreements between incumbents and NBFs start to develop, though. Collaborative relations allow for the survival of many NBFs and for the further growth of some incumbents, that benefit from collaboration for discovering better drugs.

Various exercises show indeed that it is quite difficult to substantially increase concentration in this model, unless the costs of R&D are drastically increased and technological change and marketing are made much more cumulative. Similarly, it is almost impossible, within the current structure of the model, for new biotechnology firms to displace incumbents.

Within this context, it becomes possible to start running exercises concerning e.g. the effects of alternative forms of patent protection and market regulation.

5. Conclusions

HFM – as developed so far - appear to be adequately flexible and "powerful" to perform the purposes at the base of their creation. They capture in a stylized and simplified way the focal points of an appreciative theory about the determinants of the evolution of two industries. They are able to replicate the main events of the industry histories with a parameter setting that is coherent with basic theoretical assumptions. Changes in these parameters lead to "alternative histories" that are consistent with the fundamental causal factors of the observed stylized facts. Furthermore, on these bases, it becomes possible to explore the effects of different hypotheses about agents' behaviour, the conditions which determine the profitability of different strategies or the impact of alternative designs for industrial policies and forms of market regulation. Finally, – in a more "theoretical" attitude – HFM can be used to develop and analyse more general assumptions about the determinants of the evolution of market structures, like, e.g. the structure of demand and of the relevant technological regimes. HFM, thus, provide some original insights and suggestions for the study of the evolution of industrial structures, particularly by examining the dynamic properties of structures characterized at the same time by several sources of increasing returns.

These models are only preliminary attempts and there are many opportunities for further research along these lines. A first direction of analysis – already in progress - concerns the processes of vertical integration and specialization and the co-evolution of an upstream and a downstream industry. More generally, there is obviously ample scope for the construction of models of different industries, which can explore different histories and investigate new theoretical questions. HFM might therefore prove to be valid tools to progress at the same time towards a more general and a more empirically/historically-founded theory of industry evolution and economic change.

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