discussion paper

FS I 96-319

German Technology Policy, Innovation, and National Institutional Frameworks

David Soskice

September 1996
ISSN Nr. 1011-9523

Abstract

The pattern of innovation in Germany is substantially different from that in the US and the UK. It is argued that German patterns of innovation - incremental innovation in high quality products especially in engineering and chemicals - require long-term capital, highly cooperative unions and powerful employer associations, effective vocational training systems and close long-term cooperation between companies and with research institutes and university departments. (The more radical high-technology innovation typical of the US and the UK benefits by contrast from less regulated market conditions.)

These conditions are met by the incentives and constraints of the institutional framework in which companies located in Germany are embedded. It is suggested that German technology policy is appropriate to and important for this pattern of high-quality incremental innovation. Moreover, the institutional framework - especially the role of powerful business associations - can solve the collective action problems to which German-type technology policy would normally be exposed.

Zusammenfassung

Die Entwicklungsvoraussetzungen für Innovationen in Deutschland unterscheiden sich substantiell von dem entsprechenden Muster in den USA oder in Großbritannien. In dem Papier wird die Meinung vertreten, daß die in Deutschland vorherrschenden Formen von Innovationen - Entwicklungen in kleinen Schritten bei technischen und chemischen Spitzenprodukten - langfristiges Kapital, sehr kooperative Gewerkschaften und mächtige Arbeitgeberverbände, ein effizientes Berufsausbildungssystem und eine enge langfristige Zusammenarbeit zwischen Unternehmen einerseits und Forschungsinstituten bzw. Universitätseinrichtungen andererseits voraussetzt. (Den für die USA und Großbritannien typischen hochtechnologischen Basisinnovationen sind im Gegensatz dazu geringer regulierte Marktbedingungen förderlich.)

Diese Bedingungen werden durch die Anreize und Beschränkungen des Institutionengefüges, in dessen Rahmen die Unternehmen in Deutschland arbeiten, erfüllt. Es wird in dem Papier die These vertreten, daß die Technologiepolitik in Deutschland angemessen und wichtig für den beschriebenen Innovationstyp ist. Darüber hinaus kann das Institutionengefüge - vor allem die mächtigen Unternehmensverbände - die „collective-action"-Probleme lösen, denen die in Deutschland vorherrschende Technologiepolitik normalerweise ausgesetzt wäre.

TABLE OF CONTENTS

		PAGE
1.	Introduction	1
2.	Relational Requirements of High Quality Incremental Innovation Strategies and their Problems: Primary Relations with Employees	4
3.	Relational Requirements with other Companies	9
4.	Relational Requirements with Owners	12
5.	National Institutional Frameworks and the Relational Requirements of Innovation Strategies	16
6.	Appropriate Technology Policies in Germany and the US and UK	19
Bibliography		25

1. Introduction

The pattern of innovation in Germany is substantially different from that in the US and the UK. It will be argued that German patterns of innovation - incremental innovation in high quality products especially in engineering and chemicals - requires long-term capital, highly co-operative unions and powerful employer associations, effective vocational training systems and close long-term co-operation between companies and with research institutes and university departments. These conditions are met by the incentives and constraints of the institutional framework in which companies located in Germany are embedded. It is suggested that German technology policy is appropriate to and important for this pattern of high-quality incremental innovation. Moreover, the institutional framework - especially the role of powerful business associations - can solve the collective action problems to which German-type technology policy would normally be exposed[1].

Attractive though the German system is, it is not the intention of this article to advocate its being copied in Anglo-Saxon economies, such as the UK or the US[2]. This is because their institutional frameworks are fundamentally different; it is argued elsewhere that their quite different innovation patterns - see below -are encouraged by the relatively deregulated Anglo-Saxon institutional frameworks (Soskice 1994b). The implication of this article is that the different institutional frameworks of the advanced economies provide them with *comparative institutional advantage* in innovation patterns.

National innovation patterns in the late 1980s: This sub-section sets out briefly some of the empirical basis for national innovation patterns. Perhaps the most useful quantitative/qualitative study of innovation patterns across advanced economies is Michael Porter's book The Competitive Advantage of Nations (Porter 1990). He looks at the UK and the US, our paradigmatic Anglo-Saxon economies; and at Germany, Sweden and Switzerland, which fall into our Northern European category. The broad conclusion, supplemented by other sources is that:

1 The article is mainly concerned with German innovation; innovation patterns in Sweden and Switzerland, as well as their institutional frameworks are similar to those in Germany.

2 Australia shares most of the main institutional characteristics of the UK or the US, though the labour market is somewhat less deregulated.

The US and the UK are strong in:

Radical innovation in newly emerging technologies (e.g. biotechnology, microprocessors).

Sophisticated internationally competitive services (e.g. management consultancy, advertising and related media services, international banking including investment banking, derivatives etc., tax consultancies, architectural and engineering consultancies, auctioneering)[3].

Large complex systems, especially where the technology is changing rapidly (e.g. telecommunication systems, large entertainment systems, defense systems, large software systems, airline systems, large aircraft production).

Germany, Sweden and Switzerland are strong in:

Incremental product and process innovation, often at a scientific leading edge, in established technologies, especially machinery, also chemicals; these are relatively complex products, involving complex production processes and after-sales service and frequently close long-term customer links[4,5].

Germany, Sweden and Switzerland are economies in which new industries are not easily developed, by contrast to the US and the UK; (Swe: 351, 353), (Swi: 325, 327)[6]. Comparing Germany to the US, Porter writes: "As strong as Germany is overall in research, it cannot match the US in inventiveness in new industries....Germany is the undisputed leader in improving and upgrading technology in fields in which its industry is established, but there are weaknesses in newer fields such as electronics, biotechnology and new materials". These differences are mirrored by lack of formation of new companies in Germany, Sweden and Switzerland, again by contrast to the US and UK; (G: 377; Swe: 351; Swi: 327; UK: 507; US: 527, 530).

3 On my calculations on the basis of Porter's cross-country classification of internationally competitive industries, the following were the numbers of "internationally competitive" service industries: Germany 7, Sweden 9, Switzerland 14, UK 27, US 44. (Note: these figures should be treated with some caution as there were some classificatory problems with the UK data.)

4 These are typical 2r industries, to use Matraves' terminology; her empirical results on the structure of German industry are in line with these here (Matraves 1996).

5 My calculations from Porter's data give the number of internationally competitive machinery industries as: Germany 46, Sweden 28, Switzerland 35, UK 17, US 18. (The qualification in the previous footnote applies here as well.)

6 The bracketed numbers refer to page numbers in Porter op. cit.

Other evidence of the view that the Northern European environment is not friendly to the types of innovation listed as Anglo-Saxon above is provided by the behaviour of some major German multi-nationals:

The major German banks, Deutsche Bank, Dresdner and the Norddeutsche Landesbank have all moved their international operations away from Frankfurt and to London; Commerzbank is engaged in trying to find an appropriate vehicle to make the same move. All believe that domestic business, which is seen as requiring the same competences as high quality manufacturing -namely long-term relationships and high skills throughout the workforce, is best kept in Germany. But international operations, needing the ability to hire and fire mobile and gifted professionals and reward them appropriately, can be organised more easily in London.

The three largest chemical companies, BASF, Bayer and Hoechst, have shut down most of their biotechnology operations in Germany, and focused mainly on the US. But much of their traditional mainstream high value-added chemicals research has remained in Germany.

The economics of organisation and innovation patterns: This article centers the analysis relating innovation patterns to institutional frameworks in the economics of the organisation of companies. Different types of innovation strategies, it will be argued, cause different problems of motivating researchers and other relevant employees. They also cause different problems as well in the relationships between the innovating company and companies with which it has to cooperate. Furthermore, the innovating company[7] has to persuade financiers to finance the project on terms consistent with satisfactory relations with employees and co-operating companies, and this may lead to additional difficulties.

These problems between the top management of the innovating company and those with whom it has to build appropriate relationships (employees, "cooperating" companies, owners) arise because of the difficulty of writing complete contracts on the one hand and a pervasive asymmetric information environment on the other. It is in terms of this organisation-centred analysis of the different problems posed for the innovating company by different innovation strategies that the links are established between innovation strategies and institutional frameworks: Different institutional frameworks have comparative advantages in solving the organisational problems of different innovation strategies.

The article focuses on the relationship between typical German innovation patterns, their "relational" requirements, and the German institutional

7 More accurately, the "top management" of the company rather than the company itself.

framework. Section 2 looks at the relations companies need to develop with employees, and section 3 at the relations with co-operating companies (mainly suppliers). These relationships are called the *primary relational requirements* of the innovation strategy. These primary relational requirements then imply the need for particular relations between the company and its owners (i.e. long-term finance etc.) The relation with owners is called a *secondary relational requirement* of the innovation strategy, and is discussed in section 4. Section 5 shows how the German institutional framework, but not the US/UK framework solves the problems associated with the relational requirements of high-quality incremental innovation strategies. Section 6 concludes by a closer examination of German technology policy.

Methodologically, the article is built on three major intellectual developments of the last decade or so: The work of the "institutional" political economists, most notably Hall (1986), Katzenstein (1985) and Zysman (1983); they showed how to map out the relationships between politics and macro- and micro-economic institutions. The school of industrial sociology associated particularly with Sorge (Sorge and Warner 1987), Streeck (1991) and the LEST "social effects" group at Aix-en-Provence (Maurice, Sellier, and Silvestre 1986); this renaissance in industrial sociology showed how external institutional factors interrelated with internal organisational practices. And the new economics of organisation, which has sought to understand organisational forms in terms of responses to the impossibility of writing complete contracts; see Milgrom and Roberts (1992).

Two seminal works (Kitschelt 1991; Aoki 1994) have suggested how these different intellectual developments should be integrated. This article is an attempt to follow their lead.

2. Relational Requirements of High Quality Incremental Innovation Strategies and their Problems: Primary Relations with Employees.

This section looks at the required relations with employees. It is convenient to classify these requirements along two basic dimensions: how work needs to be organised; and what skills are needed.

(i) Work organisation: The *first* dimension comes from the industrial sociology literature[8] and relates to *work organisation]* it concerns how companies need to

8 The major analytic contribution is Perrow (1984; 1986), who developed the concepts of tightly- and loosely- coupled technologies. Kitschelt (1991) also develops these concepts; for a practical discussion see Sorge and Warner

co-ordinate, and allow autonomy in, the work of their employees in order for their contribution to the innovation to be effective; (the question of skill acquisition - the second dimension - is held constant). The work organisation dimension in fact conflates two different dimensions. One is how much co-ordination across employees is necessary; the other is how much autonomy it is necessary to give employees. Each carries a different danger for management: The danger from the need for co-ordination is collective "hold-up". The danger from the need to give employees autonomy is that they cannot be easily monitored. (Of course, how serious these problems are, and how management can respond to them, will depend also upon the skill acquisition dimension).

High quality incremental innovation requires what is often referred to as *loosely-coupled work* organisation. On the one hand, the type of work which engineers, technicians and skilled manual employees do in much of chemicals and engineering in Germany in engaging in the process of incremental organisation is difficult or very costly for management to monitor directly; it would involve long explanations about why such and such an operation was being done, why especial care was being taken, and so on and so forth. On the other a high degree of co-ordination is required between employees: Many operations tie into other operations. Where individual employees or groups have expertise in particular areas, and where their solutions to problems require small changes in related areas (for instance in customising a machine) the most efficient way of organising work is to allow decentralised problem-solving. This can lead to considerable feed-back within a company in terms of design. Thus substantial co-ordination and discussion as well as actual joint work has to take place. In consequence, loosely-coupled work organisation implies both the need for high employee autonomy and high co-ordination[9].

This type of work organisation is difficult for companies to manage, since it is open both to collective hold-up and to the moral hazard which is implied by high monitoring costs. However, - to note for later in this section - loosely-coupled work organisation is appropriate to peer-monitoring, since typically the degree of co-ordination means that an employee's peers understand what the employee is supposed to be doing and are likely to observe the employee working. Of course, the mere fact that peer-monitoring is technically possible does not mean it will happen - the company has to provide appropriate incentives for that. This is examined in more detail when the skills employees need have been discussed.

8 (1987). Following Kitschelt, these concepts are seen through an economics of organisation filter: consult Milgrom and Roberts (1992) for a useful introduction, as well of course as Williamson (1985).

9 Broadly similar considerations apply to the work organisation in incremental innovation in mass customisation (as in Japan).

(ii) Skill acquisition: The *second* dimension relates to *skill acquisition.* The context here is of a world in which the skills and competences needed for effective innovation are changing rapidly in ways which are not easy for a company to predict and plan for. Critically, an innovating company has to decide whether it can rely on and/or develop the skills of its own employees to meet the requirements of effective innovation, or whether it needs to bring in the necessary new skills from the outside. In the former case we will describe the skills as "incremental", and in the latter as "radical". This usage is based on Teece's insightful definition of a radical innovation[10]: an innovation is "radical" in relation to a company if the company needs to bring in employees, with new skills, know-how etc., to bring about the innovation.

The article has already hinted - by describing German innovation patterns as "high-quality incremental innovation" - that the required skills of employees (as well as the skills involved in links between the innovating company and companies with which it co-operates) will be "incremental" not radical. (Indeed the article makes implicit reference to Teece in referring to German innovation patterns as incremental.) The skill requirements of employees engaged in high-quality incremental innovation in well-established technologies are a combination of company-specific skills, particularly a knowledge of the company product and process technology, and marketable skills in the industry technology. Because company-specific skills are strong, and because the industry technology is well-established and hence changing in a predictable way, companies tend to try and train existing employees in new industry technology marketable skills as the need arises. Thus the required skills are incremental.

In addition, at least some part of the skills are marketable. The fact that required skills are both incremental - meaning it is costly for companies to lose skilled employees, as well as marketable - meaning it is not too costly for employees to find skilled employment elsewhere - increases the collective hold-up problem of loosely-coupled work organisation.

Finally, the development of training systems for marketable skills in industry-specific technologies requires close co-operation between companies within the same industry.

Implications: In the remainder of this section, the implications of these work organisational and skill patterns for relationships between employees and CEOs are examined. It will be concerned with: (i) the labour market environment conducive to the relationship (hiring and firing rules and wage-

10 Teece (1996) argued that, independently of the organisation in which an innovation took place, any innovation was bound to be incremental - in the sense that the "discoverers" had almost certainly all sorts of prior skills, knowledge etc. in relation to which the innovation was incremental. Thus the only useful way of defining a radical innovation was in relation to a particular organisation.

setting rules); closely connected, (ii) decision-making procedures within the company needed for the relationship and which may have implications for the readiness of financiers to finance the innovation strategy; and (iii) problems associated with skill acquisition for the company and for the individual.

Company Decision-Making: Before proceeding further, a simple model of decision-making within the company is developed. As Aghion and Tirole (1994) have pointed out there is a distinction between formal and actual decision-making power within a company. Formal power rests with the management board of the company, but actual power depends on how decision-making works. Two broad modes of decision-making can be contrasted: unilateral control, where the CEO has the final say over important questions such as hiring and firing; and consensus decision-making, where it is formally or informally accepted that the CEO and the relevant employees both have veto powers over important decisions - so that a consensus has to be reached.

Imagine the CEO can choose between the two styles of decision-making; and ask under what circumstances the CEO might choose consensus decision-making. The first circumstance is obviously if the CEO has no real choice as a result of the ability of the employees to veto whatever the CEO decides. Employees will be in this situation when (a) they can take co-ordinated action or the actions of a small group disrupt the company because actions within the company require to be co-ordinated; (b) they cannot be quickly replaced, because they have substantial company-specific skills; and (c) the CEO cannot construct a credible individualised incentive structure to prevent a veto under unilateral control. (a), (b) and (c) apply to companies adopting high-quality incremental innovation strategies.

This is reinforced by a second consideration: The CEO might want to adopt consensus decision-making to reduce information costs[11]. Here again we will see that with incremental innovation strategies, CEOs will favour consensus decision-making. The argument is as follows. In deciding which of a number of courses of action to take, both the CEO and an employee E have relevant information which the other does not have. The CEO could spend a large amount of resources in acquiring E's information and then impose unilaterally the choice the CEO preferred. Alternatively the CEO and E could exchange the relevant information costlessly and then make an agreed choice (e.g. split the difference). If both sides were truthful, this would be a good consensus-. procedure alternative. However, if there was an incentive to cheat, both sides would worry that the other was cheating, so that the procedure would not work. One way to avoid this problem is for both sides to *align their incentives.* With incremental innovation, the alignment of incentives implies that the CEO should have a low-powered incentive structure, i.e. not one dependent on outcomes

11 This is the Aghion-Tirole argument.

which would be damaging to the employee and which the employee could not check on.

Thus both from the power position of employees and from the information saving perspective, CEOs adopting high-quality incremental innovation strategies should choose to have consensus decision-making. And for consensus decision-making to work, the incentive structure of the CEO needs to be low-powered.

The CEO's problems and possible solutions: There are two interrelated sets of problems, those relating to the work organisation of the company, and those relating to the development and acquisition of industry-technology skills. As regards the first set, the CEO cannot monitor, and has to rely on peer monitoring if any monitoring is to be done; in addition the individual autonomy of the employee (engineer, technician, skilled employee), the need for employees to be able to collaborate autonomously, and the importance of company-specific skills gives the workforce collective hold-up capacity[12]. For the CEO the problem is: with lack of ability to monitor, on the one hand, and the power of employees, on the other, how does the CEO get employees to work co-operatively at appropriate wage levels? For the employees the problem is: assume we work co-operatively and invest in company-specific and quite narrowly-defined industry technology skills, how do we ensure that the CEO sticks to whatever broad understanding we agree to (over employment security, reward structures and so on)?

It is worth re-emphasising that contracts cannot be written in advance to codify any such agreement in a legally enforceable form. This is because of the great range of contingencies which might arise and affect the outcome. There are two separate difficulties: There is first the standard Williamsonian transactions cost of writing such a contract and of verifying departures from it at a standard of evidence which could stand up in court. Second is the asymmetric information problem that the CEO may not be able to monitor what employees are doing and employees unable to check on what the CEO says is happening in product markets etc. (Note that this is just as much a concern to most engineers in the company as it is to skilled employees; and note also that skilled employees and technicians are complementary factors to engineers in carrying through incremental innovations.)

As we have seen the first part of a solution to these problems is that there is consensus decision-making within the company. The broad framework agreement within which the consensus decision-making works will embody: (i) the CEO accepting to follow strategies to maintain employment security (product market strategies which require existing workforce skills, and training

12 This is reinforced by marketable skills, enabling employees to move elsewhere if they are fired.

existing employees rather than hiring those with required new marketable skills), and linking earnings developments to those in the industry as a whole with some additional sharing of long-term profitability; (ii) employees accepting to work co-operatively and to peer monitor.

When functioning smoothly, consensus decision-making requires that both sides are not continually seeking evidence of the other side's inside information. Two further conditions are therefore necessary for consensus decision-making to work. As mentioned above, incentives of decision-makers on both sides of the consensus must be reasonably aligned: Thus the CEO must not have "high powered" rewards contingent, say, on current profits or the share price, for otherwise there would be continual suspicions that the CEO's recommended redundancies could be avoided or that proposed strategy switches had a hidden agenda. In addition, the employees or their representatives must have sufficient power to examine all the relevant data on which the management case - for, say, redundancies - is based.

But there is a problem for both sides here. On the one hand for the CEO: in giving real access to company decision-making to employee representatives, the company opens itself to exploitation at any time (i.e., to be able to make checkable commitments about employment security in order to avoid a "holdup" the CEO has to entrench employee representatives in a bargaining position in which a hold-up is still possible). Thus the CEO will need the assurance of an external body that the employee representatives cannot do this. On the other for the employees: they need assurance that the company has really put their representatives in this advantageous position. So the rules of the external industrial relations system, for skilled manual employees, technicians and engineers, need to assuage these opposing doubts.

In addition, the systems of vocational training of skilled manual employees and technicians, and the professional training of engineers, has to be such as to enable companies to share their industry technology knowledge in the development of industry technology skills both of skilled employees and engineers. Moreover the trainees in turn have to find credible the claims made by the training system that the relative focused skills they learn (even as engineers) will be appropriate for future job moves if necessary.

3. Relational Requirements with other Companies.

In this section the relational requirements with co-operating companies are examined, and the associated problems drawn out. This can be done more briefly than in the previous section. Three types of relationship with co-

operating companies are envisaged. In each case, it is taken for granted that the co-operating company has technical competences; what distinguishes the relation is the nature of these and other competences needed.

(i) Many relationships are arm's length and a more or less satisfactory contract can be written. Thus, though quantitatively important, these "co-operative" relations cause no organisational problems for a particular innovation strategy[13].

(ii) The need for co-operative relationships with companies with competences in agreed industry-technology standards is the central relation-type needed by companies engaged in incremental innovation within an industry-technology. Such innovation strategies in high quality products usually demands concentration across a limited range of products, with deep knowledge within the company of those products and the related production processes. This normally requires relations with other companies who are component suppliers or equipment suppliers; and/or with horizontal companies in the industry with experience of how to solve particular problems. These relations will often require close collaboration on design and so on. The feasibility of these type of relations is that there is reasonably widespread agreement on standards in the industry-technology across companies in the industry.

This type of relationship has therefore two major problems:
how to get agreement within the industry or sub-industry on standards;
and how to minimise the relational problems arising from incomplete contracts.

Both problems are sharpened by the need, both for consensus standard-setting and for relational contracts, to allow inside information to pass across companies in the same industry. If companies allow inside information on production techniques, product modification strategies, and so on, to pass to potential competitors - they are all, after all, using the same industry technology - how are they to prevent other companies appropriating the results of their research?

What these companies need (and what we will see the German institutional framework provides in the form of powerful industry associations) are bodies which ensure that companies participate in the consensus formation process and ensure that they do not misappropriate inside information of other companies. Moreover industry associations act in a general way to monitor reputations of companies, so that engagement in relational contracts is less

13 There are in fact there are some differences between Germany and the US and UK in the institutional framework governing even simple contracts, but they will be ignored.

dangerous than it might be. This framework reinforces mutual reputations for reliability built up between companies as a result of continuing relations.

(iii) The third type of co-operative relations with other companies are what will be called companies with radical competences. Radical competences of supplier company (X) are defined in relation to the innovating company (Y): The product or process or whatever that X supplies to Y or collaborates in with Y cannot (a) be explicitly contractualised - i.e. the contract is substantially incomplete and (b) requires major adaptation of standards by Y. Analogously to radical skills in the last section, some innovations may require Y to buy in the competences of another company, because a technology is changing too fast for Y to develop these competences itself, and because it is difficult for Y to predict what those competences will look like. In addition, if the company is part of a group of companies (including an industry or sub-industry grouping) which develops consensus-based standards, radical competences are outside those standards; in other words it does not the group of companies to develop these competences, for the same reason it does not pay the individual company to do so. Moreover, radical competences differ from those necessary for arm's length relations because they cannot just be plugged into the company (for instance they require collaborative work between the two). Put simply, an innovating company may have to go outside its established network of companies with which it works to get the radical competences it desires.

Incremental innovation strategies both need and do not necessarily take easily to co-operative relations with radical competence companies. They may need radical competences in order to stay at the forefront of world competition. But they may find it difficult to absorb co-operation with radical competence companies. First, the internal organisation of the company is based on existing industry-technology standards and decisions are made on a consensus basis internally. Imposing different standards is inherently problematic, since it may require many different practices in the company to change. Second, the reputations of radical competence companies are difficult to validate: this is both because, by definition, these companies have not been previously engaged in collaboration with the innovating company, so there has been no existing basis for mutual reputation building between the two companies; and because, since the radical competence company is outside the industry-technology, there is no basis for reputations within the industry[14]. Nor are these problems solvable in the incremental innovation case by transfer of ownership: for the structure of incentives for employees in a radical competence subsidiary will need to be different from those in the incremental innovation company; hence consensus decision-making within the new company will re-present the same difficulties.

14 I am indebted to Horst Kern for this argument.

What is needed in this situation is to translate these radical competences into competences based on agreed industry standards, via the industry standard-setting mechanism. This is more or less the task of the type of technology policy which the German government has made use of through the 1980s and 1990s.

4. Relational Requirements with Owners.

The primary relational requirements of an innovation strategy play an important role in the form taken by the relation between the company and its owners. Owners want ideally to have a clear picture of the risks they are undertaking in financing the innovation strategy adopted by the company[15]. They may want to ensure, for instance, that the top management of the company has a strong incentive to act in the interest of the owners, even when the owners cannot observe fully the actions of top management; or to be reassured about the value of capital locked up in the skills of its employees. How important these concerns are, and how they can be met by appropriate monitoring and incentive structures, depends in large part on the primary relations. As an example, if primary relations require consensus decision-making, then owners will find it inefficient to use high-powered incentives to align top management incentives to their own. In this section these arguments are set out systematically.

The concerns of owners can be divided into three groups.

(a) Owners will want to know whether the CEO is pursuing the optimal strategy
from the owners' point of view. How do owners find out and evaluate other possible strategies?

(b) Given the strategy, how do owners evaluate assets, including those embedded in its primary relations with its employees and with other companies,
when those assets may not be immediately marketable? Information on the assets may not be fully available to top management, being possessed by employees and/or by other companies.

(c) The separation of ownership from control means that the CEO and top management can conceal information about what they are doing from owners.
If CEO goals are different from those of owners, how can owners be sure that

15 It is assumed for simplicity that each company has only one strategy; that it is financed by its owners rather than by borrowing; and that the top management are not the owners of the company.

the CEO is carrying out their interests? (This is the standard moral hazard problem for owners.)

In order to understand differences in the ways in which owners make these assessments, a key distinction must be made between the co-ordination capacity of owners. The co-ordination capacity can be thought of as taking two forms. *First,* owners may be unable to co-ordinate their activities - usually associated with a large number of owners (though this is neither necessary nor sufficient); this is the standard case of dispersed share-holdings, and is the typical pattern of ownership of public companies in the US and the UK. *Second,* there may be a group of owners with enough shares in total to control the board of the company who can make stable agreements with each other, usually with a bank as intermediary; this is the case of stable shareholdings, often associated with cross-shareholdings, and is the typical pattern of ownership of public companies in Northern Europe, France and Japan. (In both cases ownership is separate from top management.)

The inability to co-ordinate under dispersed shareholding carries two related implications. The first is that it is difficult for owners to engage in costly monitoring and monitoring of inside information. This is because of a collective action problem: if any shareholder carries out satisfactory monitoring and credibly reveals it publicly, it will pay the other shareholders to free-ride[16]. Second, dispersed shareholders cannot make (non-legally enforceable) binding agreements, since they cannot be held to agreements. Thus, agreements to delegate monitoring of inside and costly information to banks are very difficult to make. More generally this means that dispersed shareholding is incompatible with long-term agreements in which owners - contingently on satisfactory monitoring of inside information - agree not to sell in the event of attempted hostile take-overs and consequent management changes. Under a regime of dispersed shareholding companies are valued on the basis of publicly available information.

By contrast, a stable-shareholding regime permits long-term agreements. These include agreements to delegate monitoring of companies to banks or other institutions. Hence it may be possible to monitor inside information - at least there is no collective action problem involved. Whether or not the inside information can in fact be monitored successfully will depend on additional factors - notably whether those who possess the information have an incentive to divulge it truthfully to the delegated monitor, in the event that the delegated monitor cannot collect it directly. This opens the way to agreements in which hostile take-overs are unlikely to succeed.

16 This argument is due to Diamond (1984).

(Dispersed shareholding, however, is not necessarily bad. While doubts have been raised over hostile take-overs as a management disciplining device dealing with moral hazard and competency problems[17], Allen (1993) has argued that take-overs play a role in the assessment of alternative strategies. He argues that in highly innovative industries, where neither the technology nor organisational strategies have "settled down", there are likely to be profound differences of view about strategies in companies, and these are unlikely to be confined to the top management of existing companies in the sector. In such an environment hostile take-overs may be an important way in which owners can have alternative strategies assessed.)

With these distinctions in mind, the implications of the primary relations of the high-quality incremental innovation strategy for the owners are examined. In turn the problems posed by the need for owners to (a) assess alternative strategies, (b) evaluate assets when there is inside information, and (c) protect themselves against moral hazard from hidden actions by top management, are discussed.

(a): These are areas in which both appropriate organisational forms and technologies have "settled down" in the Allen sense. Changes and developments in organisational forms and in particular in technologies are best assessed from related companies, and from other sources with close knowledge of the established technology (research institutes, related university departments etc.). These assessments will in part depend on inside information about the company and its existing technological competences. Thus this makes dispersed shareholders unlikely to be prepared to finance these type of innovation strategies.

(b): High quality incremental innovation strategies imply that inside information is diffused throughout the company and in relations with other companies; the nature of the organisation implies that monitoring is difficult. The more interrelated are activities, the less possible is assessment of the competences of groups within the company and the value of ties to other companies. While profits data and some data on product market performance will become available in the public domain, inside information will be of great importance in proper valuations of the company; this is not a moral hazard problem of top management - since much of the information may not be easily available to them. Again this rules out dispersed shareholding.

(c): Incentive structures for top management, for other employees and for cooperating companies impose constraints on relations with owners. Employees need to be given credible long-term contracts which imply that stable shareholder understandings rule out hostile take-overs and make long-term

17 The doubts are not settled, see for instance Schleifer (1988).

finance available[18]. The same is true for co-operating companies engaged in long-term relations. In addition consensus decision-making limits the possibility of high-powered incentives for top management. Again dispersed shareholder systems will not be prepared to provide finance under these arrangements.

So under what conditions will stable shareholders be ready to meet the requirements posed by (a), (b) and (c) above? There are two problems which shareholders or their delegated monitors need to solve. The first is that of accessing appropriate information, the second of ensuring an adequate incentive structure.

The relevant information is partly held within the company, partly by other companies which have close relations with the company in question; and partly more widely by research institutes and other associations with a broader knowledge both of companies within the industry or sub-industry and of the industry technology and where it is going. Given the advanced nature of technologies involved, the delegated monitor will seldom have internal expertise in assessment. Thus the critical condition is that related companies and research institutes *both have access to what is going on within the company and are prepared to reveal this information truthfully to the delegated monitor.*

Behind this condition lies a deeper condition on the nature of product market competition between companies. It is very difficult to use related companies for this type of confidential information is product market competition is too intense. If product market competition is intense, in particular if it is based on the rapid introduction of new products designed to take away customers from competitors, then companies will be nervous about engaging in relations with other companies, with associations or research institutes, which allow access to inside information. Moreover, if company B has inside information about company A (which a bank is monitoring), then B might have an incentive to lie to the bank about A's performance; if it is in B's interest that A is closed, the bank would be rightly suspicious of B's assessment of A.

The conditions for effective delegated monitoring of companies with high quality incremental innovation strategies are then twofold: (i) where companies do not compete intensely against each other - for instance because they have niche product ranges and/or where the competition is in terms of technical quality, and (ii) where companies have reason to engage in relationships in which inside information is transferred under some conditions - because companies share a common industry technology and come up against common problems.

18 This is the argument of Mayer and Alexander (1990).

Since (ii) is implied by high quality incremental innovation, *the critical "institutional" condition is the absence of intense product market competition*[19].

Resume: The conclusion of this section is that the secondary relational requirements imply that high-quality incremental innovation (i) requires stable shareholding; and (ii) in order for stable shareholders to be able to set up effective delegated monitoring arrangements, the degree of product market competition must not be too intense.

5. National Institutional Frameworks and the Relational Requirements of Innovation Strategies

By a national institutional framework is meant here the set of rules and understandings which govern the systems of labour market regulation, of education and training, of corporate governance and of product market regulation, in which companies or their subsidiaries located in a particular economy are embedded. These frameworks both constrain and offer opportunities to companies. This section sets out in stylised form the national institutional frameworks of the UK and the US on the one hand, and of Germany on the other, in the late 1980s. By then the UK and the US frameworks had become similar in important respects. And in turn the German framework had become quite similar to the Swedish and to the Swiss. There are of course many differences between the UK and the US or again between Germany, Sweden and Switzerland, but in the respects relevant here the similarities are quite striking. This section shows that the Germanic framework "solves" the relational problems of high-quality incremental innovation, and the Anglo-Saxon system cannot do so.

The Labour market: (1) Rules and Understandings: (i) Anglo-Saxon labour markets are nowadays substantially deregulated. There are few constraints on hiring or firing, and virtually no constraints on reward packages. Nor are there constraints on employee representation and the role it might play in limiting managerial decision-making, (ii) By contrast, Germanic labour markets are relatively regulated, de facto and de jure: In Germany itself, works councils, elected by employees, have legal veto powers ("codetermination rights") over management decisions on redundancies, overtime, work organisation and training. In the event of disputes, both sides have recourse to external unions and employer organisations who have more or less shared understandings of "proper" behaviour; in addition unions and employer organisations play a large

19 Note that the conditions for effective delegated monitoring in the Japanese case are necessarily different. Japanese companies engage in intense product market competition.

part in decision-making in labour courts. In Sweden and Switzerland, legal powers of works councils are not so great, but both companies and works councils can rely on unions and employer organisations in the event that they believe the other side has abused the understandings. Thus critically for our argument: in the Germanic framework, companies can set up a "works council type" arrangement - giving employees decision-making power which in certain circumstances the latter might be tempted to abuse - in the knowledge that they can have safe recourse to an external governance structure in such cases. In addition, the ability of the works council to translate its power into the bargaining of wage increases is limited: this is because wages are substantially determined externally as a result of negotiations between industry unions and employer organisations. Underlying the institutional arrangements governing both works councils and industry wage-determination are powerful employer organisations - in the last resort powerful enough to ensure that industry unions and a fortiori works councils behave appropriately[20].

(2) Innovation Strategies: The Germanic rules meet the requirements of high quality incremental innovation the need for an effective external framework for substantive consensus-based decision-making and substantial power to autonomous skilled employees (loosely coupled work organisation) without exposing the company to hold-up situations. By contrast, the US/UK deregulated rules do not meet these requirements.

Education and training system: (1) Rules and understandings: (i) The US/UK system of post-compulsory education and training is substantially deregulated. It has increasingly provided a framework in which education providers at all levels (from top research university science departments downwards) can develop courses and research environments in response to market demand. It also provides a framework in which individuals can invest in general education and - with an important qualification - in marketable skills. The qualification is that, taken together with labour market rules, it does not facilitate marketable training which requires heavy investment from and/or close co-operation from and between companies, and/or heavy investment by individuals in skills which can only be used in limited sections of the labour market. Thus it does not provide a framework for e.g. developing engineers in deep industry-technology skills relating to a particular machinery industry, even less when that is coupled to a knowledge of the product range of a particular company; equally it does not facilitate the development of an apprenticeship system. We shall see why a deregulated ET and labour market system cannot operate in these ways when we look at the rules which enable the Germanic system to do so. (ii) The Germanic framework facilitates education and training of engineers, scientists, technicians and skilled manual employees in industry technologies that require co-operation from and between companies, universities and research institutes.

20 On the workings of the works councils see Streeck (1992; 1984), Thelen (1991), and Turner (1991). On industry wage determination see Soskice (1990).

Companies are prepared to invest resources in this training because the works council system and the wage determination system, backed up by unions and employer associations, make poaching relatively difficult. Companies are prepared to discuss future strategies and technological competence needs -despite their inside information content - because employer associations can in principle informally sanction misuse by other companies of such information, and because implicit understandings governing competition (see below) deter head-on competition between companies. Engineering and science students and apprentices are prepared to invest in narrow vocational skills because their professional associations and relevant unions are closely engaged in the development of curricula with employer associations, so as to ensure that these have long term viability. In addition, companies can offer implicit long-term contracts backed up directly by works councils and indirectly by the availability of long-term finance (see below).[21]

(2) Innovation Strategies: The Germanic rules provide a framework for solving the problems of individuals (as engineers, scientists, technicians and skilled manual employees) and companies investing in industry-technology skills in conjunction with company-specific knowledge; in addition it solves the problems of co-operation between companies needed for the development of training programmes. The US/UK framework does not do this. Thus again the German framework solves the problems associated with high-quality incremental innovation while the US/UK framework cannot.

Corporate governance: (1) Rules and understandings: (i) The US/UK system of corporate governance is one of dispersed shareholding. This permits and requires unilateral control and high-powered incentives for top management. It also makes high risk finance available, so long as risk assessment does not depend on inside information, (ii) The Germanic system makes available long-term finance via stable shareholding and with bank delegated monitoring. This permits inside information, consensus decision-making and lack of high-powered incentives within the company. But it requires that companies only engage in strategies which banks can monitor directly or indirectly. Banks do not have the expertise to evaluate advanced technologies themselves. They are prepared to monitor indirectly by consulting other companies and research institutes in related technological areas who have sufficient knowledge of the company in question, and where the degree of co-operation within an industry is sufficient to make truth-telling by potential competitors incentive-compatible.[22]

(2) Innovation strategies: High quality incremental innovation requires stable-shareholding arrangements (see last section). Since it also requires

21 For more details see Finegold and Soskice (1988) and Cave and Weale (1992) on the UK, and Soskice (1994a) on Germany.

22 The work of Vitols (1995a; 1995b; 1995c) should be consulted to get a fuller picture of comparative systems of corporate governance. Another useful source is Mayer and Alexander (1990).

co-operation with other companies this provides a basis for indirect monitoring. Hence the Germanic system allows these type of innovation strategies. The US/UK system of dispersed shareholding by contrast does not: this is because dispersed shareholders cannot evaluate effectively long-term embedded inside information; and because it is not possible to give the CEO unilateral control and related high-powered incentives.

Relations between companies: (1) Rules and Understandings: (i) The US/UK framework limits co-operation between companies via a strong competition policy. In addition there are limited governance structures available to resolve disputes between companies arising in the course of long-term relational contracts[23]. As far as standard-setting is concerned, there are no governance structures available to set standards on a consensus-basis, since this requires relatively powerful business associations. Hence standard-setting is determined by market competitions, (ii) The Germanic framework allows more co-operation between companies; indeed within sub-industries there are tacit sanctions against too intense competition. There are well-developed governance structures based on strong business associations available to resolve disputes between companies, and also to develop standard-setting on a consensual basis.[24]

(2) Innovation strategies: High quality incremental innovation strategies need the Germanic framework, and would not find it easy in the US/UK framework. This is because they require consensus-based standard-setting and an environment in which long-term co-operation through relational contracts are facilitated.

To conclude this section, it has be shown that the German national institutional framework can help substantially in solving the relational problems of high-quality incremental innovation, which the US/UK institutional framework cannot.

6. Appropriate Technology Policies in Germany and the US and UK.

In this concluding section it is suggested that German-type technology policy is particularly appropriate to the problems of high-quality incremental innovation;

23 I am indebted to Rohan Pitchford for pointing out to me Tirole's argument that companies can always set up legally-binding arbitration agreements in the event of disputes, even when the relational contract is not legally binding. This procedure is limited however to awarding damages on contract termination and not to the more usual problem in relational contracts of sorting out disputes within an ongoing relation.

24 Useful sources on Germany are Audretsch (1989), Lutz (1993), and Herrigel (1993).

and that the German institutional framework can solve the collective action problems which this type of technology policy (to be defined below) may generate.

German technology policy: What are the main problems confronting German companies when they innovate? The major technological-relational problem of high quality incremental innovation which companies cannot generally solve for themselves relates to the translation of basic scientific advances into a form suitable for the company's own process or product technology. Of particular importance and difficulty are the incorporation of radical innovations in newly emerging technologies.

There are two main reasons why this is a problem:

(a) The first reason relates to the way in which work needs to be organised in incremental innovation companies. These companies need to operate as loosely-coupled technology systems. This involves (see section 2) employees having considerable autonomy in developing individually and jointly work procedures and expertise. Thus a "package" or "plug-in" approach whereby newly-hired employees with particular "radical skills" can be inserted into the company; or whereby companies with no existing relationship can bring "radical competences" into the company; or more generally where packaged new advanced technology components or processes are purchased by the company and plugged in: such an approach is generally unfeasible because there is seldom a standard interface into which they can be plugged. In loosely-coupled companies, standards for the introduction of new technology can only evolve through a process of consensus formation. This is necessary to ensure the new technology (or competences, components, etc.) can be used through the company with minimum devaluation of existing competences.

(b) The second reason relates to *incentives* to combine radical with existing competences or patterns of organisation. This is the general form of the Kern problem (see section 3). The problem is this: The integration of radical with existing competences cannot generally be achieved in an "off-the -peg" contractible manner. Therefore an implicit contract is required. But the engineer or company holding the "radical" competence has a different incentive structure to the engineer in the incremental innovation company and the company itself. This is because the "radical" engineer/company has no prior relation with the incremental innovation company, and therefore has no specific asset invested in the relationship; and in addition the radical engineer/company is unlikely to have a further relationship in the future. Hence the incremental innovation company will find it difficult to develop an implicit contract.

How does German technology policy solve these problems? There are three inter-related elements in the solution. The first element concerns the

assessment of those new technology areas in which competences are needed: This includes both leading edge developments in established technologies and newly emergent technologies. The second element is the building of (what we might call) *incentive-aligned competences,* i.e. German companies, engineers, research institutes etc., which have developed competences in the new technology areas and with which companies can make "safe" implicit contracts concerning the introduction of new technologies. The third concerns the building of *interface standards:* How can these developments be integrated into existing production and new product technologies?

(i) *Assessment:* The assessment process takes place within major standing committees which link university departments and research institutes with business associations and large companies. One of the most important of these committees, the Scientific Corporation for Production Technology[25], includes the key chair holders in different German technical universities and representatives of the relevant Fraunhofer Institutes[26] covering different aspects of production technology. This same committee also meets as a subcommittee of the Machine Tool Industry Association (VDMA), on which in addition sit leading company representatives.

Research in the technical universities is both basic and applied research at the leading edge of established technologies; the applied research can include the integration of innovations in newly emergent technologies. The incentive for professors to act broadly in the interests of companies is that professors get partial research funding and consultancies from large companies and these same companies offer top-level careers and doctoral research help to their doctoral students; but this is contingent on their research being relevant and important to these companies. Given that the relations between companies and professors is a long-term one, the incentives of professors are substantially aligned with the long-term interests of companies.

What is the incentive for companies to reveal truthfully enough of their long-term plans and their own in-house research to enable effective aggregate assessments to be made by the committee? There are three separate issues here; they are each of importance for questions of technology policy:

First, companies might be nervous of revealing future strategies, especially in relation to products or models, because of the fear that another company in the industry might profit competitively from them. As we have seen in sections 4 and 5, the Germanic institutional framework makes this less

25 The details of the Wissenschaftliche Gesellschaft für Produktionstechnik come from Lutz (1993). Her book on German technology policy, which has strongly influenced this paper, is the most analytic and practical account available. It is unfortunately not yet translated into English.

26 The Fraunhofer Institutes are industrial research organisations financed partly by government and partly by contract research.

problematic than in the US/UK framework. There is some pressure on companies not to compete head-on against each other, but instead to concentrate on market niches.

Second, companies might be nervous - as most companies are - of allowing the government to know what it was doing. It might fear that this would give the government the capacity to engage in company-specific measures. The government is however kept at arms length from individual companies throughout this assessment process - it accepts the assessment of business associations and the WPG concerning the needs of companies.

Third, companies might have an incentive to say they needed subsidies for research which they would have undertaken themselves in the absence of a subsidy. In so far as this is a collective action problem across companies, this is less likely to arise in the Germanic framework than in the US/UK framework because there is considerable knowledge across companies of each other's competences and technological situation; thus some degree of peer-monitoring can take place. A whole sector of companies (say a sub-industry) is not likely to have a collective incentive to dissimulate: This is because few companies have the ability or incentive to undertake leading edge basic research themselves, and because such research is usually necessary for the dynamic competitive capacity of these of high quality incremental innovation industries.

(ii) *Incentive-aligned competences:* Given the identification of the new technology areas, the building up of competences takes place jointly within networks of: the relevant technical university departments (or institutes in them), the relevant Fraunhofer institutes, other industry related research institutes, and critically in the research departments of companies. Typically within any new technology program there are a series of joint research projects, in order to develop a range of competences. The resources for the program come primarily from the federal government, but they are dispensed via the business associations and research institutes with limited government involvement.

Company involvement is of course voluntary. It is important to ensure that competences are initially built up in companies with the existing research capacity to participate effectively, and also that they have strong potential market links to other companies who might need these competences. To help ensure these conditions, companies are usually required to meet 50% of the expenses of the research themselves.

This process builds up a cluster of competences within German industry and the German research community. This helps to solve problem (b) above. That is to say, because these companies have similar incentive structures to potential client companies (our incremental innovators) it is easier for the

latter to engage safely in implicit contracts with them; and this is reinforced by the availability of business association informal mediation in the event of difficulties.

(iii) *Interface standards:* Now return to problem (a) above. Companies with loosely-coupled work organisation typically develop many home grown routines and practices in their product and process technologies. This is also true of the work organisation of long-standing relations between companies. Therefore the introduction of new technology, if it is to reach effectively through the industrial sector, must be based on the widespread acceptance of the relevant interface standards. Standard-setting cannot however be either the result of market competition, as in the US/UK framework, or imposed by the large companies and/or the research community (as in the French framework): such imposed standard-setting would make it very difficult for companies with loosely-coupled work organisation. Such companies need to be able to participate in the evolution of standards. The Germanic institutional framework allows this: Standards are set on a consensus basis. Of course, this takes time and a great deal of negotiation. But it permits - once common standards for a new technology have been developed - the relatively rapid diffusion of the technology.

Newly emergent technologies and the limitations of German technology policy: German technology policy does not aim to encourage radical innovation in newly emergent technologies. What it is (partially) concerned to do is take the results of such radical innovation and package them in ways which enable them to be absorbed by German companies, thus resolving the problems (a) and (b) above. This almost inevitably implies a time-lag between innovations in newly emergent technologies and their incorporation in the German industrial system. Neither the ablest professors and researchers, nor their best students, have a real incentive to develop an expertise in new developments which may not prove of lasting value to the large research-oriented companies which provide them with research resources and potential careers. Only when newly emergent technologies have become clearly enough of relevance - when a considerable degree of uncertainty has disappeared - does it make sense for these scientists to work seriously on them.

There is no need to see this in general as a weakness of the German system. German companies are often leaders in their export markets, and incremental innovation competitors face similar difficulties. However, there is a potential problem in some cases. Quicker incorporation may be required where German companies face differently organised competitors, who may be able to adjust faster than they can. German chemical and in particular pharmaceutical companies compete with American and British companies who can arguably absorb the results of biogenetic innovations more rapidly.

The response of the large German chemical companies, as was mentioned in the introductory section, has been to buy American biotech companies. A similar response in a completely different sector has been that of German banks, who have been unable to provide a sufficiently rapid incorporation of a range of new innovative international services: to set up substantially autonomous British subsidiaries. In both cases, use has been made of the much more deregulated US/UK institutional framework to encourage more radical innovation.

It is however quite unclear why this locational response, on its own, should work - at least not if the German companies believe it can solve the problem of incorporating radical innovations from the US or UK into their incremental innovation companies in Germany. For the fundamental problem of incentives is not one that can be solved by common ownership. The basic locational advantage of tapping into American biotechnology is that career incentives of scientists there are quite different from those in Germany. But that hinders attempts to develop smooth transfer mechanisms between the American and the German parts of the company. (Similarly with banking: The incentives for British specialists is to command high earnings in the market; part of that is to be able to take clients away in the case of moving to another bank. When German bankers understand these incentives they are going to be less keen on using their British subsidiary to help their own clients.) Whether German multinationals can evolve effective organisational incentive structures to remedy these problems will be a major question for the future.

Bibliography

Aghion, P. and J. Tirole 1994: Formal and Real Authority in Organizations, mimeo. Nuffield College, Oxford, and IDEI, Toulouse.

Allen, Franklin 1993: 'Stock Markets and Resource Allocation' in *Capital Markets and Financial Intermediation,* edited by C. a. X. V. Mayer. Cambridge: Cambridge University Press.

Aoki, Masahiko 1994: The Japanese Firm as a System of Attributes: A Survey and Research Agenda', in *The Japanese Firm: Sources of Competitive Strength,* edited by M. Aoki and R. Dore. Oxford: Clarendon Press.

Audretsch, David 1989: 'Legalized Cartels in West Germany', *Antitrust Bulletin 34 (Fall): 579-600.*

Cave, Martin and Martin Weale 1992: 'Higher Education: Expansion and Reform', *Oxford Review of Economic Policy* 8 (2).

Diamond, D 1984: 'Financial Intermediation and Delegated Monitoring', *Review of Economic Studies* 51:393-414.

Finegold, D. and D. Soskice 1988: 'Britain's Failure to Train: Explanations and Possible Strategies', *Oxford Review of Economic Policy 4* (November).

Hall, Peter 1986: *Governing the Economy: The Politics of State Intervention in Britain and France.* Cambridge, Mass.: Polity Press.

Herrigel, Gary 1993: 'Large Firms, Small Firms and the Governance of Flexible Specialization: the Case of Baden-Württemberg and Socialized Risk' in *Country Competiveness: Technology and the Organizing of Work,* edited by B. Kogut. New York, Oxford: Oxford University Press.

Katzenstein, Peter J. 1985: *Small States in World Markets.* Ithaca: Cornell University Press.

Kitschelt, Herbert 1991: 'Industrial Governance, Innovation Strategies, and the Case of Japan: Sectoral or Cross-national Analysis?', *International Organisation.*

Lutz, Suzanne 1993: *Die Steuerung industrieller Forschungskooperation.* Frankfurt/Main: Campus.

Matraves, Catherine 1996: German Industrial Structure in Comparative Perspective, *Journal of Industry Studies,* this issue

Maurice, Marc, Francois Sellier, and Jean-Jacques Silvestre 1986: *The Social Foundations of Industrial Power.* Cambridge: MIT Press.

Mayer, Colin, and Ian Alexander 1990: 'Banks and Securities Markets: Corporate Financing in Germany and the UK', Centre for Economic Policy Research, LSE, Discussion Paper No. 433.

Milgrom, Paul, and John Roberts 1992: *Economics, Organization and Management.* Eaglewood Cliffs, N.J.: Prentice-Hall International.

Perrow, Charles 1984: *Normal Catastrophes.* New York: Basic Books.

Perrow, Charles 1986: *Complex Organisations: A Critical Essay.* New York: Random House.

Porter, M.E. 1990: *The Competitive Advantage of Nations.* London: MacMillan.

Schleifer, A. and L. Summers 1988: 'Breach of Trust in Hostile Takeovers', in *Mergers and Acquisitions,* edited by A. Auerbach. Chicago: Chicago University Press, NBER series.

Sorge, Arndt, and Malcolm Warner 1987: *Comparative Factory Organisation: An Anglo-German Comparison of Manpower in Manufacturing.* Aldershot, UK: Gower.

Soskice, David 1994a: The German Training System: Reconciling Markets and Institutions', in *International Comparisons of Private Sector Training,* edited by L. Lynch. Chicago: University of Chicago Press.

Soskice, David 1990: 'Wage Determination: the Changing Role of Institutions in Advanced Industrialised Countries', *Oxford Review of Economic Policy* 6 (4): 1-23.

Soskice, David 1994b 'Innovation Strategies of Companies: A Comparative Institutional Analysis of some Cross-Country Differences', in *Institutionenvergleich und Institutionendynamik. WZB Jahrbuch 1994,* edited by W. a. M. D. Zapf. Berlin: Sigma.

Streeck, Wolfgang 1984: *Industrial Relations in West Germany: A Case Study of the Car Industry.* London: Heinemann.

Streeck, Wolfgang 1991: 'On the Institutional Conditions of Diversified Quality Production', in *The Socio-Economics of Production and Employment,* edited by E. Matzner and W. Streeck. London: Edward Elgar.

Streeck, Wolfgang 1992: *Social Institutions and Economic Performance: Studies of Industrial Relations in Advanced Industrialized Countries.* London and Beverly Hills: Sage.

Teece, David 1986: 'Profiting from Technological Innovation: Implications for Interaction, Collaborative Licensing and Public Policy', *Research Policy* 16 (6):285-305.

Thelen, Kathleen 1991: *Union of Parts.* Ithaca: Cornell University Press.

Turner, Lowell 1991: *Democracy at Work: Changing World Markets and the Future of Labor Unions.* Ithaca: Cornell University Press.

Vitols, Sigurt 1995a: Corporate Governance versus Economic Governance: Banks and Industrial Restructuring in the US and Germany. Berlin: Wissenschaftszentrum Berlin Discussion Paper FS I 95-310.

Vitols, Sigurt 1995b: Financial Systems and Industrial Policy in Germany and Great Britain: The Limits of Convergence. Wissenschaftszentrum Berlin discussion paper FS I 95-311.

Vitols, Sigurt 1995c: German Banks and the Modernization of the Small Firm Sector: Long-term Finance in Comparative Perspective. Wissenschaftszentrum Berlin Discussion Paper FS I 95-309.

Williamson, Oliver 1985: *Institutions of Capitalism.* New York: Free Press.

Zysman, John 1983: *Governments, Markets and Growth: Financial Systems and the Politics of Industrial Change.* Ithaca: Cornell University Press.