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DRUID WORKING PAPER No. 97-6

**Restructuring and Embeddeness
Of Business Enterprises
- Towards An Innovation System
Perspective On Diffusion Policy**

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October 1997

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Abstract

The paper deals with the policies for an idealized transition of a National System of Innovation (NSI) from a system reflecting a relatively closed industrializing economy to an NSI which reflects the conditions of a well-developed "Information Society" and "Learning Economy". The analysis of the transition process analyse the NSI from the viewpoint of the needs of the existing firms of the business sector. The problem is how different types of industrial and technology policy may help the business-oriented restructuring of the NSI. The policies are: horizontal support for R & D of advanced firms; SME schemes for laggard firms, etc.; new institutions and organizations for the cooperative production of new technological inputs, such as customized chips; proactive diffusion policies; and market building. It is suggested that policies should initially contribute to the self-organised restructuring of advanced enterprises. On the basis is this preliminary change in the NSI it is possible to turn promoting the restructuring of imitators and laggards which have less awareness and fewer absorbtion capabilities of the new technological input. The goal is to generate a cumulative learning processes about restructuring which benefit both the firms receiving support and other less advanced firms. In the implementation of the policies it is important to recognize the time dependence (need to exploit the learning potential from advanced firm restructuring; and the need to assure sufficiently strong system effects).

Keywords

National Systems of Innovation, learning Economy, Diffusion of innovation, innovation policy

JEL Classification

O38, O32, L15, D23

ISBN 87-7873-025-2

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Preface

We are quite happy to integrate international scholars in the DRUID network and to publish their contributions in the DRUID working paper series. Especially when their contributions are central for the themes of research around which our programme of research is built. This paper gives an interesting contribution to the analysis of national systems of innovation (Theme C). Morris Teubal has been a guest professor at Aalborg University for a period in 1996 and participated in several of the DRUID-conferences.

In this paper Morris Teubal develops a new perspective on technology policy where the focus is upon the transition of a national system of innovation and policy developments are related to the different stages in such a transition. The paper is still in the form of a rather sketchy and complex taxonomy. But it is imaginative and we believe it gives stimulus for moving the debate further ahead in this important field of research.

Bengt-Åke Lundvall

Restructuring and Embeddeness Of Business Enterprises -Towards An Innovation System Perspective On Diffusion Policy

Morris Teubal¹

The long term research objective of the topic of this paper is to apply the National Systems of Innovation framework (Nelson 1993; Lundvall 1992, Edquist 1997) to analyze the transition of economies to what can be termed the Information Society or a Learning Economy. The starting point is the appreciative theory framework of analysis developed in Galli-Teubal (1995) and Anderson-Teubal (in process) with its focus on Business Sector Restructuring (RBS) and the impact on this process of increasingly wide and more complex subsystems generated during NSI transition. Thus, “system effects” are being visualized in these papers as potentially playing critical roles in the process of enterprise restructuring required by the challenges of globalization and liberalization on the one hand and by the implications of the technological revolution on the other.

The objective of this paper is to further analyze the process while modifying somewhat both the focus and the overall framework of analysis. As with previous work I adopt a *systems focus* which means I will be considering both the direct effects of policies directed to RBS as well as other policies which only have an indirect impact (‘system effects’) on such a process. A major thrust in the latter will be to analyze the process (and nature) of successfully “embedding” the Business Sector into a broader subsystem involving greater complexity, a process which may contribute to successful RBS. In prior work this involved- beyond a first phase of autonomous restructuring- a second phase involving the generation of a new hierarchical level to the subsystem, one populated by more complex entities- collective organizations which were termed Technology Centers (TC’s). This paper further develops these while also considering other changes in the nature of the more open, complex and linked innovation system which is being generated in the wake of changes in the environment (and of ‘BS embeddedness’ in this system). It also analyzes the ‘ideal’ role of a

¹ This paper has benefited from extensive discussions with E. Andersen and K. Smith and from comments by B. Johnson, D. Foray and F. Malerba. It was configured and in part written while the author visited Aalborg University (Department of Business Studies), the STEP-Group, and PREST. Thanks to these institutions and to the Jerusalem Institute for continued financial support.

broader set of policies or policy categories than that which has been usual in the past in analyses of this kind. This in my opinion permits further specification of the policy requirements for successful innovation system transition. Subsequent work will apply this framework to explicitly consider transitions to an Information Society (e.g. as described in EC 1996; OECD 1996).

In previous work we used the notion of Anticipated Institutional Change (AIC) to represent the package of policies leading to the establishment of TC's². The package includes both changes in institutions, facilitation of enterprise coordination, stimulating the establishment of new technological infrastructures which are critical for RBS, and other activities up to initial diffusion of the novel technological services flowing from the new infrastructure. These are supposed to generate the above-mentioned "(hierarchical) system effects" which could help the autonomous efforts of the business sector to initiate and sustain its own restructuring.³ In our more complex policy framework AIC will continue to play a very important role although other policies and aspects of embeddement will be considered as well. First, policies directly oriented to promote RBS - in this paper these will be Horizontal Policies (Teubal 1996a,7) which could trigger a collective, cumulative process of learning how to effectively implement a restructuring process. Second, the higher hierarchical level will eventually metamorphose from a TC to a market for novel technological inputs which are considered central to the restructuring process⁴. This process will be important for materializing a wider diffusion of business sector restructuring (ie. beyond initiators and imitators). Finally, the rich set of policies and their phasing generate a

² The term TC (Technology Center) in this paper expresses the organizational outcome of a process of coordination and cooperation among firms whose objective is the generation of new technological capabilities relevant for the restructuring needs of the Business Sector. They are an example of "Basic Technological Infrastructure" (Justman & Teubal 1995). The Government does not own the TC--it is not a Government Laboratory-- nor is it the central actor in the process of its creation. It essentially is a facilitator of the process.

³ Since these policies do not involve directly stimuli or incentives towards business enterprises they are referred to as 'indirect' policies i.e. working through system effects harnessed through the creation of a second hierarchical level to the NSI. Building the new NIS could also be visualized as generating a new "level playing field" for the business sector i.e. creating the conditions for everyone to be able to compete without discriminating unnecessarily between large and small firms, foreign and domestic etc. This does not mean that some types of firms will not have an advantage over others in the new system nor that the process of selection could not lead to a large number of enterprise failure.

⁴ Alternatively, we may say that this new level involves at least one phase leading to a TC and another one involving a reconfiguration of the TC in parallel with building a new market for the novel technological input. The phases in this paper would represent sub-phases of Galli & Teubal's first phase of NIS transition a fact which also entails a further specification of the processes taking place in such a phase (That paper has also a third phase-ignored here- which involves creating links between a University sector and the recently restructured Business Sector).

new set of policy coordination, coherence and timing issues and thereby help unravel and make more explicit a number of critical dimensions and assumptions underlying an appropriate policy framework for Innovation System (IS) transition⁵. One potentially interesting implication concerns the nature and role of broad, horizontal policies in RBS and the balance between these and targeted & technology specific policies in NIS transition, a major issue in Diffusion Policies.⁶ In the conceptual model that follows targeted policies will play an important role even though we largely ignore explicit interfirm differences in sector and in technologies.

2. The Nature of Business Sector Restructuring

Enterprise restructuring in response to changes in the external or internal environment of the Business Enterprise sector e.g. liberalization\ globalization and new technological opportunities , could involve one or more of the following aspects-

- product specialization, adoption of new technologies and enhanced world market orientation
- introduction of new functions(e.g. R&D, search) and associated routines(Teubal 1996,1997)
- organizational innovations such as Just in Time, Total Quality Management(Ishikawa 1985) , Business Process Re-engineering(Hammer & Champy 1993), Down(right)sizing, and Innovation Management Techniques(Green Paper 1996)
- collaborative structures, enterprise networking and links between enterprises and among these and other organizations \ institutions(for a summary of trends see Galli & Teubal 1997)
- shift to precision manufacturing and\or introduction of the 'design' function
- development of distinct dynamic capabilities(Teece & Pisano 1994, Teece et al 1995, Prahalad & Hammer 1990)

⁵ In principle the framework can also be extended to consider the policy implications of the potentially deleterious effects of IT such as social exclusion and unemployment. Future work will more explicitly deal with this issue (It will have to consider not only incumbent firms but also new firms and individuals).

⁶ See for example Soete and Arundel (1993). These authors use the terms general\specific to describe diffusion policies rather than horizontal\targeted policies as used here within a NIS perspective.

- Adoption of Information technologies together with enhanced training of employees, adoption of team-based incentives and enhanced employment of skilled personell(E. Brynjolfsson 1996, Bresnahan 1996); etc

This is not a complete list nor are all items completely independent of others. Some may be relevant for the restructuring of some firms at certain times, others for other firms at other times. Not all firms attempt to restructure “to harness the forces of globalization, deregulation, technology or demographics...” (Hamer and Pralahad 1994, chapter 12) and not all attempts to do so are successful. My objective here is not to survey the extensive literature on the various aspects of restructuring but rather to provide a broad overview to the type of changes I have in mind.

I implicitly assume firm heterogeneity at least in the sense that different groups of firms will restructure at different times and in connection with a different subset of restructuring components. Their decision will not only depend on the information they exogenously have but also on processes of *learning to restructure* the knowledge of which will flow from advanced or innovator firms (who restructure early) to imitator and laggard firms.

Most of the aspects of restructuring are *implicit* in the model--these are termed *general*; their implementation can be visualized as depending on the knowledge and experience of enterprises including experience from others. Many of the organizational innovations and the introduction of new management routines seems to belong to this category. Full restructuring of any enterprise, however, is assumed in this paper to depend also on a *specific* aspect which involves the effective incorporation of a new (technological) input or new technological services into the organization. This aspect is extensively discussed and made explicit in the paper (esp. section 3). The new inputs are provided by the newly created TC rather than from imports since a necessary condition is geographical proximity of the source of supply. This is justified in terms of the need for user-supplier interactions, provision of close technical support and customized adaptation of the good or service which is both novel to the economy and relatively complex as far as effective adoption is concerned.

The new technological input is assumed to be required for the restructuring of *all* enterprises--although in different configurations. In this sense it is of strategic importance for the economy and therefore some measure of policy targeting of the supply and diffusion of

this input is inevitable. The input can be visualized as specialized measurement or design services which would enable, together with more general organizational changes, propel firms to introduce 'precision manufacturing' or to be involved in 'product design'.⁷

The above assumptions implies that it makes sense to talk about *a cumulative process* of learning to restructure since whatever the differences among enterprises concerning the general aspects, they always will confront a common problem of tackling with the specific aspect of restructuring. In terms of 'diffusion processes' the specific aspect involves directly the diffusion of 'artifacts' whereas all aspects of restructuring-both general and specific-also involve diffusion of knowledge (and \ or skills -see Metcalfe 1988).

Horizontal sharing of Information \ knowledge

Numerous examples could be found about horizontal sharing (e.g. due to networking) and horizontal transmission (also beyond networks) of experience, information and knowledge that occurs in the wake of liberalization of trade, globalization, etc and of the resulting restructuring process just mentioned. ('Horizontal' sharing here refers to sharing by firms who belong to different sectors) Examples are experience about *how to* search for an appropriate new and a more focused specialization pattern (external consultants here may play an important role in this diffusion process); general knowledge \ experience about foreign markets and how to do business in these markets; knowledge about the new management and organizational routines required for R&D (or more complex forms of R&D); and experience from introducing and implementing new organizational technologies (e.g. the experience of Xerox in 'benchmarking' and of Kodak, GE, Rover & British Airways in introducing TQM was important for other firms that came afterwards see Garvin 1993, C. Carr 1996 and C. Wick & Stanton Leon 1993). In the context of this paper these 'diffusion' processes pertain to the broad aspects or dimensions of enterprise restructuring. At the early stages of a successful restructuring process significant flows (and

⁷ I mentioned that the TC represents a new hierarchical level of the evolving National System of Innovation. More generally this new hierarchical level would comprise both collective organizations \ institutions **and** markets linked with the provision of new restructuring-relevant technologies whether or not they are related to the shift to precision manufacturing. These technologies could include new design technologies, flexible manufacturing and new organizational \ managerial techniques and processes. Not all of the requirements for restructuring involve actors or institutions belonging to the second hierarchical level of the innovation system. The assumption made here however is that some critical ones do. For a discussion of what constitutes a new hierarchical level, see Andersen and Teubal op. cit.

horizontal sharing) of information & experience about the above and about the various components of restructuring is likely to take place. Moreover, I submit that it is likely that consolidation of the above into a cumulative process of collective *learning* about restructuring has probably taken place in economies with successful BS restructuring⁸

The upshot is that enterprise restructuring could be a collective learning process of the business sector which is both cause and effect of successful National Innovation System transition. Restructuring should be viewed as a diffusion process not only of organizational innovations but also of knowledge & skills related both to artifacts&organization and to other general aspects of restructuring.

3. Towards the ‘Systems’ Embeddement of the business sector-a Simple Model

3.1 The issues

Business Sector restructuring depends ultimately on decisions of individual enterprises, but these are taken within framework conditions which include both the structure of the wider system in which they operate *and* government policies - both macro and meso\micro policies. The feasibility and profitability of restructuring, therefore, also depend on factors that transcend the scope and ‘direct’ efficiency of the restructuring efforts of individual enterprises even those efforts which are affected by the experience and knowledge received from other firms. They will also depend both on incentives & other policy actions and on ‘second level’ organizations, institutions and even firms which both incumbents and government may be instrumental in bringing about.

Assume that a relatively small group of firms - advanced or ‘Schumpeterian’ entrepreneurs - will autonomously initiate restructuring before adaptations have taken place in the wider system and in policy. These firms may play a crucial role in NSI transition since--as described above-- they may induce *collective* learning and set in motion a cumulative process

⁸ Government agencies implementing *horizontal restructuring policies (HRP)* to stimulate such restructuring may play an important role in generating this cumulative, experience - based, process through the creation of a ‘policy implementation network’ (Teubal 1997). It must be noted that the emphasis of this paper on these (horizontal) effects which straddle across sectors dovetails well with absence of *explicit* intersectorial differences. Despite this restriction other sources of enterprise heterogeneity are considered in this paper.

of restructuring in the sector^{9 10}. However, as suggested above, in a wide variety of circumstances the possibility and strength of the cumulative process that follows autonomous restructuring may critically depend on embedding the BS into a more complex system involving higher hierarchical levels. In the absence of such an embeddement it may be that a large segment of firms will not restructure or will not do it effectively¹¹. This because of market failure, institutional constraints and absence of sufficiently strong ‘system effects’ (System Failures). For example, non-availability in the geographical and cultural neighbourhood of these firms of new intermediate organizations or linking agents with whom to interact, learn and purchase new technological inputs may block the effective completion of restructuring even by relatively capable entrepreneurs. It may also block the introduction of the organizational changes which accompany and even constitute a central aspect of such restructuring.¹² The outcome might be a weak process of ‘follow-up’ restructuring ie. that following the autonomous restructuring process, and a truncated transition of the innovation system (Anderson and Teubal).

While existing work suggests the potential importance of “embeddedness” the process is not a simple one and involves much more than supply-push type actions. Effective embeddedness depends on a complex set of institutional changes and investments in new technological infrastructures as well as in diffusion of novel technological services and possibly market building.¹³ It follows that an orchestrated and coordinated set of policy measures is required

⁹ An interesting real world counterpart to the advanced firms segment could be the Japanese automobile assembling plants established in the UK during the last 10 years. Nissan and other producers (Toyota, Honda) spurred a revolution in other segments of the manufacturing sector by spearheading the introduction of new organizational and management techniques linked with three areas: a commitment to continuous improvement (Kaizen); cooperative relationships between workers, managers and suppliers; and pervasive measurement of all aspects of business (to identify both serious faults and what precisely needs improvement). The “restructuring” impact included an enormous increase in quality standards of suppliers (e.g. Lucas and GKN) and “horizontal” diffusion of such innovations to other companies such as Ford and Rover. See Financial Times (1996).

¹⁰ The collective learning process which took place was not limited to the motor industry. “Managers from all over the country flocked to Sunderland to visit the plant ...The Government has sponsored teams of experts to learn from Nissan and other Japanese carmaker (Financial Times, op. cit).

¹¹ Despite the important cumulative diffusion effects described above there still exists “a long tail of underperforming smaller companies”. Moreover, “suppliers to UK car plants (with some exceptions) do not match the world’s best.

¹² There is a vast literature on the relationship between technical and organizational change starting with Schumpeter himself. For recent work on how one type affects the other and/or the need of coordinated and complementary changes see Bresnahan 1996, and E. Brynjolfsson 1996. Despite ample recognition of this link little seems to have been said in the literature on the potential policy implications of this relationship.

¹³ The importance of providing external advice to SME’s and of developing ‘markets’ for such services is well acknowledged (Vickery 1996) and embodied in Government Programs e.g. the EU’s Innovation Management Techniques support program.

not only to generate qualitatively new links among enterprises and between them and other agents and actors of the economy; but to create wholly new markets as well.

It is worth noting that the importance of the 'embeddedness issue' and of associated system effects might be even greater for transition of the innovation system towards a Learning Economy. This because of the skewed effects of IT: on the one hand it offers new opportunities for advanced entrepreneurs; on the other it may have a tendency to create new problems due to the fact that substantial numbers of firms (including SME's), other organizations and regions could significantly lag in the adoption of the new technologies. Similarly with individuals in connection with the opportunities and threats opened up by IT relative to their level of skills. Thus the new technologies may lead to serious problems of social exclusion, lack of regional cohesion, and unemployment (see Wolff 1996, Papaconstantinou & Colecchia 1996; EC & OECD op. cit).

It follows that explicit attempts at strongly inducing restructuring of potentially fast learners within the less privileged segments of the business sector (and of individuals & society at large) should also play a central role in NIS transition, one that may be the key for high productivity, low unemployment and a lower level of social exclusion in Europe. This will tend to increase the importance of embedding the business sector into an even wider system while raising similar issues viz a viz individuals. The boundaries of the relevant Innovation System will also tend to be broader than otherwise, since not solving the social problem today may not make the system transition a sustainable one in the future.

3.2 Framework of Analysis and Restructuring Phases

The analysis of business sector restructuring focuses on the specific dimension which involves absorption within firms of novel technological inputs or services, previously not available in the economy. More specifically, assumptions are made about the extent by which firms are aware, have articulated their need, and are capable of absorbing the new input-conditions for shifting to the precision manufacturing configuration demanded by world markets.¹⁴

¹⁴ Supply considerations for these inputs will be considered as well.

Three phases of restructuring are considered. Initial restructuring of the business sector takes place in the first phase; while emergence of a Technology Center supplying novel technological services (a critical aspect of restructuring) and of a Market for such services will occur in Phases 2 and 3 respectively¹⁵. The latter two phases involve embedding the enterprises of the business sector into a wider NSI involving the second hierarchical level previously mentioned, whose ‘system effects’ if strong enough could pull the whole business sector through the process of restructuring. All three phases are assumed to be necessary for a successful transition of the NSI.

The business sector is composed mostly of incumbent firms there is only marginal creation of new firms supplying the novel technological services (in Phase 3 of the transition process) and other consultancies supporting the restructuring of laggard firms. But there is *no widespread creation* of new firms. Incumbent firms comprise three groups: advanced firms; potential imitators and laggards (a further distinction between ‘mild’ and ‘severe’ laggards will be introduced later on). Advanced firms will restructure in Phase 1 while imitators and laggards will -under a complete NSI trajectory-restructure in Phases 2 and 3 respectively. For our purposes here we assume-despite some other *implicit* distinctions - that there are no other differences among firms in the Business Sector which have to be made explicit e.g. according to economic sector, industrial branch or technology\markets.¹⁶

Phase 1

A1) A small segment of advanced firms perceive or anticipate the changes in the environment and will autonomously *initiate* the restructuring process. While Horizontal Restructuring Policies could be implemented to reinforce the *broad* dimension of advanced firms’ restructuring, these firms must possess capabilities for undertaking such a process (specific dimension)-- despite the fact that the new technological inputs are not yet readily

¹⁵ I already mentioned that Technology Centers are viewed here as resulting, in the first instance, from a Coasian process i.e. coordinated actions of advanced firms to build private institutions\organizations to internalize external economies. AIC would still be required to enable or facilitate the process (like in the Swiss and Japanese cases as argued by Weder and Grubel, 1994). The proactiveness and catalytic subsidization of AIC policies may have to be stronger, however, if advanced entrepreneurs are few or if their disposition or capacity for cooperation is weak. Thus promoting new institutions \organizations is complementary to public subsidization i.e. they are not only nor always substitutes.

¹⁶ Subsequent work will attempt at integrating this kind of analysis which is essentially ‘institutional oriented’ to the ‘technological regimes’ and ‘technology systems’ literature (see B. Carlsson 1996 and F. Malerba & Orsenigo 1996).

available in the economy. It follows that these firms will be finding make-shift and imperfect solutions to their precision manufacturing needs--either in-house production or from external sources;

A2) *Completion* (or deepening) of the process will depend on availability of the new inputs which--due to economies of scope- will depend on creation of a technological center(TC)¹⁷;

A3) Some Schumpeterian entrepreneurs also have the disposition and capability to cooperate among themselves to create such a center, but this will not be sufficient due to institutional obstacles and market failure;

A4) The timely implementation of Anticipated Institutional Change by the Government may lead to the creation of a TC. AIC will include changes in institutions, helping the coordination of private sector efforts, identifying and providing incentives to the establishment of new Technological Infrastructures which will generate the new required technological services; etc (see Galli & Teubal op.cit.). I assume that such an intervention will be forthcoming;

A5) Potential imitators and laggard firms initially possess a lower degree of 'felt need' concerning restructuring and also weaker capabilities (throughout) for undertaking the process and in particular for accessing and effectively utilizing the novel technological services required. A necessary but not always sufficient condition for overcoming such constraints is their embeddement in a wider system, a process which will take place in subsequent phases.¹⁸

Phase 2

A6) Experience with the restructuring of Schumpeterian entrepreneurs may generate a body of collective knowledge about restructuring which may enhance awareness and perceived need about restructuring among the imitator population of firms. Refocused Horizontal Policies promoting restructuring will enhance both the experience obtained and its codification into a more systematic and accessible fund of knowledge.

¹⁷ Alternatively we may consider a two stage restructuring process--the first where cost is high and the second when it declines due to ready availability of the input from the collective organization.

¹⁸ This paper assumes a *policy subsystem* which is both forward looking and sufficiently responsive to emerging Business Sector needs. It should also possess capabilities for effectively designing and implementing relevant new policies.

A7) However, due to weak restructuring capabilities, implementation of such restructuring is not automatic even after TC creation when the novel technological services may be offered for sale.

A8) More specifically it is assumed that a *proactive diffusion policy* should be implemented by the TC (probably backed up by Government incentives) in order to promote diffusion of the inputs to potential *imitators*. Proactive diffusion implies specific attempts at generating awareness and significant efforts at understanding the ‘what’ and the ‘why’ concerning the user needs of various categories of enterprises. It also could involve attempts at codifying such knowledge- especially about the interface between the new technological service configurations and the different types of users¹⁹ - and provision of ample technical back up to the transactions involved. Proactive diffusion policies will, therefore, contribute to building “demand” for the services on the part of potential imitators.

Phase 3

A9) While past experience with restructuring could contribute in a limited way to the awareness and capabilities of laggards, it is not sufficient to assure successful diffusion of restructuring among this (probably dominant) segment of firms. Nor will a simple continuation of the proactive diffusion policies successfully implemented in Phase 2 suffice;

A10) Non-automaticity of the diffusion process through the large and (potentially-as far as adoption behaviour is concerned) varied population of ‘laggard’ enterprises during phase 3, due to remaining ‘demand’ and ‘capability’ constraints, together with general efficiency considerations, justify attempts at creating an “organized market” (Lundvall 1985) for the novel technological input (x). Such a market will endogenize the process, but policies are required both to build the market and to assure that it promotes *wide* diffusion of the input. Market building policies should ideally be undertaken by the TC who in the process might have to be downsized.²⁰ They will involve a continuation of policies for building demand which were undertaken in previous phases (“proactive diffusion policies”) to which will now be added policies to create new supply agents e.g. through the training of consultants and even transfer of bits of the infrastructure to private laboratories. These measures, even if

¹⁹ We assume that such differences exist but are not made explicit in our appreciative theory exercise.

successful, are unlikely to promote diffusion to all members of the relevant segment of laggard enterprises (they may take care of 'mild' laggards but will be insufficient for the restructuring needs of 'severe' laggards);

A11) For 'severe' laggards proactive diffusion by a reconfigured and probably down-sized TC may have to be continued. Moreover, all laggards will require *complementary SME - support policies*. These may include training policies, general SME management support schemes, and creation of an organizational\management\technological consultancy segment of specialized firms.²¹

A summary of the demand and supply situation with respect to the new input x (which was assumed to be an essential ingredient in the restructuring process) is shown in Table 1. Following our previous description a clear distinction is made between the situation facing the three segments of the Business Sector during the phase in which they are initiating their restructuring process. Such phases are shown in column 1: the first entry corresponds to advanced firms and to phase 1 (since restructuring of such segment occurs in this phase); etc. Table 2 summarizes the capacity to access and use the novel input x on the part of the corresponding enterprise segment. This capacity is only partial for imitators and laggards (in phases 2 and 3 respectively). The insufficiency occurs despite the fact that a Technological Center has arisen which supplies the input at the beginning of phase 2 (thus making it easier for imitators to access\use the input and to undertake the restructuring) while a full market for the input has emerged at the beginning of phase 3 which would further pave the way for firms to incorporate the input. The fact that, despite these constraints, imitators do undertake restructuring in phase 2 and laggards in phase 3 is due to Government Policy (including the policy of the TC) -which is also briefly described in Table 2.

²⁰ This raises issues concerning the incentives of the TC to promote market building, see Justman & Teubal op. cit

²¹ The policies undertaken will affect the selection process operating within the Business Sector. The new opportunities to absorb the new inputs and to undertake restructuring should not weaken the overall selection environment, only make it more efficient by creating a new 'level playing field'. The scope of 'slow-learner' exit is a policy decision which should consider broader national objectives including issues of cohesion, (thkus the task of policy goes beyond the timely creation of the more complex system of innovation). Note that the initial gaps in the support system and absence of adequate enterprise embeddement ("system failures") imply that the market selection mechanism may be inadequate by itself to perform the job. Market selection may be much more effective after enterprise embeddement has taken place (but as we have seen, it need not be the only criterion for selection under the new system of innovation).

While a full discussion of policy follows in the next section, note in Table 3 the sequence of policies supporting a full process of BS restructuring (and NSI transition). All phases involve both Horizontal and Targeted policies. Figure 1 summarizes a successful process of RBS. Before explaining it fully we should introduce the notion of “dynamic factor” and discuss policy issues more systematically than what was done until now.

**Table 1: SUPPLY & DEMAND AND ABILITY TO USE
FOR THE NEW TECHNOLOGICAL INPUT (x)**

<i>Enterprise Segment</i>	<i>D: Demand A: Ability to use</i>	<i>Supply</i>
<i>A- Advanced Firms (phase1)</i>	<i>D: autonomous awareness & felt need</i>	<i>a) Initially only available from in house effort</i>
	<i>A: full ability (also if in house substitutes)</i>	<i>b) available from TC</i>
<i>I-Potential Imitators (phase 2)</i>	<i>D: awareness and partial articulation of need (learning from advanced firms)</i>	<i>Available from TC</i>
<i>L-Laggards (phase 3)</i>	<i>A: partial ability</i>	
<i>mild</i>	<i>D: some awareness of need (learning from others)</i>	<i>From the new market</i>
	<i>A: partial ability</i>	
<i>severe</i>	<i>no awareness nor articulation of need</i>	<i>Residual supply from reconfigured TC</i>
	<i>A: a weak ability</i>	

**Table 2: BUSINESS SECTOR RESTRUCTURING (R):
CAPACITY TO ACCESS & USE NEW INPUT (X) AND POLICY IMPLICATIONS**

A -Advanced Firms (Phase 1)

Capabilities

- 1a) capacity to initiate R with imperfect, in-house, substitutes; and a capability to organize cooperative & coordinated action to create a TC (necessary but not sufficient for emergence of TC).
- 1b) capacity to complete R (after establishment of TC and availability of x)

Policy Implications

- 1a) Horizontal Restructuring Policies (HRP) to strengthen autonomous R and to generate collective learning (non-targeted but aimed at Advanced firms)
- 1b) Targeted Anticipated Institutional Change (AIC): changes in the institutional framework, coordination efforts, identification and support of relevant new Technological Infrastructures and stimulating establishment of a TC.

I - Potential Imitators (Phase 2)

Capabilities

Given X from the TC, only a partial capability to absorb the new input and undertake restructuring due to weak technical skills and insufficient ability to articulate or translate specific R needs in terms of the new input.

Policy Implications

Continuation of HRP with a new focus aimed at imitators rather than advanced firms.

Targeted pro-active diffusion policies- strong technical back-up to sales and systematic attempts at building demand (by TC)

Targeted Market Building Policies (continuation by TC of demand creation policies and initiation of supply building policies)

L - Laggards (Phase 3)

Capabilities

- mild L: Given the market for X, a partial capability to restructure due to weak skills and absence of organizational capabilities
- severe L: Extremely weak capabilities.

Policy Implications

An SME- support scheme (instead of a HRP).

Continuation of proactive diffusion by (reconfigured) TC for those firms not effectively reached by market or by market with incentives.

**Table 3: THE DEPLOYMENT OF POLICIES:
SEGMENTAS&PHASES**

Segment Phase	<i>A</i>	<i>I</i>	<i>L</i>
1	HRP, AIC*	networking	networking
2	<i>endogeneous R</i>	HRP, MB* PD*	networking
3	<i>endogeneous R</i>	<i>endogeneous R</i>	SME, PD*
	<i>endogeneous R</i>	<i>endogeneous R</i>	<i>endogeneous</i>

Symbols

HRP: Horizontal Restructuring Policies;

AIC: Anticipated Institutional Change

PD: Proactive Diffusion Policies;

MB: Market Building;

SME: SME-support scheme.

***:** indicates trargeted policies.

A: Advanced;

I: Imitator;

L: Laggard

3.3 Conceptual Clarifications

Key Sector Alternative to a TC

An alternative to a TC is a set of new firms supplying novel technological inputs following a pattern similar to Rosenberg's Key Sector (Rosenberg 1962). In our context, these firms could be involved in specialized chip design and batch production services; in novel technological services associated with precision\quality production; in software & new communication services and products, etc. Frequently, full fledged markets may develop in some of these new products. It should be noted that the relevance of the key sector concept goes beyond the machine tool industry studied by Rosenberg (see data in Patel & Pavitt 1994). Such sectors would belong to the category of 'specialized suppliers' within the overall taxonomy put forth by Pavitt (1984) provided that they involve new 'generic' inputs as well. I will be assuming that at least a subset of important inputs of such nature could develop into relatively well functioning markets.

The key sector may result from the process of vertical desintegration within incumbent firms (Andersen & Teubal op.cit.). In this case it still may be useful to consider a distinction between an initial diffusion process comprising Phase 2 from emergence of a full fledged market for the new, generic, type of input in Phase 3. Rather than having a collective organization being involved in initial activities (technology transfer and absorption from abroad; and initial diffusion) we would now have one or a small number of innovator firms launching the new inputs and, with the help of user feedbacks, initiating the process of applying the new technology. The subsequent market building phase would simply be represented by the take-off of the new technology in the wake of convergence to some kind of standardization or even dominant design (Abernathy and Utterback 1977). Explicit supply based policies, such as those undertaken by the TC (training of existing consultancies; spinoffs from TC personnel, etc), would not be undertaken by firms-since this

would normally mean creating new competitors²². But building of demand would still be a central aspect of firm strategy.²³

Policies may still be required for both of these phases. For example, enabling or facilitating coordination of the processes of backward desintegration which may lead to the establishment of new input suppliers (see Andersen and Lundvall 1995); and compensating for market failure which may be rampant at the initial phases of development of new key firms and the new generic technologies which they develop and diffuse (see also Teubal op.cit.)

Coordinated Building of Supply and Demand

Successful restructuring involves the *coordinated building of demand and of supply* for new technological services. The problem is not only that of coordinating supply and demand; it is *of building both in a phased and coordinated way*.

During phase 1 the autonomous initiation of restructuring involves or leads to emergence of a demand for such services. Due to economies of scope in new capability development (or in the absorption of such capabilities from abroad) the appropriate and cost effective type of supply response is, very likely, not immediately available. This because such a response may have to overcome market failures and other obstacles associated with the collective effort to create the (local or semipublic) goods. It will take time and may also require Government assistance. Thus at sub-phase 1a supply adaptation takes place at the individual firm level where makeshift solutions are sought. But this is not an appropriate adaptation in the long run which requires collective generation of the new capabilities in order to exploit economies of scope(a TC enables precisely this). For this to happen in a timely fashion (sub-phase 1b), AIC may be crucial. Note that the disparity between supply and demand may temporarily increase once AIC is activated--since *expectations* of timely

²² Despite this firm cooperation -even among competitors- at the early stages of new market development, is common and may be important for the future development of the industry (See Langlois 1992 for an analysis of the early development of the PC industry). It is even conceivable that additional entrants may contribute to building the overall market for incumbent firms (a possible example is the case of laser based eye operation systems).

²³ Key to market building by firms might be that the initiator\innovator key firms create a user-producer network while serving as the central node of this network (a PBX in the parlance of Teubal et al 1991). For different configurations of market building under different assumptions about interactions and innovation see Teubal & Zuscovitch 1996.

supply of inputs, with appropriate configurations and low cost, will reinforce the restructuring efforts of Schumpeterian entrepreneurs (Galli & Teubal op.cit).

Elimination of the above mentioned supply bottleneck through creation of a TC, will, in our model, generate a demand bottleneck. This because the new services are now available at marginal cost to all firms, not only the advanced ones. However creation of demand need not be an automatic process and not all firms are aware of their needs for the input (laggards) or even if they were, are capable of accessing them and utilizing them for precision manufacturing (potential imitators). Thus, the transition in Phase 2 and 3 could be understood in terms of effectively creating a demand for (or eliminating excess supply of) the new inputs which are critical for restructuring.

Policies may have to be implemented for this purpose. These should involve both horizontal incentives to directly promote the general dimensions of restructuring--albeit with a different focus and target population than those of phase 1--and a number of targeted policies. The latter involve both proactive diffusion (which is a demand creating process which accompanies sales and which also involves technical back-up) and market building policies, both of which may be undertaken in a decentralized fashion by the TC²⁴. While the proactive diffusion policies may be sufficient to initially 'integrate' potential imitators into the new system, full-fledged market building and other policies may be required to make their embeddeness automatic and long standing; as well as to contribute to embedding laggards.²⁵

Dynamic Factors affecting the restructuring process

Dynamic Factors positively link agents' actions or specific processes within early phases with new opportunities facing *other* agents in later phases (They may also link processes within a particular phase but this is ignored here). They are of two types: restructuring by advanced firms generate experience and knowledge which enhance the capability of imitators

²⁴ Governmentments may have to actively support TC's in their market building process since such a social profit perspective on the part of these organizations may imply incurring 'private' losses. See Justman and Teubal 1995.

²⁵ Compared to Phase 2 an even more extreme and massive deficiency of demand could exist in phase 3. One aspect of the solution already mentioned is a new **social** institution--the market for the critical input. A differentiated market (see Teubal & Zuscovitch, op cit) would support a set of specialized suppliers which would be able to cater to the *ongoing* needs of various types of users. This would provide both breadth of coverage, flexibility & adaptability to changes in technology and needs.

and laggards to subsequently restructure; and new infrastructure, collective organizations and social\other institutions of early phases will benefit agents in subsequent phases. The latter include the TC which emerged in phase 1 and facilitated the restructuring of imitators in phase 2 and, together with market building, that of laggards in phase 3²⁶.

The prescence of dynamic factors in the process of business sector restructuring is indicator of a potential contribution to the economy; but they are not in themselves-with some exceptions depending on valuation of capabilities in capital markets- a measured and currently available (& fungible) addition to GNP or wealth. They create future options whose impact will also depend on complementary policies and on pertinent behaviour by new agents in the future. Despite some inherent problems in evaluating “dynamic factors” they should be taken into account and appropriate indicators should systematically be collected.

Finally it may be worthwhile to mention that there is a dynamic role played by certain players or actors at certain stages of NSI evolution. Thus *advanced, Schumpeterian entrepreneurs play a such a role* in two respects: they generate a fund of intangibles which is useful for other firms that restructure in the future; and their cooperative efforts also contribute to generate new technological infrastructure and organizational capital (as well as partial absorption of overhead costs for the former) for future use. The second most important dynamic role in our model is played by the collective organization stimulated by advanced firms-the TC. Their proactive diffusion policies should play an important demand creating role which will benefit phase 3 laggard firms which restructure. Such an activity in Phase 2 also contributes to imitator restructuring and thereby also, indirectly, to the fund of restructuring experience which imitators generate and which laggards may subsequently use.

²⁶ A parallel may be found with dynamic aspects of growth and trade theory. Thus specialization according to static comparative advantage may lead to a low-learning trajectory for the economy (see Teubal 1973 and some of the contributions of the new growth theory such as Lucas (1993) and Grossman and Helpman (1991). Alternatively, specializing in high-learning sectors or activities may also be associated with dynamic factors in this case a fund of intangibles and of ‘organizational capital’ which potentially contributes to future “production possibilities” (and which are only imperfectly evaluated in the present). In contrast to neoclassical or advanced neoclassical models where dynamic factors focus on technological intangibles or in scale economies emerging in the process of “‘sectoral’ structural change” their role in NSI transition is to generate “cumulativeness” of the process. This involves links among different types of firms and between them and new institutions\organizations. Central to these are management and organizational routines. Note that the emergence of dynamic factors, much more than in neoclassical models, is only a precondition of cumulativeness.

4. Policy Issues and Policy Framework for Successful NSI transition

4.1 The set of policies and their deployment through time

The set of policies considered here includes the following elements:

- * Horizontal Restructuring Policies (HRP)
- * Anticipated Institutional Change (AIC)
- * Proactive Diffusion Policies (by the TC)
- * Market Building (by the TC)
- * SME-support schemes.

Annex 1 presents summary descriptions of a possible functional content of each policy.

From the point of view of beneficiary firms, HRP are focused according to transition phase: in phase 1- towards the restructuring needs of advanced entrepreneurs; in phase 2-to those of imitators; and in phase 3-to the needs of laggards which means that the HRP is transformed into an SME-support scheme (I assume that a dominant if not overwhelming share of laggard enterprises are SME's). Despite this focusing HRP are *horizontal* in the sense (i) that they are aimed at firms, according to general criteria, irrespective of industrial branch or technology area or type (see Teubal 1997); and (ii) their objective is to provide support for general aspects of restructuring such as the introduction of new management \ organizational routines (e.g. TQM) or novel *functions* of relevance to enterprise restructuring such as R&D and associated routines; (iii) their objective is to generate a collective learning process which exploits the commonalities of the experience with restructuring accross industrial sectors \ types of technologies (Teubal 1996a,1997). On the other hand AIC, proactive diffusion and Market Building policies are *targeted policies* in the sense that they promote diffusion of the strategic new input or technology ("novel technological services") which policy makers, advanced firms and the TC (after its inception) have identified as being of critical importance for the restructuring needs of the Business Sector as a whole.²⁷ This means that policy makers no less than responding to felt

²⁷ In Andersen & Teubal op.cit. the targeted nature of AIC is discussed. In a multi sector setting where each sector or group of firms requires a different type of new technological input it is possible to implement a

needs of some firms also are anticipating the needs of others who presently cannot articulate their restructuring needs²⁸ or who require technical back-up in order to access required new technological inputs.²⁹

In Table 3 I summarize the deployment of policies at the various phases of the restructuring processes and for the various business sector segments. The diagonal is the central focus of the Table and its cells depict-- at each phase and for the business sector segment *whose restructuring is initiated then*-- the set of horizontal and targeted policies implemented during an ideal NSI transition. The policies in each cell of the diagonal, if successful in implementing RBS of the relevant segment, influence the policies of the next cell. Moreover the targeted ones (indicated by*) *respond to* a felt need by the relevant business sector segment (located in the same cell) while at the same time anticipate the needs of firms belonging to a less sophisticated segment of the business sector (located in the next cell in the diagonal in SE direction).

Two additional aspects of Table 3 should be mentioned the first of which being policies stimulating networking of imitators and laggards already in phase 1 (and also to laggards in phase 2). This policy should be regarded as a preparatory type of policy which sets the stage for full restructuring later on. It is information intensive & a low-budget policy. Its main contribution would be to generate awareness of changes in the environment and assurance of the possibility of change (e.g. by demonstration) as well as a mechanism for the systematic collection of new, restructuring-relevant information. In the restricted sense given

semihorizontal policy rather than a purely targeted policy that would stimulate different TC's and associated technological infrastructures. The Government may announce that any group of firms who got their act together would receive support (incentives, information, coordination, etc). Thus the Government need not know what specific input types are required by each branch of the business sector. It would, however, have to know about the broader general class of inputs to which each one of the specific types belong. Thus some targeting or prioritization at a higher level of policy would still be required.

²⁸ A clear distinction should be made between 'general need' and articulated need/demand for a particular new product; and this can be applied to the issue of restructuring. The possibility of the former without the latter has been pointed out in Teubal 1979 ('low market\ need determinateness') In our context this could mean a very general awareness of the necessity of restructuring on the part of enterprises without a clear idea that this implies the need to utilize and incorporate the strategic new technological input.

²⁹ It may be worthwhile to clarify a number of points. First, HRP while directly aimed at satisfying the 'felt need' for restructuring on the part of *some* business enterprises (the advanced or innovator segment) also involves anticipation of needs (Teubal op.cit). Second, the distinction between horizontal and targeted policies also corresponds to the distinction between the broad restructuring dimension and the specific one. Third, recent work on horizontal programs shows that these do not necessarily imply neutrality in incentives. Moreover, the learning processes involved during implementation (including enhanced Government capabilities to identify and locate market failure) may transform an horizontal/neutral policy to a set of semihorizontal and even targeted policies. Finally note that the SME- support scheme combines horizontality with a strong demand-creating bias-a dimension which differentiates it, to some extent, from a regular Horizontal Technology Policy (See Annex).

here to the term ‘stimulating networking’, the policy promotes and generally provides for a secretariat for a group of firms who are searching for such information e.g. about new markets and new technology. If successful they may induce laggards (imitators) to move forward into the imitator (advanced) category. Success of these policies has been recorded in contexts such as Chile (PROFO Programs) and Norway (private communication by K. Smith).³⁰

Second, the table also indicates the phase when firms ‘endogenize’ their restructuring process e.g. beyond phase 3 for laggards. Finally, note that the policies correspond to the initial conditions facing each segment at each phase I (Table 2). Initial conditions in phases 2 and 3 reflect the effect of the dynamic factors generated in phases 1 and 1, 2 respectively.

Figure 1 summarizes the RBS process under a full NSI transition. The horizontal axis indicates time and the vertical one indicates the hierarchical level of the reconfigured NSI. Thus at the first hierarchical level we observe a succession of restructuring processes starting at Phase 1 with that of advanced firms (represented by Ra); and followed by Ri and Rl (restructuring of imitators and then of laggards). At the second level establishment of TC during sub-phase 1b and emergence of the new market M sometime during phase 2. The dashed arrows show the direction of the dynamic factors with the horizontal ones at level 1 indicating the spillovers from advanced firms and the corresponding learning to restructure by imitators & laggards. The remaining dashed arrows related more specifically to the supply and demand for the new input x (represented by the full line straight arrows and the notation S or D respectively). Thus Ra also contributes-through the demand for x and the subsequent establishment of a TC-to the normal availability of the input to imitator firms in

³⁰ The Promotion of newtorks in Chile involves subsidizing the manager of a network of similar firms with the objective of improving access to Government incentives; enhancing bargaining power of the SME's viz a viz large firms; improving the pattern of division of labor among firms in the network; diffusing organizational innovations, etc (Thanks to G. Crespi for information about these networks). These policies are not, in most cases, identical or similar neither with pure user-producer networks nor with full-fledged networks of innovators (or flexible specialization networks) discussed in the context of Industrial Districts (see Bianchi & Bellini 1991) as alternatives to the Fordist, mass production model of organization. Such networks/network promotion policies which have been discussed in the European context are akin to aspects of the overall restructuring process proposed in this paper and not only to the preparatory stage of such a process as has been the intention here. The similarities with the model of this paper are found first and foremost as regards the imitator and laggard segments of the business sector where restructuring requires the implementation of ‘system effects’. For example, policies to promote the creation of new ‘networks of innovators’ include the stimulation of collective institutions (“Service Centers” such as CITER established in Emilia Romagna in 1980 for new and weak companies in the textile and clothing sectors) to stimulate the creation, diffusion and utilization of new technological and market information (e.g. trends in fashion designs and training to operate and use design workstations) and for overall coordination. In this paper these would correspond to (hierarchical) level 2 organizations such as our Technology Centers whose function is to assist RBS of imitators (and also of groups of laggards). Note that in the configuration shown in this paper the TC is

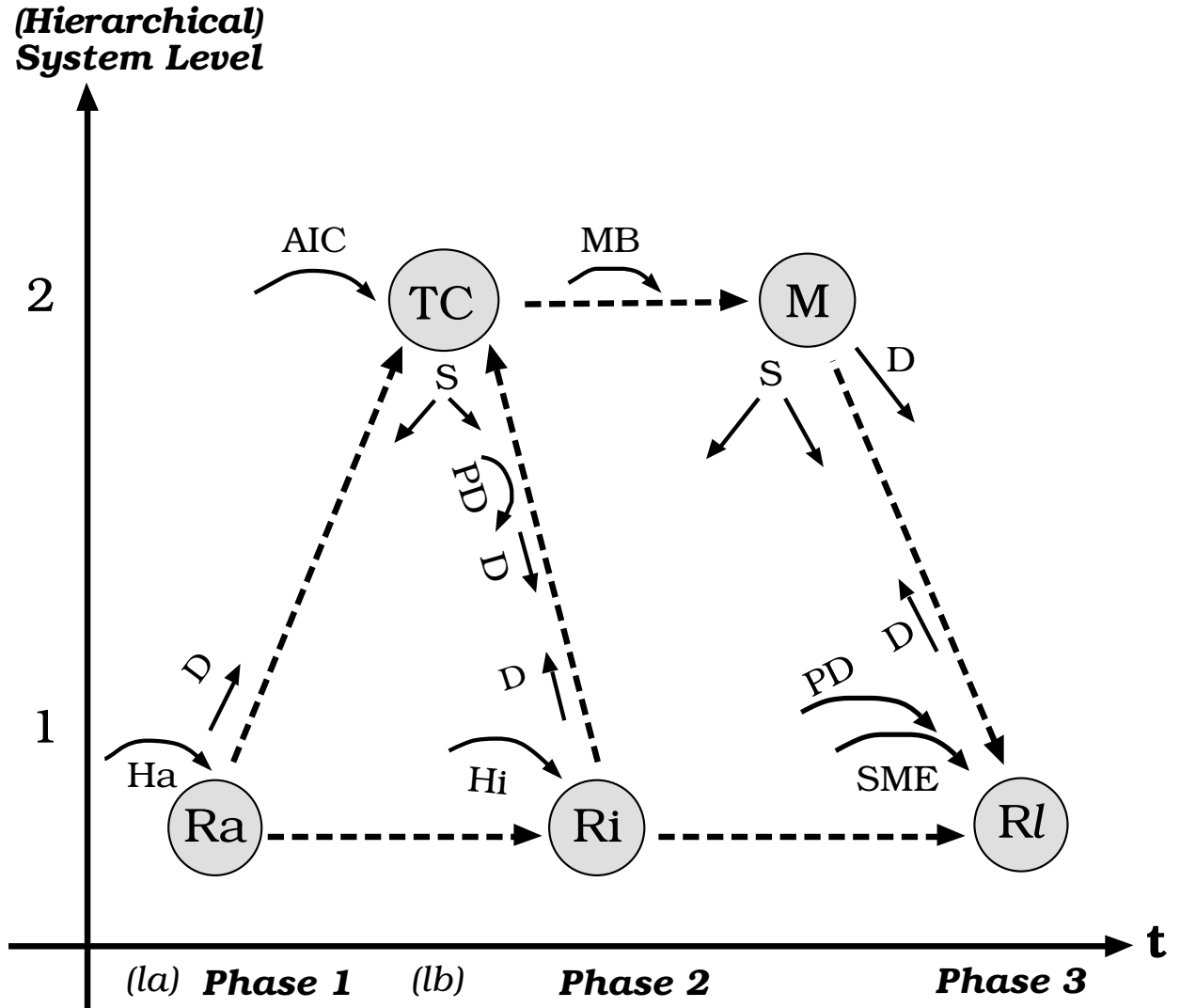
Phase 2, thereby contributing to Ri in this phase. Ra also indirectly contributes to laggards via the transformation of TC into M.³¹

The mobilization and stimulation of these dynamic effects by policy is also represented in the diagram (curved arrows with policy acronyms). Thus AIC reinforces the autonomous effect of demand for the new input and leads to an earlier and more effective TC which in turn, through S, contributes to Ri. Proactive Diffusion Policies (PD) undertaken by the same TC will contribute to generate the demand D for the new input (Phases 2,3).

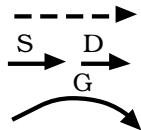
created to complete the restructuring of advanced firms and thereafter contribute to the restructuring of other segments--a dynamic effect.

³¹ Note that the establishment of a differentiated organized market (Lundvall 1985) contributes to R1 through the stimulation of both S and D and not only through a pure supply effect. The reason for this is that the specialized suppliers comprising the new sector both provide technical back-up to users and continuously learn how to couple the new technology to the needs of various classes of laggard firms. They, in fact, are creating 'demand'.

**FIGURE 1: DYNAMIC FACTORS & GOVERNMENT
POLICY IN RBS - THE FULL NSI TRANSITION CASE**



Notation



direction of effect of Dynamic Factors

Supply, Demand Effects

Government (or TC) Policy

$G = \{Ha, Hi, SME, AIC, PD, MB\}$

R_j = Restructuring of Business Sector Segment J ($J = a, i, e$)

Ha = Horizontal Restructuring Policies (aimed at Advanced Firms)

Hi = Horizontal Restructuring Policies (aimed at Imitators)

SME = SME - Support scheme (aimed at Laggards)

PD = Pro-active Diffusion Policies

MB = Market Building Policies

; M = the new market

AIC = Anticipated Institutional change

; TC = the Technology Center

Overall, the Figure represents both innovation system transition and the enhanced embeddement of business firms associated with such transition.

4.2 Synthesis of Policy Implications

A number of potentially interesting implications follow from the analysis.

1. The criticality of initial policies

Policies can be viewed as supporting or failing to support the materialization of dynamic increasing returns to restructuring or alternatively to generate a cumulative process of change, one engulfing increasingly wider segments of the BS. Thus small initial differences in the appropriateness or in the efficiency of policy, due to path dependency, may have very significant long term implications. Also, absence of policy when autonomous restructuring is weak may fail to trigger NSI transition.

2. Successful initial policies build upon and reinforce the autonomous restructuring process of advanced entrepreneurs. They generally involve both horizontal and targeted programs.

Successful policies should initially be focused towards dynamic sectors (in our model, the advanced segment of entrepreneurs) who potentially may generate intangible and other dynamic factors which promote cumulativeness of the business sector transition process i.e. imitation by follower firms. This is consistent with the Evolutionary Theory presumption that ‘imitation’ is a major mechanism of economic growth (Nelson and Winter 1982) and with the fact that there are strong differences in the real world in the innovativeness of enterprises³². To materialize this strategy, horizontal policies should be implemented since many restructuring problems are common to firms in different sectors and technologies

³² This is reflected empirically in the Innovation Surveys run in several countries in the last 4 years. In the Norwegian case when considering for example all manufacturing firms with more than 200 employees the innovation survey shows that a small percentage of such firms account for the majority of new products introduced in the 3 years before the survey was taken while about half of the firms have not introduced any new product whatsoever (thanks to K. Smith for this observation; see also Nas 1996). A related issue concerns the notion of a strategic industry (Nelson 1984): this paper suggests that certain industries may play a strategic role in the transition of national innovation systems (through restructuring experience spillovers) without themselves necessarily being strategic—at least in the narrow sense of the term. The model of NIS transition in this paper allows for differentiated enterprise categories based on the phase in which their restructuring is initiated, rather than on sectoral characteristics. Further work should allow for structural differences in “technology regime” as well (see Malerba & Orsenigo 1996 and Breschi & Malerba 1997).

although the specifics may differ from case to case and because at least some learning and some important spillovers straddle across sector and technology boundaries. Such policies are appropriate to stimulate the *broad* aspects of restructuring³³. Targeted policies, on the other hand, focus on the *specific* aspects of restructuring which means targeting an input \ technology of strategic importance for the economy. They are necessary since full RBS must involve both the general *and* the specific aspects of the process.

3. Horizontal Policies will evolve with experience and could contribute to variety.

HTP comprise a chain or string of interconnected programs supporting general aspects of restructuring whose enterprise focus evolves with the restructuring experience. Thus during the successful innovation system transition case considered in this paper, a program supporting imitator firms will come after a program directed to advanced \ innovator firms. Its impact will depend on the experience accumulated from the restructuring process stimulated by the previous HTP program. Moreover, by focusing on different types of firms and even on different functions and organizational changes, the various programs play a role both in catering to variety and in stimulating it (firm differences are partly endogeneously generated by the restructuring process which in turn is stimulated by HTP). Variety is also promoted as a consequence of learning *during implementation* of a particular HTP program: eventually we should expect a set of different promotion schemes one for each sub- category of firm, state of core competencies & organizational capabilities (Teubal 1996b).³⁴

4. Targeted Policies stimulate institutions and infrastructure that perform both a demand satisfaction function with respect to advanced firms and a demand anticipation (and market building) function. viz a viz less sophisticated business sector segments.

³³ Notice that *focused* horizontal policies in Phase 1 differ from a policy of picking winners or of supporting National Champions, despite the fact that beneficiary firms are supposed to play a strategic role in business sector restructuring (strategic in the sense of the previous footnote).

³⁴ This will also involve less neutrality and more selectivity in incentives. Thanks to Keith Smith for having stimulated my thinking about the role of a specific horizontal programs in stimulating variety. My conclusion is that even in situations where a horizontal program is being substituted ,through learning, by a set of targeted programs there would still be room for a *downsized* horizontal policy scheme to allow for 'random' or 'unexpected' variety.

In this model targeted policies involve either creation of a TC or subsequent implementation of policies by such “intermediate organizations”. TC creation satisfies the needs of advanced firms in Phase 1 and anticipates the “needs” of imitator firms in Phase 2. Similar considerations hold in connection with market building policies undertaken in Phase 2 - they partly respond to the contemporary needs of imitators, but on the other hand, they also anticipate the needs of laggards (some of which are not yet aware of the need to restructure).

5. The effect of targeted policies is to embed business firms into a more complex system involving new types of organizations and/or social institutions(indirect impact on RBS).

Embeddement through a new market has scope, depth and flexibility implications which enables enterprises-particularly imitators and laggards- to continuously adapt in an endogenous fashion in response to changes in the environment (provided they are not radical changes). The process results from emergence of a new hierarchical level of organization in the national system of innovation. Both self organization *and* Government Policy might be required.³⁵

6. Appropriate timing and coordinated policy deployment are crucial

Due to cumulativeness of the processes of innovation system transition the timing of policies is crucial. For example, too early application of an SME- support scheme may be wasteful and risks at being non effective since the restructuring possibilities of these firms could be limited due to non-embeddement and to the dearth of spillovers from advanced firms. Second, undue delay in the implementation of Phase 1 targeted policies, by failing to

³⁵ The literature on regional systems and clusters also emphasizes the embeddedness attained by individual firms e.g. Malmberg and Maskell (1996) talk about firms embedded in a networked structure of customers, suppliers and institutions which both provide opportunities and exert pressures for knowledge accumulation. The tradition represented by the above authors also emphasizes the importance of interactions and interactive learning; of proximity in space (also for economies of agglomeration); and even of embeddement of the regional system within an even wider system involving also cultural factors and other broader institutional variables. While the role of market forces in the operation of the system is recognized there seems to be an underemphasis in the role of markets as social institutions in generating enterprise embeddedness (i.e. greater stability in the face of changes; continuous product and process improvements, flexibility etc). Another major distinction with this paper (and with part of the industrial district and network of innovation literature) is the emphasis here in the dynamics of system change rather than on (the static) characteristics of a successful cluster or regional system. How did the Danish furniture industry evolve? It is clear that the story is more complex than a simplistic analysis of Marshallian external economies would seem to imply, since institutions to capture potential externalities must be allowed to arise endogeneously as part of the process. Thus it may be important to make a distinction between hierarchical system effects--which help propel enterprise restructuring during the transition period - and the embeddment feature which is then achieved upon termination of this period.

reinforce autonomous restructuring, may reduce spillovers and what can be profitably be learned by other firms. It will also block the specific restructuring efforts of imitators. Thus timing of policies and more than this, the balance and coherence between horizontal and targeted ones (and between those aimed at different enterprise segments) are critical issues determining whether or not a cumulative restructuring process will emerge.

5. Summary and Link with Diffusion Policies

The restructuring process described above which leads to a new national system of innovation could be viewed as a multifaceted, cumulative process of diffusion of new technologies, new management and organizational routines\capabilities; and even of new strategies of business enterprises. The process is close to Metcalfe's broad view of the diffusion of technology which -following Layton's view of 'technology'- includes artifacts, skills and knowlege(Metcalfe 1988, 1994). This is a broader set of processes than those underlying most artifacts'-focused diffusion models. The knowledge (and, to some extent-skill) aspect of diffusion in this paper is the *cumulative learning to restructure process* which accompanies a successful transition to a more complex and open national system of innovation. It plays one of the central roles in enhancing the awareness,articulation of needs and absortion capabilities of enterprises in the business sector, both in regard to the general(largely organizational) components of the diffusion process and in regard to the specific, technological, component. The information sets facing the agents , which are relevant for their adoption decisions, are definitely not exogenously given but depend endogeneously on the diffusion process itself.³⁶

The process begins with advanced firms and proceeds gradually to engulf imitator and laggard enterprises. By and large NSI policies--which are diffusion policies since system transition, in this paper, is a process of diffusion of restructuring-- belong to two groups: horizontal policies and targeted policies. The former directly provide incentives to enterprise restructuring and contribute to generate the knowledge which links the

³⁶ The notion of 'artifact' in this model should include both new technology \inputs and new organizational routines. It follows that the 'knowledge' aspect relates to the interface between adopters and their caracteiristics on the one hand and the characteristics or configurations of the various kinds of technological and organizational 'artifacts' on the other.

restructuring experience of advanced firms with those of imitators and laggards; while targeted policies stimulate emergence of new collective organizations and technological infrastructure which supply novel inputs for the specific aspects of enterprise restructuring.

This diffusion *policy* perspective to enterprise restructuring where both horizontal and targeted programs are used to induce a cumulative process of restructuring while also generating critical 'system effects' seems to differ from other perspective developed in Europe during the nineties(see "Oslo Manual" in OECD 1992, Soete and Arundel 1993, the Green Paper on Innovation -EC 1995). Soete & Arundel analyse the main characteristics of an integrated and systemic view of innovation and diffusion processes and then proceed to derive sets of relevant policies linked to each of these characteristics. Each set follows from a particular feature of the innovation\diffusion process (Soete and Arundel op. cit. Table 4, p.38). My contention is that additional insights might be obtained by utilizing a broad 'diffusion of enterprise restructuring' perspective such as the one presented here. I explain by making reference to the cumulativeness aspect and to the uniqueness of each diffusion process as raised by Soete and Arundel.

Cumulativeness of the Process.

This paper is based on a distinction between *early experience* in diffusion (or in restructuring) and emergence of a more or less codified body of *knowledge* about this process, one that could be easily and efficiently accessed and implemented by a variety of other economic agents. Insufficient attention is given to the latter(both in Academic work and in policy making) as if experience would be gathered,classified and codified

automatically there being no need to consider the collective learning process itself.³⁷ Naturally this is unwarranted particularly in cases where enterprise restructuring involves numerous technologies, functions and organizational forms as well as a large variety of different enterprise types. When a fragmented process of experience is not followed by subsequent knowledge consolidation, it may fail to generate the cumulative diffusion\restructuring process aimed at.

It follows that 'policy' aimed at generating collective learning for cumulativeness in the restructuring process should include a component which systematizes existing experience and codifies it according to a broadly accepted terminology which is also readily recognized by "users" (i.e. the enterprises poised to restructure see also Bianchi and Bellini op. cit.). In reality most policy recommendations still have a neoclassical flavour which focuses on incentives and effectively ignores learning particularly how the *process* of collective learning is build up from an aggregation of individual experiences. Apparently they rarely look for impacts beyond the firms actually supported. To my mind this gap should be traversed before a structured and coordinated set of policy actions will emerge one which could trigger the multifaceted process of enterprise restructuring and reinforce its diffusion.³⁸

Uniqueness of the development\and diffusion processes of each innovation

A policy implication is the need to find a balance between a range of specific programs supporting diversity and more general policies (Soete & Arundel op.cit.). This is achieved in this paper by a mix between horizontal and targeted policies which exploit the link between the "innovation" aspect of firm restructuring (the autonomous restructuring of advanced firms) and the "diffusion" aspect (subsequent restructuring by imitator enterprises and by laggards). Moreover by focusing on the restructuring process of *firms* rather than on the diffusion of a *technology*, issues concerning the timing and coordination of the various policies can, in principle, be addressed explicitly.

³⁷ In fact, the accumulation of experience from the progressive use of a new technology seems frequently to be visualized as being similar in its automaticity to the enhanced efficiency attained in network technologies through an increase in the number of users.

³⁸ Despite this absence of a well developed theory of collective learning ignoring the issue of triggering collective learning when discussing policy is not justified. Thus means should be taken to assure a 'critical mass' of experience, as a necessary condition for collective learning. Moreover, codification requires undertaking case study work and developing conceptual structures to integrate the variety of experiences.

Horizontal Policies

Finally, our policy framework clarifies the nature and role of horizontal restructuring policies (HRP) in the diffusion of enterprise restructuring. These play a significant role in that they may trigger and reinforce collective learning about restructuring. Their role has been underestimated in the past due to the focus on specific technological development\diffusion programs (given the inherent specificities of technology).³⁹ HRP stimulate adoption and diffusion of new “functions” such as R&D or design ; new management routines or organizational forms accross sectors and even technologies. They may be of *flexible application* i.e. they may cater to different restructuring needs of firms even in the context of a single program⁴⁰; and, while open to all firms, they are *focused* at each phase to a different segment of the business sector.⁴¹ Finally, the main HTP programs change along the transition process.

It is also important to emphasize the importance of horizontal programs for promoting variety (Teubal 1997) and for ensuring the successful transformation of firms whose characteristics are not detectable a- priori by policy makers (and which therefore would not, at least in an early stage, be catered by a separate program). Fundamental uncertainty about the sources of new variety would seem to justify the need for horizontal programs both in respect to the restructuring of incumbent firms and for the promotion of entrepreneurship and new start ups.

A major challenge of future work is to consider the policy implications of other sources of variety among firms in the Business Sector e.g. related to economic sectors and core technologies. This will undoubtedly alter the balance between horizontal and targeted

³⁹ In previous work I mentioned the underemphasis given by neoclassical and evolutionary economists alike on Horizontal Technology Policies (HTP). There seems to be a common reason for underemphasis of horizontal policies, one that is probably misplaced once one recognizes both the fundamental uncertainty surrounding innovation\diffusion and ignorance of policy makers.

⁴⁰ Such a flexibility has characterized the New Technology (NT) Program for Northern Norway, a successful regional restructuring program (Step, 1996). Thanks to K. Smith for having pointed out this feature.

⁴¹ Initial focusing of horizontal programs to an advanced or Schumpeterian segment of firms is a central feature of the policy framework of this paper The NT program was directed to innovative firms only and in a second phase a subset of focal firms was picked out for special treatment. It could be justified in terms of identifying potential for generating dynamic effects and thereby generating the cumulative process mentioned above in the text. Note that the shifting enterprise target also implies a change in the structure of the activities or functions promoted, in the incentives provided and in other related actions. I should also mention that firms' focusing within an horizontal program could be based on general criteria for participating in Government Programs and thereby is consistent with programs which are open to all firms. It should not be confused with a policy of supporting national champions.

policies. The insights obtained may help bridge the gap between “theory” (in this case, appreciative theory) and the practice and practical needs of industrial -technological policy promoting the transition of National Systems of Innovation.

ANNEX 1; SUMMARY DESCRIPTIONS OF POLICIES

1 Horizontal Restructuring Policies (HRP)

1.1 Phase 1-aimed at Advanced Firms

Assumptions: Awareness of need to restructure and fairly widespread R&D. Also the beginning of a new strategic outlook in many firms and new forms of organizational learning. Despite autonomous restructuring activity there are widespread institutional constraints and market failures blocking effective and full implementation of the process.

Functional areas supported(one or more)

- Search and introduction of search function
- Enterprise R&D and product design
- Cooperative, precompetitive R&D
- Precision manufacturing and new process technology
- Export marketing
- Organizational learning and introduction of sophisticated new routines & processes
- Generation of distinct, dynamic capabilities
- Links and Collaborations (Universities, Government Labs, Technology Centers; other firms)

1.2 Phase 2- aimed at Potential Imitators

Assumptions: Some awareness but lack of capabilities to undertake change. R&D is not widespread; and pervasive market failures in innovation and in introduction of new routines. Also, very strong failures in connection with the diffusion of new technology (and associated routines)

Functional Areas Supported (one or more)

- Search
- Links with new external sources of technology
- Utilization of external consultants
- Links with Technology Centers and Universities
- Networking with other enterprises
- Technology Transfer and Absorption (including training)
- Product Design and Enterprise R&D
- Organizational Learning (greater emphasis than for advanced firms, especially of less sophisticated capabilities)

1.3 Phase 3: aimed at Laggards (mainly SME's)

- *Major Functions only weakly covered in previous phases*
Training, preparation of business plans, diffusion of basic management techniques (managing cash flows, inventories etc) and organizational routines.
- *Consultancy*
Stimulating the emergence of a specialized consultancy segment and market to help articulate demand (importance of geographical and cultural affinity); promoting links with consultants and with external sources of information and advice.
- *Networking with other enterprises*

- *Enhanced support of technology transfer and absorption*
Incentives, information, and technical back up.
- *Special Financial aid* (to compensate for inherent capital market imperfections)

2. Proactive Diffusion Policies (Specific new inputs)

- requires technical back-up to users
- The TC should identify and adapt right configurations of service for each user type
(building demand through learning by interaction and adaptation)
- involves also strong incentives to use new technological services

3. Market Building Policies

- involves building demand (see above) and building supply
- building supply through training of new consultants, spinoffs of TC personell, making existing equipment available to consultants, etc.
- pursuing a positive social profit policy despite potentially negative private profits .

4. Networking etc Policies (for Laggards and Imitators)

- Collaborative search for new information on markets and technology
- collaborative search for new orders and collective division of labor in producing commisioned orders
- collective transfer and adoption of new technology
- developing problem solving capabilities collectively
- provision of information, coordination and institutional help
- incentives for creating and mantaining a Secretariat for each network.

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Danish **R**esearch **U**nit for **I**ndustrial **D**ynamics

The Research Programme

The DRUID-research programme is organised in 3 different research themes:

- *The firm as a learning organisation*
- *Competence building and inter-firm dynamics*
- *The learning economy and the competitiveness of systems of innovation*

In each of the three areas there is one strategic theoretical and one central empirical and policy oriented orientation.

Theme A: The firm as a learning organisation

The theoretical perspective confronts and combines the resource-based view (Penrose, 1959) with recent approaches where the focus is on learning and the dynamic capabilities of the firm (Dosi, Teece and Winter, 1992). The aim of this theoretical work is to develop an analytical understanding of the firm as a learning organisation.

The empirical and policy issues relate to the nexus technology, productivity, organisational change and human resources. More insight in the dynamic interplay between these factors at the level of the firm is crucial to understand international differences in performance at the macro level in terms of economic growth and employment.

Theme B: Competence building and inter-firm dynamics

The theoretical perspective relates to the dynamics of the inter-firm division of labour and the formation of network relationships between firms. An attempt will be made to develop evolutionary models with Schumpeterian innovations as the motor driving a Marshallian evolution of the division of labour.

The empirical and policy issues relate the formation of knowledge-intensive regional and sectoral networks of firms to competitiveness and structural change. Data on the structure of production will be combined with indicators of knowledge and learning. IO-matrixes which include flows of knowledge and new technologies will be developed and supplemented by data from case-studies and questionnaires.

Theme C: The learning economy and the competitiveness of systems of innovation.

The third theme aims at a stronger conceptual and theoretical base for new concepts such as 'systems of innovation' and 'the learning economy' and to link these concepts to the ecological dimension. The focus is on the interaction between institutional and technical change in a specified geographical space. An attempt will be made to synthesise theories of economic development emphasising the role of science based-sectors with those emphasising learning-by-producing and the growing knowledge-intensity of all economic activities.

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