

Schumpeter's process of creative destruction and the Scandinavian systems: a tale of two effects

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Esben Sloth Andersen, Michael S. Dahl,
Bengt-Åke Lundvall, and Toke Reichstein

SHORT ABSTRACT: The paper studies of the process of creative destruction according to Schumpeter's programme of making a 'Theoretical, Historical, and Statistical Analysis of the Capitalist Process'. He had both a Mark I and a Mark II of concept of creative destruction, and they are important for understanding the coevolution between economic life and socio-political life. A method for partitioning of evolutionary change into a selection effect and an innovation effect is described, and sketches of the historical experience of Denmark and Sweden are made accordingly. Finally, a statistical study of creative destruction in Denmark is proposed through an example.

LONG ABSTRACT: The purpose of this paper is to outline theoretical and empirical studies of the process of creative destruction in concrete countries—like those of Scandinavia. The starting point is an attempt to combine the types of analysis found in Schumpeter's Evolutionary Trilogy. The style of analysis is mainly related to *Business Cycles* with its triple 'Theoretical, Historical, and Statistical Analysis of the Capitalist Process'. However, no attempt is made to enter Schumpeter's theory of the waveform evolution of capitalism expressed in terms of business cycles. Instead, the theoretical core concepts from *Capitalism* and *Development* are discussed in relation to statistical and historical evidence. This discussion takes place in four steps. First, it is emphasised that there is both a Mark I and a Mark II of concept of creative destruction. While the former is 'Darwinian', the latter is 'Lamarckian' and considers innovation and imitation as ways of avoiding creative *destruction*. This difference has much relevance for the use of the concept of the process of creative destruction as a tool for understanding the coevolution between economic life and socio-political life—since the latter is often dominated by the issue of avoiding creative destruction. Second, a method for analysing creative destruction is proposed. This method partitions any evolutionary change into a selection effect and a (broadly conceived) innovation effect, and by further decomposition both destruction and the response against this threat are made measurable. Third, short sketches of the historical experience of Denmark and Sweden are made in the formalised Schumpeterian terminology. Fourth, the unique Scandinavian datasets that allows the enormously detailed study on their processes of creative destruction during the last 25 years are presented both in general and in terms of a small and preliminary study of a particular topic.

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1. Introduction

The increased level of scientific specialisation has hampered the full appreciation of Schumpeter's work among modern researchers. It is one of the major reasons why the Schumpeterian renaissance largely builds on isolated parts of his work—and even on individual sentences. Nathan Rosenberg pointed this problem out twenty years ago, and it has still not been solved. Therefore we may, with Rosenberg, welcome the new development but at the same time point out

that this renaissance has, so far, been an excessively partial one. That is, it has confined itself to a rather restricted portion of a much larger body of thought. One of Schumpeter's greatest strengths was that he took a very wide-ranging view of the economic process. He saw this process as a part of a larger social and historical frame of reference. ... [But] many of Schumpeter's contributions to economic and social thought remain neglected—even by people who would not shrink from the label 'Neo-Schumpeterians'. (Rosenberg, 1986, 197–198)

Schumpeter's work turned on economic and social evolution, and he presented most of his results in what may be called the Evolutionary Trilogy: *The Theory of Economic Development*, *Business Cycles*, and *Capitalism, Socialism and Democracy*. Therefore, the problem of present-day research is reflected in the limited ability to integrate the analyses found in these books. Instead, we tend to specialise in economic routines and their innovative transformation (*Development*), in the quantitative analysis of waveform economic evolution (*Cycles*), or in the coevolution between economic life and socio-political life (*Capitalism*). The full power of Schumpeter's analysis, however, can only be grasped by combining these areas of study more systematically than he did himself. The heading for such a combination could suitably be taken from the subtitle of *Cycles*, which better than the main title described its contents: *A Theoretical, Historical, and Statistical Analysis of the Capitalist Process*.

One of the major examples of Schumpeter's 'wide-ranging view of the economic process' is embedded in his concept of 'creative destruction'. It can easily be demonstrated that this concept permeates the whole of his Evolutionary Trilogy, but he first presented this concept explicitly in *Capitalism*:

The essential point to grasp is that in dealing with capitalism we are dealing with an evolutionary process. ... [It is a process] that incessantly revolutionizes the economic structure *from within*, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism. It is what capitalism consists in and what every

capitalist concern has got to live in. (Schumpeter, 1942, 82–83)

Through this concept of the process of creative destruction, Schumpeter effectively pushed aside standard ideas about economic change. First, economic evolution is not a simple growth process in which all sectors of economic life expand in a balanced way. Instead, it is characterised by the creation of novelty and the destruction of old products and processes. Furthermore, many of the existing firms and other organisations do not smoothly upgrade their competencies and switch their areas of specialisation. Instead, they often perish in the evolutionary process. Finally, employees that lose their jobs are often facing great stress and significant welfare losses that seem more obvious than their long-term advantages of capitalist evolution. Their reactions constitute a permanent challenge to the institutions of capitalism. Thus, the process of creative destruction is a concept that reflects the competitive struggle and focus on the reactions to the temporary welfare losses at the micro, meso, and macro levels.

Although Schumpeter's concept of the process of creative destruction effectively depicts his basic vision of capitalist evolution, and although it is common to speak of creative destruction in the literatures on business strategy and structural change, it is still an open question whether it is an operational concept. Thus, Helmstädter and Perlman (1996, 1) considered it a 'careless slogan' that should be dismissed:

Schumpeter wrote in 1942 of creative destruction as being the heart of progress, but by 1947 he had reconsidered his earlier careless slogan and substituted and stressed 'the creative response' in place of destruction.

This solution, however, ignores the fact that Schumpeter never abandoned his vision of creative destruction. In the mentioned paper from 1947, Schumpeter emphasised the creative response because he was involved in the establishment of the Harvard Research Center in Entrepreneurial History, but he still considered this a limited aspect of the overall process of creative destruction. Less than two month before he died, he addressed the macroscopic issue of business cycles, and here he had to return to the overall process which produces waveform evolution. In that connection, Schumpeter (1949, p. 326) stated that 'we must investigate historically the actual industrial processes that produce it and in doing so revolutionize existing economic structures.' Thus, there is little doubt that he continued to focus on 'the process of creative destruction which we have taken to be the essence of capitalism' (Schumpeter, 1942, 104n).

The abandonment of the concept of creative destruction produces a 'Schumpeter Light' that might fit the needs of limited innovation studies but

that ignores the needs of macroscopic Schumpeterian studies. The latter studies, however, are very difficult to perform as demonstrated by attempts ranging from Aghion and Howitt (1998) to Perez (2002). To proceed, we suggest that it is necessary to move further away from the use of ‘creative destruction’ as a catchy piece of thought-provoking rhetoric to the development of it as an analytical tool for studying the process of socio-economic change. In other words, we want to relate it explicitly to the qualitative modelling that was initiated in *Development* and the quantitative studies begun in *Cycles*.

Our specifications and operationalisations are intended to be fully general, but we have chosen to relate to two of Schumpeter’s scattered remarks on Scandinavian affairs. In the first German edition of *Development*, Schumpeter (1912, 112; our transl.) remarked that ‘the peasant comes in direct contact with modern evolution ... in Denmark ... But ... [he only makes] adaptations to changed circumstances ... [of] previous demand.’ This remark is interesting because it demonstrates that Schumpeter from the very beginning was aware that even small firms are able to adapt their routines to new situations and thus avoid creative destruction. It also demonstrates his reluctance to use his concept of entrepreneurship on mixed situations with both innovation and adaptations like the Danish agricultural ‘revolution’ in the period 1860–1914. This is unfortunate since the basic Schumpeterian vision and analysis are very fruitful for handling the transformation of the Danish agriculture and the Danish economy in those years (see e.g. Bjørn, 1982). The second remark concerns Sweden: ‘The laborist world would not have the phenomenon of economic progress, but it would be perfectly workable for the rest. ... England and Sweden are good examples for my thesis.’ (Schumpeter, 1949, 252–253) These statements appears to be verified by the Keynes-like models for post-war Sweden, but we shall try to demonstrate that the actual policy of this country (and other Scandinavian countries) was much more ‘Schumpeterian’ than normally recognised. Actually, we shall try to demonstrate that Schumpeter’s concept of the process of creative destruction can be used a core tool for understanding the socio-economic evolution of mixed economies. Furthermore, this type of evolution is just an example of all the types of socio-economic evolution for which the concept can be applied.

2. Economic and social aspects of the process of creative destruction

2.1. *Three different concepts of creative destruction*

The term ‘creative destruction’ is highly ambiguous if considered in isolation from the context in which Schumpeter presented it. Actually, we shall argue that there are at least three distinct concepts of creative destruction, and we can relate these concepts to the names of Sombart, Simon, and Schumpeter.

The literal meaning of the concept appears to be that ‘destruction’ is in some sense ‘creative’. Actually, this was the way Werner Sombart, a leading member of the German Historical School, used it. He did so in a book on *War and Capitalism*, so the problem of destruction was obvious. Taking the example of the mass destruction of European forests, he stated that

from destruction a new spirit of creation arises; the scarcity of wood and the needs of everyday life ... forced the discovery or invention of substitutes for wood, forced the use of coal for heating, forced the invention of coke for the production of iron. That these events, however, made possible the enormous development of capitalism in the 19th Century, is beyond doubt for any well-informed person. (Sombart, 1913, 207; transl. by Reinert and Reinert, forthcoming)

Herbert Simon (1982) had the view that it not the actual destruction of resources but the potential threat to the survival of firms that leads to the change of routine behaviour. According to Simon’s model of satisficing behaviour (that is e.g. applied by Nelson and Winter, 1982, Ch. 9), firms follow given routines as long as they are able to uphold a satisfactory performance. When this is not the case, e.g. because of competitive pressures, they start an innovative or imitative search for better routines. If successful, they scrap their old routines and, thereby, they might avoid the destruction of their organisations. This view seems to fit the above-mentioned transformation of Danish agriculture in the nineteenth century.

Schumpeter did not agree with Schmoller’s concept of creative destruction and he would not have agreed with the concept that Simon developed after his death. For him, creation was a relatively independent event and not the adaptive response to shortages or other pressures. Thus, the entrepreneur’s innovation comes first, and it is its introduction into the system of economic routines that causes the destruction of old routines. Schumpeter’s formulation of his concept of creative destruction can be connected to his analytical scheme of economic evolution that he formulated in *Development* and in *Cycles*. According to this scheme, the

evolution of the routine economy tends to take place through the following sequence of events:

- Initial equilibrium: The analytical starting point is an economic system that is based on solid routine behaviour. This system is assumed to have found an equilibrium that allows the economic agents year after year to operate in their accustomed ways.
- Innovation: The initial equilibrium breaks down when a minority of innovators starts their enterprises. This leads to an economic upswing, but gradually the stream of innovations fades out because of the depletion of innovative skills and the difficulties of innovating under disequibrated conditions.
- Renewed equilibrium through *creative destruction*: Eventually, the innovative impulse is insufficient to uphold the upswing. The downswing sharpens the competitive process of creative destruction, where many old firms are selected out of the economic system while others survive by destructing old routines. At the end, a renewed and well-established routine system emerges.
- Economic evolution as the *process of creative destruction*: The economic evolution of the routine system consists in a series of routinised equilibria and innovative disturbances that challenges given routines. This process creates socio-political reactions that might radically change its future functioning.

This summary of Schumpeter's scheme of economic evolution demonstrates that he really had two related concepts. 'Creative destruction' is the selecting out of firms or their routines by the pressure from an innovation. 'The process of creative destruction' is a combination of this kind of selection and the innovative activities that drives the process. Thus, the broad concept is a synonym for economic evolution that emphasises its conflict-ridden character.

2.2. *Mark I and Mark II of Creative Destruction*

The maximum level of conflict due to the process of creative destruction emerges in the case of a purely 'Darwinian' process in which firms live and die with their routines, but Schumpeter did not suggest such a level of conflict in his *Capitalism*. On the contrary, he presented the process in connection with oligopolistic practices of large firms:

Every piece of business strategy acquires its true significance only against the background of that [evolutionary] process and within the situation created by it.

It must be seen in its role in the perennial gale of creative destruction; it cannot be understood irrespective of it or, in fact, on the hypothesis that there is a perennial lull. (Schumpeter, 1942, 83–84)

Thus, Schumpeter presented creative destruction in relation to the sketchy model that has later been called Schumpeter Mark II (initially by Phillips, 1971). While Schumpeter in the Mark I of *Development and Cycles* largely assumed a harsh ‘Darwinian’ competition between firms with basically fixed behaviour, he in *Capitalism* (Chapters 7–8) included the ‘Lamarckian’ possibility that large firms try to avoid being selected out by means of research and development and marketing. Thereby, large-scale units ‘largely create what they exploit ... in the process of creative destruction’ (p. 101). Schumpeter also emphasised that ‘in the process of creative destruction, restrictive practices may do much to steady the ship and to alleviate temporary difficulties’ (p. 87) and that ‘perfect and instantaneous flexibility may even produce functionless catastrophes’ (p. 105). Furthermore, ‘[s]ituations emerge in the process of creative destruction in which many firms may have to perish that nevertheless would be able to live on vigorously and usefully if they could weather a particular storm’; they tend ‘to inflict functionless losses and to create avoidable unemployment’ (p. 90). These aspects of Mark II demonstrate that it includes within-firm responses as well as potential areas of government intervention against ‘cumulative depressive effects’ (p. 90). They also, surprisingly, relate to the example of the Danish agricultural sector—which Schumpeter had dismissed as uninteresting.

Although Schumpeter formulated his concept of the process of creative destruction in relation to his Mark II, it has often been presented in terms of Mark I. The reason is that this model of the process of creative destruction is much simpler, but the result has been unrealistic and of little practical importance. When we move to Creative Destruction Mark II, we have to confront its in-built complexities. We also start to recognise that Schumpeter’s general analysis of socio-economic change is not as simple as it might appear at first sight.

2.3. *The coevolution of the economy and the socio-political system*

Before Schumpeter had finished his *Cycles*, he received a letter asking about his sociologically oriented studies of the destiny of capitalism. This letter specifically inquired about the last paragraph of his paper on ‘The Instability of Capitalism’. Here Schumpeter (1928, 395) emphasised

that no account whatsoever has been taken [in the paper] of any but purely economic facts and problems. Our diagnosis is, therefore, no more sufficient as

a basis for prediction than a doctor's diagnosis to the effect that a man has no cancer is a sufficient basis for the prediction that he will go on living indefinitely. Capitalism is, on the contrary, in ... a process of transformation into something else[.]

The question was how to study this process of transformation, and Schumpeter (2000, 309) replied that although he had never worked out the analysis in detail, he had 'repeatedly thought about the subject and spoken about it in addresses'. Furthermore, his project on *Cycles* had persuaded him to move forward:

For if one thinks of business cycles as the typical form of capitalist evolution and if one looks upon these long time movements, which are sometimes called industrial revolutions, as one species of cycles, it is but natural to link up with the cyclical phenomenon practically the whole of the economics and sociology of capitalist society. (Schumpeter 2000, 309)

The concept of the process of creative destruction may be seen as Schumpeter's main tool for connecting the economics and the sociology of capitalist society. His well-known argument is that although the long-term consequence of the evolutionary process is a raise of the general standard of living, the problem is the socio-political reactions to the immediate losses and gains. These reactions are influenced by the fact that capitalism has been 'the propelling force of the rationalization of human behaviour' (Schumpeter 1942, 125). This 'rationalization' is related to a 'rationalist attitude' that dismisses notions of fate and sacred institutions and demands some degree of predictability of social life. However, capitalism still includes the instability of creative destruction. Those who lose tend to react with strong resentment and to ignore the issue of long-term gains: 'Secular improvement that is taken for granted coupled with individual insecurity that is acutely resented is of course the best recipe for breeding social unrest' (p. 145). This type of reaction leads to the labour movement, and it is supported by intellectuals whose 'hostility increases with every achievement of capitalist evolution' (p. 154).

Those who gain from creative destruction, in contrast, are not considered effective defenders. According to Schumpeter, entrepreneurs and capitalists were never such defenders, so the capitalist system survived because of the support from other classes like the remnants of feudalism, but these 'protecting strata' were being destroyed (Schumpeter, 1942, 135–139). Furthermore, the driving force of economic evolution tends to lose its vigorousness. The owner-managed firm and the paternalistic bourgeois family—with its long-term interests in the destiny of its progeny—are disintegrating, and this weakens the motivation for entrepreneurial activity

(p. 159). The large corporation may appear as an excellent substitute that ‘tends to automatize progress’, but it also ‘ousts the entrepreneur and expropriates the bourgeoisie’. Thereby it becomes clear that the ‘true pacemakers of socialism were not the intellectuals or agitators who preached it but the Vanderbilts, Carnegies and Rockefellers.’ (p. 134)

Schumpeter wrote about these elements of his analysis of the undermining of the process of creative destruction immediately after the Great Depression and during World War II, so the gloomy perspective is understandable. Nevertheless, many have tried to test the validity of Schumpeter’s ‘predictions’. This ambition, for instance, dominated a volume celebrating *Capitalism* with 40 years of hindsight and with contributions by, for instance, Paul Samuelson, Gottfried Haberler, Arthur Smithies, Robert Heilbroner, and Tom Bottomore (Heertje, 1981). As Herbert Gintis (1983, 85) remarked in his review of that book, this kind of assessment is a major error: ‘We have long abandoned the attempt to assess Marx’ social theory on the basis of his “predictions”, and would never conceive of applying such an approach to Weber, Ricardo, Smith, or Marshall. Why then apply such a criterion to Schumpeter?’ Instead, we should develop his concept of the process of creative destruction and see whether it can explain the events of a period characterised by trade liberalisation and ‘globalisation’. Similarly, we should find out whether it could explain the development in countries, like those of Scandinavia, where the process seems to have undergone major changes. However, before we do so, we need to clarify major issues about the process of creative destruction by formalisation and quantification.

3. Formalising the concept in terms of two effects

3.1. From Joseph Schumpeter to George Price

Schumpeter’s attempts to formalise and quantify his analysis of economic evolution are found in *Cycles*—but they are very fragmentary. The reason is not, as it has often been suggested, that he lacked basic mathematical and statistical skills (which he did not). The real problem is demonstrated by the fact that even the highly skilled economists that he enlisted to help him—including Ragnar Frisch, Paul Samuelson, Gerhard Tintner, and Nicolas Georgescu-Roegen—were not able to help him. Like Schumpeter, they sought for an answer by studying the behaviour of aggregate time series of central economic variables, but they all lacked the interest in and tools for studying the underlying evolution at the level of firms and industries and to base analysis on this foundation. However, a major part of the solution was

being developed in a neighbouring field of science.

While Schumpeter was struggling with his theoretical, statistical and historical analysis of economic evolution, the analogous analysis of the process of biological evolution made a large jump forward. The background for this jump should not least be found in the late nineteenth and the early twentieth century with the emergence of the discipline of biometrics. Although both the name and the research programme of econometrics were clearly inspired by biometrics, the two disciplines differed in a very fundamental way. While standard econometrics was dominated by a need of getting rid of the disturbing effects of economic evolution in order to simplify the study economic problems, biometrics was largely developed to measure and analyse biological evolution. The core founders were Frances Galton (Darwin's cousin) and Karl Pearson, and the editorial article of the first issue of their journal *Biometrika* emphasised that Darwin's theory of evolution by natural selection had a statistical character and that its development needed a statistical examination of a large number of cases. The development of the biometric research led to breakthroughs in both statistical methods and evolutionary theory during the 1920s and 1930s—not least thanks to R. A. Fisher (1999). Thus, the programme of biometrics appears from its very start to have been more comparable with evolutionary issues than was the practice of the Econometric Society—of which Schumpeter was a founding member and, for a while, president.

Today, it is not necessary to study the complex history of biometrics to grasp its importance for the understanding of the concept of creative destruction. The reason is that researchers have transcended the biometric tradition to develop what may be called a general evolutionary metrics. Although there are several contributors to this generalisation, George R. Price was able to sum up and develop its main lessons in a few papers that he wrote in the beginning of the 1970s (see Frank, 1995; 1998). Price's work clarified Fisher's main result about natural selection, helped to overcome the fruitless controversy on group-based selection versus individual selection, and developed a general and very fruitful partitioning of *any* evolutionary change. Price's partitioning includes not only the effect of selection but also the effect of causes that increase variation (see Knudsen, 2004; Andersen, 2004). These two effects clarify creative destruction in both Mark I and Mark II.

3.2. *Decomposing evolutionary change in two effects*

Price's equation is quite simple, and we can quickly *illustrate* it by the example of productivity change in discrete steps. We study aggregate

productivity change between two points of time, and we find that it can be decomposed into two effects:

$$\text{Total change} = \text{Selection effect} + \text{'Innovation' effect}.$$

The selection effect is due to the differential promotion of firms. If firms with above-average productivity grow faster than below-average firms, then the result is an increased average productivity. However, a contribution to change in average productivity also comes from within-firm productivity change, and we call this the ‘innovation’ effect. It is largely due to innovation and imitation, but it also includes what Fisher (1999, 41–42) called the ‘deterioration of the environment’.

To find these effects, we start by studying firms that exist at both points of time. For these firms, we need information on four variables: A_i is the productivity of a firm’s employees; $\Delta A_i = A'_i - A_i$ is the change of this productivity between the two periods; s_i is the firm’s employment share; and ρ_i is the firm’s reproduction coefficient (by multiplying its the first-period size by its reproduction coefficient, we obtain the size in the next period). Given this information, we calculate additional population-level information. The core variable is the mean productivity $\bar{A} = \sum_{i=1}^N s_i A_i$ and the task is to explain mean productivity change $\Delta \bar{A} = \bar{A}' - \bar{A}$.

To explain mean productivity change, we start from the regression coefficient of reproduction on productivity, which we denote $\beta_{\rho,A}$. We also need to know the variance of the productivities $\text{Var}(A) = \sum_{i=1}^N (A_i - \bar{A})^2$. This variance describes the differences on which selection operates. With these definitions, we recognise that the covariance between reproduction coefficients and productivities is the variance times the efficiency of selection:

$$\text{Cov}(\rho, A) = \sum_{i=1}^N s_i (\rho_i - \bar{\rho})(A_i - \bar{A}) = \beta_{\rho,A} \text{Var}(A).$$

This is the selection effect, which is determined by the available variance and the efficiency of the selection process. If $\text{Var}(A) = 0$, selection cannot produce any change of mean productivity, but neither can it if the efficiency of selection (the regression coefficient) is zero.

The study of the innovation effect starts from the intra-firm change in productivity $\Delta A_i = A'_i - A_i$. The effect of this change on mean productivity is dependent on the firms’ employment shares in the second period, so we

need to introduce the reproduction coefficients (since $s'_i = s_i \rho_i$). The total size of the effect is the mean or the expected value of all the firm-level contributions to the innovation effect.

$$\overline{\rho \Delta A} = E(\rho \Delta A) = \sum_{i=1}^N s_i \rho_i \Delta A_i.$$

Given the specifications of the selection effect and the innovation effect, we can understand Price's decomposition of evolutionary change. Price's equation states that mean productivity change

$$\Delta \bar{A} = \frac{\text{Cov}(\rho, A)}{\bar{\rho}} + \frac{E(\rho \Delta A)}{\bar{\rho}} = \underbrace{\frac{\beta_{\rho, A} \text{Var}(A)}{\bar{\rho}}}_{\text{Selection effect}} + \underbrace{\frac{E(\rho \Delta A)}{\bar{\rho}}}_{\text{Innovation effect}}. \quad (1)$$

Price demonstrates that this equation is an identity that may be used for the decomposition of any kind of evolutionary change. In the case of productivity change, the equation shows that it is determined by two effects. The first is the selection effect that exploits the (market-share weighted) variance of the productivities. If this variance is large, then mean productivity may increase quickly. The effectiveness of this selection is influenced by the degree to which the relative reproduction coefficients of firms reflect their productivities, and this degree is measured by linear regression as we have already discussed. The second component is the 'innovation' effect, but this naming is not generally correct (unless we e.g. accept the notion of negative 'innovations' and effects of environmental change). To see why this name is appropriate in the present context, we have to consider the meaning of $E(\rho \Delta A)$. If there is no change in the productivity of any of the individual firms, then the sum is zero. Why should productivity change at the firm level be different from zero? There are, of course, many potential reasons for both negative and positive values, but in the present context we shall concentrate on the knowledge issue. Here productivity change may be positive because of innovations or learning processes. It might be negative because the firm does not have an effective system of reproduction of its knowledge. The capacity shares of the firms, of course, influence the expected aggregate effects of both learning and forgetting.

As already mentioned, productivity is just an example of an evolving characteristic. From the viewpoint of creative destruction, however, the evolving characteristic is the reproduction coefficients themselves. Furthermore, what is of socio-economic concern is that some firms grow with less than the average growth rate and, especially, that some of them have negative growth rates. To use Price's equation for studying these

issues, we simply substitute ρ_i for A_i in equation (1). Thereby we obtain:

$$\Delta\bar{\rho} = \underbrace{\frac{\text{Var}(\rho)}{\bar{\rho}}}_{\text{Selection effect}} + \underbrace{\frac{\text{E}(\rho\Delta\rho)}{\bar{\rho}}}_{\text{Innovation effect}}. \quad (2)$$

From this equation we may quickly move to the discussion of *relative* creative destruction. To do so we note that half of the selection effect must come from firms with decreasing employment shares. The question is how these firms perform with respect to the change in their reproduction coefficients. To study this question we start by splitting the firms into two subpopulations c and d . Firms are members of subpopulation c that consists of relatively growing ('creative') firms if $\rho_i \geq \bar{\rho}$. Otherwise, they are members of the subpopulation d that consists of firms that are encountering any degree of relative decline/destruction. Then we split up the firm-level selection effect and the firm-level innovation effect of equation (2) according to the membership of these subpopulations:

$$\begin{aligned} & \underbrace{\frac{\text{Var}(\rho)}{2\bar{\rho}}}_{\text{Creative selection effect}} + \underbrace{\frac{\text{Var}(\rho)}{2\bar{\rho}}}_{\text{Destructive selection effect}} = S^c + S^d, \\ & \underbrace{\frac{\sum_{i \in C} s_i \rho_i \Delta \rho_i}{\bar{\rho}}}_{\text{Innovation-response-to-increase effect}} + \underbrace{\frac{\sum_{i \in D} s_i \rho_i \Delta \rho_i}{\bar{\rho}}}_{\text{Innovation-response-to-decrease effect}} = I^c + I^d. \end{aligned}$$

Let us consider this equation from the viewpoint of creative *destruction*. Here the important issue is whether or not the relative decline of firms in the first period is compensated by growth in the next period. The relative destructive selection effect S^d is a positive contribution to the total evolutionary effect. The problem is how relative destruction in the first period is connected to the innovation-response-to-decrease effect of the next period. If weakened firms did not react or reacted through a negative innovation effect, then they would face an irreversible process of decline. But they may also have the possibility of compensating reactions to their weakened position. Thus Schumpeter emphasises that the response of weakened firms is often to imitate the growing firms. The response is even more radical in Simon's (1982) theory of satisficing behaviour. According to this theory, super-normal performers are satisfied and do nothing to improve their performance. In contrast, sub-normal performers are dissatisfied and engage in innovation. Thereby, they may be able to improve their position. The crucial question for the long-term process of relative creative destruction is, therefore, whether $I^c < I^d$. This is, of course, an

empirical question, and it is not easy to answer. One of the difficulties is that random factors play a large role in determining growth rates, and therefore we see a large degree of ‘regression’ toward mean behaviour.

To include the issue of *absolute* creative destruction into our analysis, we only need to change slightly the above procedure. Firms are members of subpopulation *C* growing firms if $\rho_i \geq 1$. Otherwise, they are members of the subpopulation *D* that are absolutely declining. Then we split up the firm-level selection effect and the firm-level innovation effect according to the membership of these subpopulations. The questions related to this partitioning are more or less the same before. But now the problem of firing of employees enters into the discussion. In the long run the absolute destruction effect is obtained by moving labour from declining firms to growing firms. But this movement is seldom a smooth one. From the viewpoint of the moving employees there is often a welfare loss due to temporary unemployment and loss of social context. From the viewpoint of the declining firms the problem is that the loss of employees may in many ways influence productivity in a negative way. Thus we encounter not only new reasons for compensating responses to decline but also new difficulties of avoiding vicious circles.

The above analysis was made in terms of continuing firms, so we need to include mergers, exits and entries. There are several ways of handling this problem, and we have not yet decided on the most operational method. One possibility is to consider mergers during the period as if they took place in the beginning of the period. Exiting firms have zero shares at the end of the period under study, so they only contribute to the selection effect. For genuinely new firms, the individual reproduction coefficients are undefined, but we can easily measure the degree to which they add to the innovation effect.

3.3. *Reinterpreting creative destruction*

We are now ready to return to the discussion of the Schumpeterian models of creative destruction. In Mark I, the new firms introduce innovations and imitations while the old firms are largely unable to adapt. Therefore, we expect a large selection effect. This effect includes the expansion of firms with above-average productivity, but the strongest socio-political responses come from those related to the negatively selected firms. In Mark II, there may still be new entrants, but the innovative and imitative activities of the continuing large firms dominate. If all innovative activities are transferred from individual entrepreneurs that innovate by creating new firms to oligopolistic firms with permanent in-house innovation, then we should

expect to see that an increasing part of evolutionary change is due to the innovation effect while a decreasing part is due to the selection effect. The reason is that such oligopolistic firms do not wait with their reactions until they are selected away. Instead, they use innovation as a means of keeping up with the average behaviour of the population of firms. Thus, what the selection effect obtained in an earlier phase of capitalism will now be obtained through the innovation effect. Since this proposition is not generally obvious, we seriously need empirical studies about the issue. In these studies, we will also have much need of the multi-level version of evolutionary change. The reason is that the Schumpeterian large-scale firms consist of many units, and some of the apparent disappearance of the selection effect may be due to a movement from selection between firms to selection within firms. It is, however, on balance likely that we shall find an increased importance of the innovation effect as a partial substitute for the selection effect. Consequently, socio-political resistance to change should diminish. However, the change that takes place within firms is very visible, and resistance may be organised at this level.

4. The two effects and the development of the Scandinavian systems

It is not possible in the present paper to enter a real ‘Theoretical, Historical, and Statistical Analysis of the Capitalist Process’ in the Scandinavian countries. Nevertheless, it is helpful to consider how the above theoretical and statistical accounts for the process of creative destruction might serve to explore Schumpeter’s casual comments on these countries.

4.1. The case of the transformation of Danish agriculture

We used productivity change to exemplify our formalisation of Schumpeter’s process of creative destruction, but normally other measures of evolution are better. Let us start by considering the Danish agricultural ‘revolution’ that took place in the period 1860–1914. In the beginning of that period, the threat of destruction of Danish farms was very real. They based themselves on grain exports to Britain, and the price of grain fell radically because the US gained access through railways and steamships. The alternative was to sell products like butter, bacon and eggs. Thus, the main evolving variable was the average share of the products of animal husbandry in the output of the farms. The selection effect played a minor role in this evolution, which largely took place by changing the product mix of each farm. Instead, innovation was partly organised at the national level, and effective strategies of diffusion were designed (e.g. the exclusion of

patent protection).

These efforts within the agricultural sector were complemented by the innovative transformation of the sectors that produced agricultural inputs and processed the agricultural output. Much of this transformation can be described in terms of Schumpeter Mark I, so many firms in these sectors faced negative selection. However, the diversity of the supporting sectors meant a decentralised industrial structure in the Danish economy. The addition of strong labour interests to the position of agriculture in the socio-political system did little to change this structure. Instead, much emphasis was put on delimiting the negative effects of creative destruction by a welfare system and a flexible labour market system.

This change took place from the 1930s and onwards, and when the system was in place, relatively egalitarian wages was used to increase productivity in the industrial sector. The mechanism was that uniform wages served to weed out weak firms, while quick reskilling and other labour market initiatives served to promote strong firms. However, this policy of selecting out weak firms was less developed than in Sweden. Instead, an increasing emphasis was put on the adaptability of established firms. This policy, however, has not changed the basic industrial structure, so the main policy has a mix of Mark I and Mark II elements. Presently, quick globalisation and decreased social cohesion to some extent challenge this policy. So it is a large question how far the innovation and learning effect has been able to replace the selection effect (and thus creative destruction in the narrow sense).

4.2. The case of the 'Scandinavian Model'

The 'Scandinavian model' can be found in rather different versions in Denmark and Norway (and Finland), but the Swedish case is the most developed and well known (Magnusson, 2000). As Schumpeter noted (1942, 325-326), a fundamental historical compromise on the process of creative destruction was established in Sweden in the 1920s and 1930s (see Edquist and Lundvall, 1992, 272-274; Henrekson and Jakobsson, 2001). Thereby, the leadership of the trade union movement changed its attitude to the introduction of new technology and to rationalisation of the labour process into a positive one. One reason was that much of the Swedish industry was highly centralised so that it was easy to make agreements. Even more important reasons for the change was that the Social Democratic government could guarantee that new production technology would not result in widespread unemployment and that unions seemed capable of appropriating what they considered a rightful share of the productivity

gains.

After World War II, the compromise allowed the development of a Swedish model for economic policy, including wage policies (mainly developed by Rehn and Meidner). One important aspect of this model was the acceptance of and even the active support of industrial transformation emphasising the selection effect (often phrased in terms of Salter, 1960). If an industrial sector was ailing, it was assumed to reflect low relative productivity and/or stagnating demand. General economic policies pursued by the state (through investment funds and labour market policies) and by the centralised trade unions (through egalitarian wage policies, securing the largest wage increases for the lowest paid worker) combined forces in stimulating a transfer of resources from the ailing sectors to growth industries with better long-run prospects. Lundberg (1985; see also 1996) has described the raise and fall of this version of the Swedish model. Although he largely presented his analysis in Keynesian terms, it is clear that the model had significant Schumpeterian elements, but it is also clear that the positive effects of these elements tended to vanish (see also Lindbeck, 1997; 2004). The few Swedish economists who had Schumpeter as their major source of inspiration, probably, were the first to recognise this problem (Dahmén, 1991). A major reason was that a few large firms dominated the Swedish economy to an unusual degree. Therefore, the potential for selection effects largely disappeared, and the large firms were unable to compensate by sufficient innovation effects.

In other words, Sweden tended to look like a relatively pure Mark II, with the important difference that government and unions supported the large firms to an important degree. This support, of course, came at a cost, but an even more important problem was that although the processes depicted by Mark II and Mark I coexisted (Granstrand and Alänge, 1995; Henrekson, 2005), the latter was rather weak. Efforts have been taken to change this situation, but the macroscopic results are still unclear. The problem, of course, is whether Mark I will become dominant or whether the adaptive and innovative responses within Mark II are sufficient to solve the problem. Similar threatening problems are not found in Denmark. Although the Danish model was much like the Swedish one, more emphasis was put on Schumpeter Mark I because of the decentralised industrial structure. However, both models now put more emphasis on promoting innovation and learning within firms (thereby avoiding destruction?). This change is supported welfare policies emphasising competence, flexibility and social cohesion—but the policies for the ‘learning economy’ are to some extent under pressure from rapid globalisation.

Among those who have tried to rethink the Swedish and Danish systems in more or less Schumpeterian terms are Lundvall (2002) and Lundvall and Lorenz (forthcoming). They phrase the threat of creative destruction in terms of a ‘transformation pressure’ that can either be decreased (e.g. by protectionism) or increased (by open trade and/or high welfare costs). They see two major means of securing that an increased transformation leads to sustainable results. First, the firms need to be able to respond to the pressure by being able to adapt innovatively. This reaction depends on the willingness and capabilities of their employees, and the solution is to enhance the system of learning and competence building. Second, the overall reaction to the pressure also depends on the avoidance of serious welfare losses—by enhancing the adaptability of firms and by compensating those that, nevertheless, are hit. This compensation should not be made after rigid rules. Instead, it should emphasise quick adaptation.

5. Measuring destruction and learning in Scandinavian economies

5.1. The research programme

The rough accounts for the process of creative destruction in Denmark and Sweden are not sufficient for understanding what goes on. Especially, it is uncertain how far it has been possible to transform the threat of being selected out into intra-firm adaptation and innovation rather than into inter-firm selection. This issue can be studied in a number of ways, and hitherto we have largely used innovation survey data (see Lundvall, 2002). However, a strong case can be made for studies of the changing process of creative destruction by means of complete census data.

The general method can be summarised as follows. First, we define a selection criterion (e.g. productivity) and partition in the selection effect and the innovation effect. The selection effect reflects the differential growth of firms based on their initial productivities; it depicts simple creative destruction and promotion. The innovation and learning effect combines the effect of new firms and of productivity change within established firms; they are important parts of the process of creative destruction. Then we decompose the selection effect into a positive selection effect and a negative selection effect, where the negative selection effect measures the creative destruction of jobs. Furthermore, we decompose the innovation effect into the effects of newly rising firms and of established firms, where the adaptive response of established firms can be considered an alternative to their creative destruction and where a question is whether their response is triggered by threats (potential or actual).

5.2. *The data*

During recent years economists have gained access to longitudinal micro-data that has led to a renewal of the Schumpeterian research programme as indicated by surveys of e.g. micro-based productivity studies (Bartelsman and Dooms, 2000) and studies of creative destruction in terms of labour flows between firms (Davis and Haltiwanger, 1999; Armington and Acs, 2004). However, these studies have not applied an explicit evolutionary methodology and the applied datasets have been very limited. In contrast, all Nordic countries (Denmark, Finland, Iceland, Norway, and Sweden) have full and linkable data for their populations of persons and firms.

In order to investigate the process of creative destruction, we initially rely on the comprehensive dataset with information for the entire Danish economy (Dahl and Reichstein, 2004). This dataset combines very detailed information on all individuals and all establishments, gathered from the official registers of the Danish government, which records unusually detailed information about the economic activities in the country due to its extensive welfare policies. As a result, it covers all Danish firms and plants as well as the entire Danish labour market. The dataset is maintained by Statistics Denmark (2004) under the name ‘Integreret Database for Arbejdsmarkedsforskning (IDA)’ (which translates to: ‘Integrated Database for Labor Market Research’). The dataset is internationally recognised as being extremely useful for economic and other social science research. Recent publications that have exploited this source include Sørensen (2004) and Bingley and Westergård-Nielsen (2004).

IDA contains several elements and characteristics that make it particularly interesting for economic and social science research. First, it holds extensive information on the characteristics of individuals, e.g. sex, age, length and level of education, work experience, occupation, family status and relations, household characteristics, wages and other income, wealth, and unemployment. Second, individuals are matched directly with establishments and employers. It is possible to distinguish between plants and firms, which are characterized by their location, industrial affiliation and other basic information. Third, the database is longitudinal. It has been updated annually since 1980, and thus it is possible to follow individuals, plants and firms from one year to another. Additionally, the identity of plants and firms is preserved over time. If a plant is bought by another firm, the plant retains its original identity, unless the majority of the employees leave the firm. This means that unless the structure and the group of employees changes during the takeover, a plant will not be labelled as an exit if it is taken over.

5.3. An example: the share of academic labour in Danish employment

When designing a very first study within the research programme, we have abstained from immediately studying the overall process of creative destruction in Denmark. The main reason is that by using the methodology initially for easily interpretable studies, we decrease the probability of error in later large-scale studies. Since productivity studies are not easily interpretable, we have instead studied the response to particular challenge. It has been argued that, under the present conditions, the share of highly educated employees can be taken as a proxy for the adaptability and innovativeness of firms. Thus, firms in which this share is relatively high should be best suited to avoid being creatively destroyed. To handle this issue, we define the share of highly educated employees as a rule that evolves over time (for instance, expressed as a rule of the firm's human resource management system). The question is whether evolution of this average share is dominated by the selection effect or the innovation effect.

By drawing on the IDA database, we estimate the selection and innovation effect in the Danish economy from 1980 to 1999. In separating the selection and innovation effect, we use the Share of Highly-educated Employees (SHE), i.e. the share of employees with a university or higher degree. The selection effect with respect to SHE routines is the relative covariance between reproduction coefficients and SHE. The innovation effect with respect to SHE routines is the relative mean of the product of the change of SHE and the reproduction coefficients.

Apart from reporting the selection and innovation effects with respect to SHE routines in Danish manufacturing, Table 1 also report the effects estimated by disaggregating manufacturing into the four Pavitt sectors (see Pavitt, 1984). Dividing manufacturing into the Pavitt sectors enable us to investigate the two effects in four different sectors that are distinctive in terms of production technologies and learning modes. Such differences may very well produce variations in the level of each of the effects as well as variations in the relative size of the two effects across the Pavitt sectors.

Table 1: Selection effect and innovation effect in the Danish economy from 1980 to 1999 calculated using a version of Price's equation (preliminary results!).

	Selection Effect	Innovation Effect	Innovation/Total Effect
Total Manufacturing	162285.84	427.52	0.0026
Supplier Dominated	5872.18	71.64	0.0121
Scale Intensive	37787.99	179.14	0.0047
Specialised Suppliers	46072.75	245.92	0.0053
Science Based	2590.45	63.35	0.0239

Table 1 reveals that—in the case of Denmark and on the basis of the very first calculations—the selection effect is the dominant of the two regardless of whether we investigate total manufacturing or each of the four Pavitt sectors. Put in another way, the results suggest that the evolution of the Danish manufacturing and the sub-sectors primarily can be attributed to firms with above average share of employees with a university degree rather than to changes to the staff configuration of existing firms. Relatively speaking the Science Based sector has the highest innovation effect. But even in this case the innovation effect can only be attributed to about 2.4% of the total effect

One way to interpret the higher selection effects is that the relative reproduction coefficients of the firms reflect the share of workers with a university degree rather well. Another would be to say the variance of the share of employees with a university degree is rather high. Both of these would produce high selection effects. The innovation effects are all positive suggesting the share of employees with a university degree tend to increase over the period investigated. Had it been negative the surviving firms would have been hiring relatively fewer people with a university degree.

The composition of Danish manufacturing sector serves to decrease innovation effect relative to the selection effect. The reason is that, in the case of Denmark, the Scale Intensive sector accounts for more than double the number of firms than in any of the other three Pavitt sectors. There is a small discrepancy in the fact that the Specialised Suppliers sector is the smallest of the remaining three Pavitt sectors. Yet the share of the total effect which may be attributed to innovation is the second lowest the four Pavitt sectors considered. It is worth mentioning that the number of firms in the Specialised Supplier, Science Based and Supplier Dominated sectors are fairly equal.

5.4. *Further work*

The above study of the evolution of the Share of Highly-educated Employees (SHE) in Danish manufacturing is obviously only using a limited part of our general method for studying the process of creative destruction. First, it does not yet include the effect of a change of SHE on overall employment. Second, it includes only manufacturing although the IDA database allows an analysis of all Danish firms (and even the public sector). Third, it does not decompose the selection effect and the innovation effect as described in Section 3.2. Fourth, SHE is but a tiny aspect of the overall process of creative destruction. Nevertheless, the evolution of SHE demonstrates that there are areas in which the Danish economy is not as adaptive and innovative as it is often believed. Thus, it provokes a deeper analysis into this issue.

6. Summary and conclusion

The purpose of this paper was to outline theoretical and empirical studies of the process of creative destruction in concrete countries—like those of Scandinavia. This purpose emerged through an attempt to combine the types of analysis found in Schumpeter's *Evolutionary Trilogy*. The style of analysis mainly related to *Cycles* with its triple 'Theoretical, Historical, and Statistical Analysis of the Capitalist Process'. However, no attempt was made to enter Schumpeter's theory of the waveform evolution of capitalism expressed in terms of business cycles. Instead, it was theoretical core concepts from *Capitalism and Development* that were discussed in relation to statistical and historical evidence. This discussion took place in four steps. First, it was emphasised there is both a Mark I and a Mark II of concept of creative destruction. While the former is 'Darwinian', the latter is 'Lamarckian' and considers innovation and imitation as ways of avoiding creative *destruction*. This difference has much relevance for the use of the concept of the process of creative destruction as a tool for understanding the coevolution between economic life and socio-political life—since the latter is often dominated by the issue of avoiding creative destruction. Second, a method for analysing creative destruction was suggested. This method partitions any evolutionary change into a selection effect and a (broadly conceived) innovation effect, and by further decomposition both destruction and the response against this threat was made measurable. Third, short sketches of the historical experience of Denmark and Sweden were made in the formalised Schumpeterian terminology. Fourth, the unique Scandinavian datasets that allows the enormously detailed study on their processes of

creative destruction during the last 25 years were presented both in general and in terms of a small and preliminary study of a particular topic.

The conclusion is that further research is urgently needed. Although this research will have to clarify the theoretical issues more thoroughly than in the paper, the immediate needs are to develop the suggested historical and statistical studies separately. The historical study concerns the economic history and the history of economic and industrial policies in the Scandinavian countries. This study does not have access to the advanced datasets that are only available for the last 25 years and that hitherto have hardly been used for evolutionary analysis. Nevertheless, the statistical concept of the evolutionary process helps the analysis of the special features of the process of creative destruction in Scandinavia and the different policies that have both promoted and changed this process. The statistical study may appear overwhelming when compared with the possibilities in the datasets. The main features of this study, however, are clear. After a few case studies, like the one presented in the paper, the main issue is to partition the overall process of creative destruction in the described way. This will first be done for a single country, but the goal is to compare at least two countries. Finally, the results of the statistical study should be combined with the results of the historical study. Thereby, we hope to respond to Schumpeter's challenge of making an integrated theoretical, historical, and statistical analysis of the process of creative destruction in particular countries. We also hope to add to the analysis of economic and technology policies of evolutionary economists like Metcalfe (1994; 1998).

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