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Crouch (ed.): *Challenges to European Economic Governance*

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EUROPEAN UNIVERSITY INSTITUTE, FLORENCE
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EUI Working Paper **SPS** No. 2002/13

**Challenges to European Economic Governance:
Responding to Change in the Machinery Industries**

edited by

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Preface

Colin Crouch

This four-nation study forms part of a larger project concerned with adaptations in local production systems in the largest western European countries (France, Germany, Italy, and the United Kingdom) in the wake of the restructuring crises of the 1990s. We are in particular concerned with the role of local concentrations of small and medium-sized enterprises (SMEs). That role has been ambiguous. On the one hand a growing body of literature had pointed to the competitive advantages of geographical clusters of SMEs within particular sectors, possessing it was believed superior flexibility and capacity for adjustment over large, Fordist corporations (e.g. Becattini 1979; Brusco 1982; Herrigel 1989; Maier 1989; Piore and Sabel 1984; Sabel et al 1989). These perceptions passed relatively rapidly to policy makers at national and in particular European Union level, who began to encourage such modes of industrial organization, especially to replace the terminally declining Fordist sectors to which they provided such an antithesis (Pyke and Sengenberger 1992).

On the other hand, greater international competitiveness for the European economies often also seemed to require a capacity to develop global corporations, the very opposite of geographical clusters of SMEs. Further, from the late 1980s on large corporations demonstrated that they were not trapped in the path-dependent logic of rigid gigantism as the academic literature had predicted. Not only did they down-size and de-layer, but they frequently showed a capacity to re-create some of the conditions of small-firm clusters within their own hierarchies. Finally, though not often clearly perceived by policy makers, local production systems usually depend on certain forms of local competition goods (LCCGs) to sustain both the individual firms and the cluster as such. Such a concept encounters some difficulty with the neo-liberal assumptions of most current economic policy, which stress the stripping down of collective facilities unless they can be provided within a pure market. A more sceptical literature developed (e.g. Amin and Thrift 1994; Braczyk, Schienstock, and Steffensen 1996; Grabher 1993; Harrison 1994a and b; Herrigel 1996b).

It is therefore timely to consider how these tensions are being resolved. We do this by considering the role played in the maintenance of local production systems by specific forms of governance - the state, formal and informal associations, corporate hierarchies, the market - and combinations of these. We hypothesize that it

is these patterns of governance which either sustain or fail to sustain the supply of competition goods on which clustered SMEs depend. In particular, what became of the local production systems which were the centre of attention of the initial, enthusiastic literature about industrial districts in central Italy, Baden-Württemberg and some other locations? The machinery industries were one such focus, and it is to these that we here devote attention. A second question concerns attempts by policy makers to encourage replacement of declining large-scale industries by firms from new, SME-dominated sectors; how successful have these been? A second part of the current project (not included here) addresses this question in relation to the steel industry. Third, beliefs that local production systems might indeed have a future were stimulated during the 1990s by awareness that many of the high-tech industries that were becoming the focus of new economic growth showed tendencies to form SME clusters resembling 'traditional' sectors like machinery, or even clothing and textiles (Swann, Prevezer, and Stout 1998). In a final part of the project we shall consider the viability of these claims.

Finally, taken together the results of this research enable us to consider whether the previously very divergent patterns of economic governance found in the four countries are undergoing any convergence, whether as a result of generally globalizing pressures or within a more particular process of Europeanization.

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1. Introduction: The European Machinery Industry under Pressure

Colin Crouch

Machinery-producing industries occupied an important place in the literature on local production systems which developed during the 1980s. Innovative final goods industries usually required frequent changes in the tools and machinery they used. Firms in both the machinery industries and their final goods customers would gain if they had access to tacit knowledge and rapid informal communications to improve speed and accuracy of the response of the former to the needs of the latter. There was therefore an observed tendency for firms in machinery industries to be located geographically close to their customers. For examples, firms making machine tools for the motor industry would cluster around motor-manufacturing corporations. While some machinery firms were themselves large, these were also sectors where adaptable, flexible small firms could thrive according to the model of flexible specialization. As a result industrial districts, or at least local clusters, of SMEs in associated machinery industries would develop around either large individual customer firms or industrial districts of final goods producers. These machinery districts would in turn either produce or benefit from further LCCGs as a result of their own mutual proximity.

Machinery firms within clusters therefore had a double advantage over similar firms in isolated locations. First, their proximity to the customer industry brought the competition good of ease of knowledge transfer and responsiveness to the customer's changing needs. Second, the cluster of machinery firms produced aggregations of services relevant to their own work.

These industries featured prominently in the two European regions which produced much of the 1980s literature on flexible specialization and local clusters: the area in and around Stuttgart in Baden-Württemberg; and Emilia Romagna, one of the main Italian regions which produced the original concept of industrial districts. Important in the former was the machine-tool industry supplying the motor industry and some other branches of engineering (Herrigel 1989; Cook and Morgan 1990; Maier 1989; Sabel et al 1989; Semlinger 1993); and among several districts in the second was the packaging machinery industry in and around Bologna and Modena (Bianchi and Gualteri 1990; Brusco 1982; 1992; Capecchi 1997; Curti 1994; Curti and Grandi 1997; Piore and Sabel 1984). In both cases the sources of

LCCGs were identified as the sharing of facilities and expertise rendered possible by relations of high trust, themselves developing from the strength of the embeddedness of the industry concerned within the local community and its institutions. These two sectors were economically successful, and the machinery industries in Germany and Italy in general thrived, certainly in comparison with their equivalents in France and the United Kingdom. These latter two countries were normally considered to lack industrial districts and LCCGs (for the UK see Zeitlin 1995). All this seemed consistent with 1980s theories of local economies.

Then came the European recession of the 1990s, and hard on its heels a change in the academic analysis of these industries. Most of the German machinery industries went into steep decline, the country's share of global exports in the sector dropping from 22.6% in 1992 to 17.7% in 1993, before recovering a little in 1998 (UN: various years). Academic observers began to speak of a crisis of local production systems, especially in Germany (Braczyk, Schienstock, and Steffensen 1996; Cooke and Morgan 1994; Heidenreich 1996; Heidenreich and Kraus 1998; Kerst and Steffensen 1995). Some authors discovered the disadvantages of local embeddedness, the excessive specialization and local rootedness of German local production systems. Initially this referred more to the heavily locally integrated system of Nord-Rhein Westfalen than to Baden-Württemberg (Grabher 1993), the latter being seen as having retained a capacity for adaptation and innovation outside its core activities (Herrigel 1993); but see Herrigel 1996b for a slightly later and more pessimistic view of the south-western *Land*. At the same time other, or overlapping, groups of observers saw the inevitable advantages of giant global firms over small and medium-sized enterprises (Heidenreich 1996), and anticipated the demise of the SME cluster model in Italy and elsewhere (Harrison 1994b).

How does the situation look now, at the start of a third decade? What proved more accurate: original assessments of the advantages of SME clusters and flexible specialization, or the later predictions - often by the same authors - of the obsolescence and growing rigidity of the model? Or can one distinguish between forms of local rootedness that produced lock-in, and others which left scope for or even encouraged diversification? And was decline specific to 'locked in' machinery industries? If revisionist theories of the negative consequences of embeddedness and the new advantages of scale were accurate, then the German and especially Italian machinery industries should have fared worse than the French or British ones. Alternatively, embeddedness might have led Stuttgart, Bologna and Modena to

remain trapped, though flourishing, within a dying industry, while less rooted environments made possible escape from machinery into new activities. According to this possibility, small-firm machinery sectors might be expected to decline more comprehensively in the relevant regions of Britain and France than in Baden-Württemberg or Emilia-Romagna, but would be replaced by employment in more dynamic sectors.

This gives us an initial concern with cross-country comparisons, as our chosen countries seem to give us two previous cases of strong machinery industries within strong local production systems, and two cases of weak industries within weak local systems.

In looking at the cases in this way, we must first bear in mind that in previous work (Crouch et al 2001) we have challenged some of the findings of the initial flexible specialization literature as it related to Germany. We did not find either that Baden-Württemberg constituted such a distinctive economy within the overall German context, nor, more significantly, that German LCCGs depended for their production on inter-firm networks, whether of the informal kind hypothesized for Italy or of the more formal associational kind usually seen as effective in Germany itself (Glassmann and Voelzkow 2001). German production clusters seemed to depend more on access to specialized, publicly provided facilities than on any sharing and trust among producers. And the firms taking advantage of such facilities were not necessarily small, though they often took the form of large customer firms and circles of suppliers, many of the latter being SMEs. Our findings for large parts of Italy did not contradict the early literature so strongly, provided this accepted the role of local political and governmental institutions in the provision of LCCGs - and also the growing role of large customer firms - and not just inter-SME relations (Burroni and Trigilia 2001).

Our study of the UK was also consistent with the existing emphasis of the literature: 'Why are there no industrial districts in Britain?' (Zeitlin 1995), though there were strong indications of at least empirical clustering in some sectors in that country, including both traditional and high-tech goods, as well as the machinery industries of the West Midlands (Crouch and Farrell 2001). France, again following the expectations of the literature, was also a weak case for small-firm clusters, but (as the literature would lead us to expect) for partly different reasons than in the UK (Aniello and Le Galès 2001). In the former country economic governance was provided by a certain mix of state and market institutions; in France it was the state.

Whereas the machinery industries had once been strong in the UK, they had always been weak in France; never included among the state's strategic sectors, they were left to develop according to the market. Meanwhile, in both France and the UK the exceptional status of the national capital cities seemed to have negative consequences for the maintenance of dynamic SME sectors in other parts of the country.

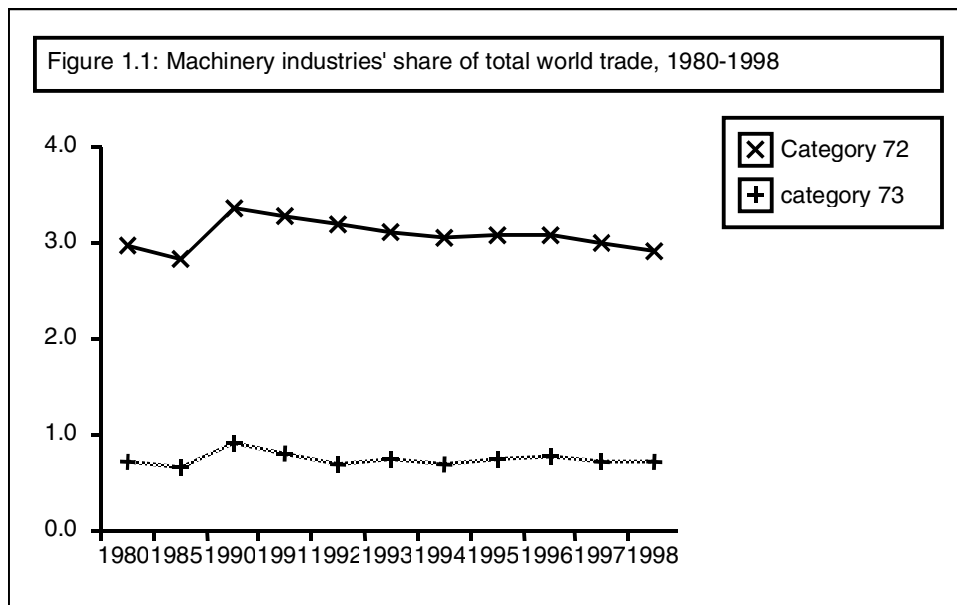
But we are not solely interested in inter-country comparisons. In fact, the knowledge gained from these comparisons is mainly important for what it can tell us about a more general question. As the machinery industries tried to come to terms with the crises of the early 1990s, did they do this by enhancing or by dumping local production systems? Was an emergence of large firms necessary to save the sector, or did SMEs provide a better degree of flexibility? Could the sector be saved at all within these economies, or was the only viable solution an exit into other activities? And, finally, can we identify a specifically European approach to the resolution of these problems, or did nation-state differences remain paramount? The four case studies which follow try to address these questions.

Machinery industries in the 1990s

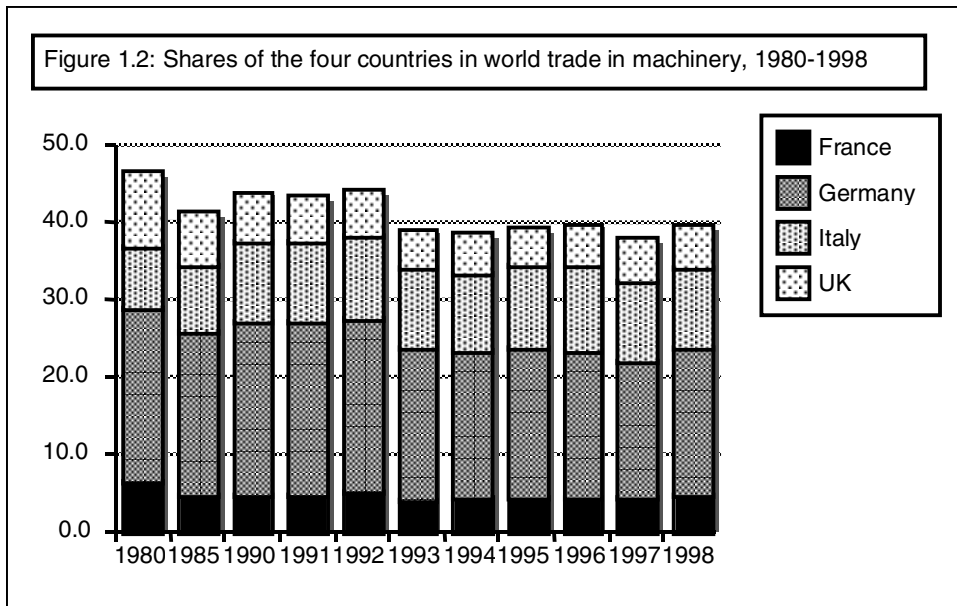
The machinery sector is concentrated in two two-digit categories of the International Standard Industrial Classification: 72, Machinery for Special Industries; and 73 Metal-working Machinery. Machine tools, a sub-sector of particular interest in the literature on flexible specialization, are found within sub-categories of each of these: 7281: Machine Tools for Special Industries; and 736: Metal-working Machine Tools. This latter comprises the bulk of category 73 and the majority of machine tools production.

As can be seen from Figure 1.1, world-wide category 72 suffered a 12% decline as a proportion of total world trade during the 1990s, falling steadily from 3.3% to 2.9%. It should not however be seen as a secularly declining industry, as in 1980 it had also represented only 3.0% of total world trade. The much smaller category 73 remained constant at around 0.7% throughout the period. The share of global production taken by our four countries together in category 72 dropped gradually from 45.7% in 1980 to 38.9% in 1997, before picking up in 1998. The fall in the smaller metal-working machinery sector (73) was steeper, from 50.1% in 1980 to 34.1% in 1997, again picking up slightly in 1998. Since these two decades saw the arrival of a number of new major producing countries and the general process of economic

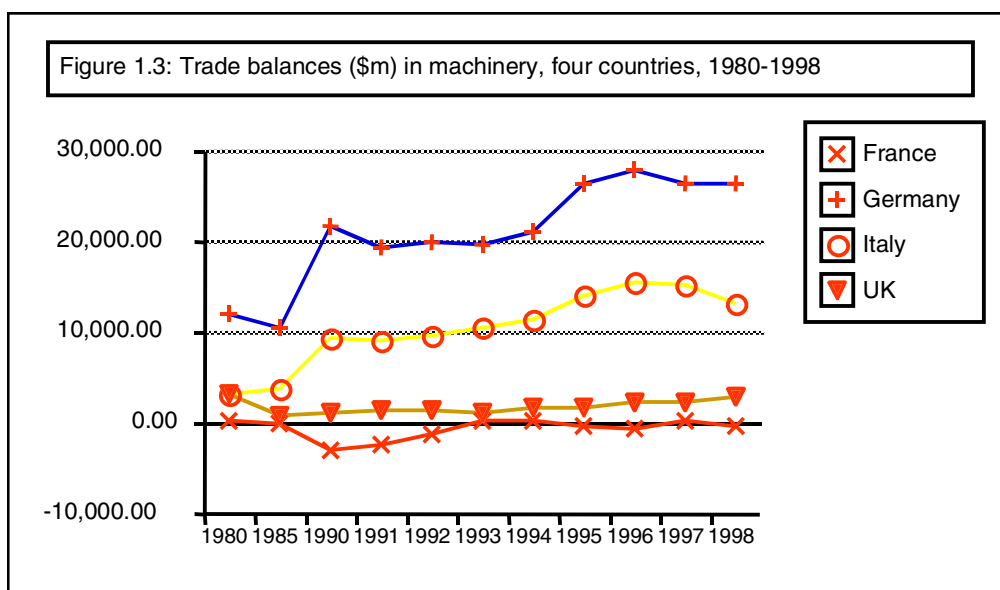
globalization, it might be considered that the main western European producers had successfully maintained their presence in these sectors. However, distribution among the countries is very uneven. Germany normally takes up almost half the share of the four countries in the two industries combined, and Italy a further quarter, leaving the UK with between 12 and 14%, and France with between 10 and 12% (Figure 1.2).



Shares of world trade provide a useful indicator for assessing the strength of an industry within a country. An important argument of authors critical of local production systems is that these bind together the industries of a region in a way that eventually becomes uncompetitive, because they have no incentive to respond to exogenous change. For example, Grabher (1993) attributes the decline of the industries of the Ruhr to the virtually perfect inter-dependence of supplier and customer industries and the economic policies of the *Land* government of Nord-Rhein Westfalen. While the final producers in the Ruhr system sold their products on world markets, it would seem to follow from Grabher's argument that supplier firms were tied overwhelmingly to their local customers and did not participate in export activity themselves. Industries with high rates of export participation should escape this trap.



In addition to Figure 1.2, showing trends in export performance, Figure 1.3 shows trends in our countries' trade balances in these industries. The most outstanding performances were among Italian firms, which defied the overall trend for European producers to take a declining share of world trade in machinery, maintaining and even strengthening their international position, until a decline in the final year of the series. Rising from 8% of world trade at the start of the 1980s, during the 1990s Italy's share ranged between 10.2% and 10.5%. The country also sustained constant very positive trade balances in both industries.



Interpretation of German data between the 1980s and 1990s is made difficult by unification of the eastern and western republics in 1991, and the absence of reliable data on East Germany before that time. We have little alternative but to assume that the eastern *Länder* made a zero contribution to exports during the 1980s, but to do this probably exaggerates 1990s performance in relation to that of the 1980s for all Germany. However, even this shows some decline in German performance after 1994. But it is a decline from a very strong position, the country still accounting for over a fifth of world trade in both industries. Both also continue to sustain very positive trade balances.

The British machinery industries were in gradual decline from an already small share of world trade throughout the 1980s and until 1993, when they reached about half of their 1980 level. Since then they have staged a small recovery. The country has maintained a surplus in the special machinery sector, though this had become weak by the mid-1980s. Metal-working machinery moved into deficit by the mid-1980s, worked itself back into a small surplus by 1993, but has since slightly declined again.

The French industry, which had a slightly smaller international prominence than the British up to the 1980s, went into considerable decline in the first part of that decade, and continued to move downwards until 1993, since when it has moved back to the 1985 level. The special machinery industry moved into deficit at the start of the 1990s, but has since hovered around balance. Metal-working machinery has however continued to be a deficit sector.

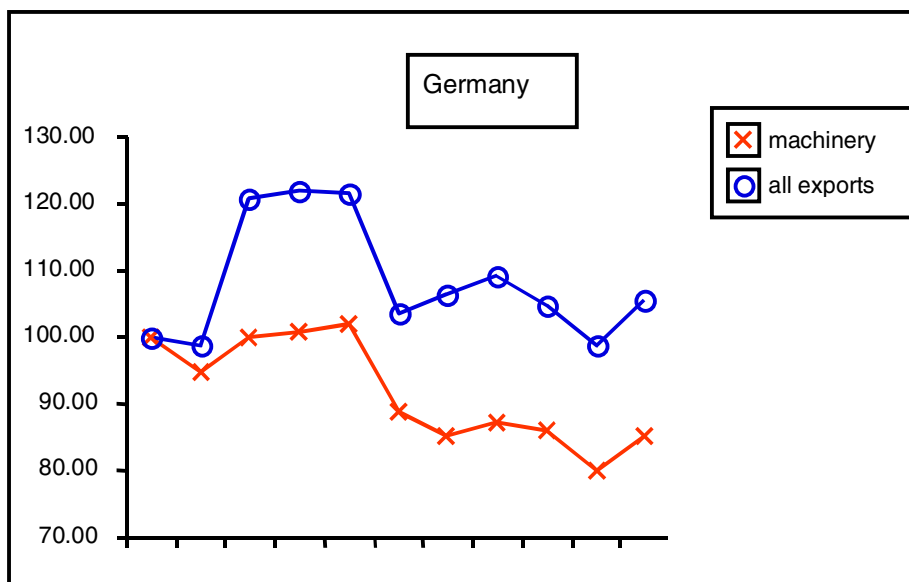
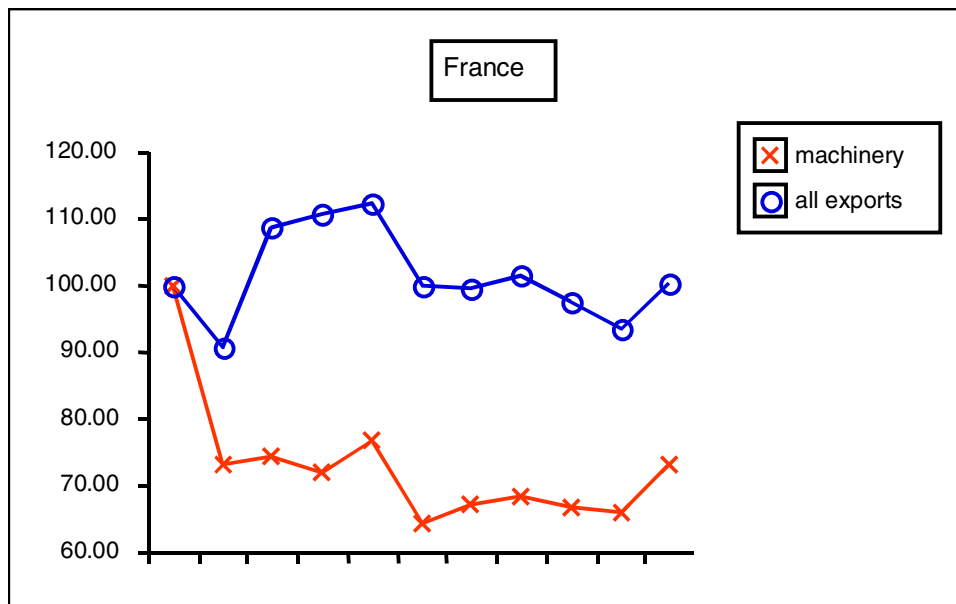
These overall national records are consistent with the hypothesis that local production systems bring competitive advantages, and are not consistent with that which would expect lock-in effects of such systems to weaken international performance. The Italian industries performed best of all, followed by the German. The least locally embedded case, the French one, had the worst performance. However, after the early 1990s the German industries suffered consistent decline while the UK experienced some recovery. Is this evidence that the thesis of the disadvantages of 'lock-in' in local systems is finally being demonstrated? But this thesis would predict a steeper decline in the Italian than in the German case, since it is Italy which historically displayed a full industrial district model, and yet the Italian industry has done considerably better than both the German and the British cases. It is also notable that the German industry experienced an improving trade

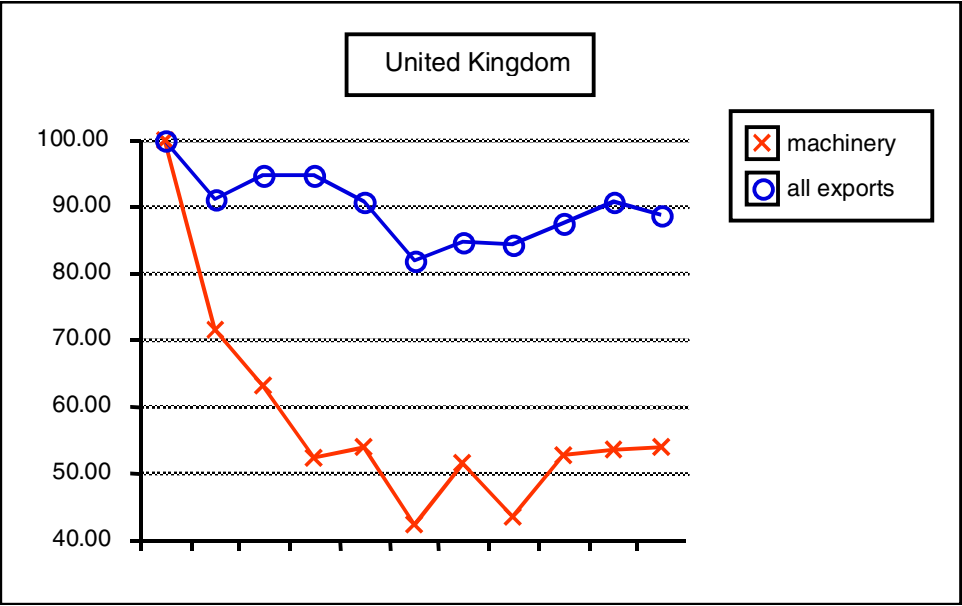
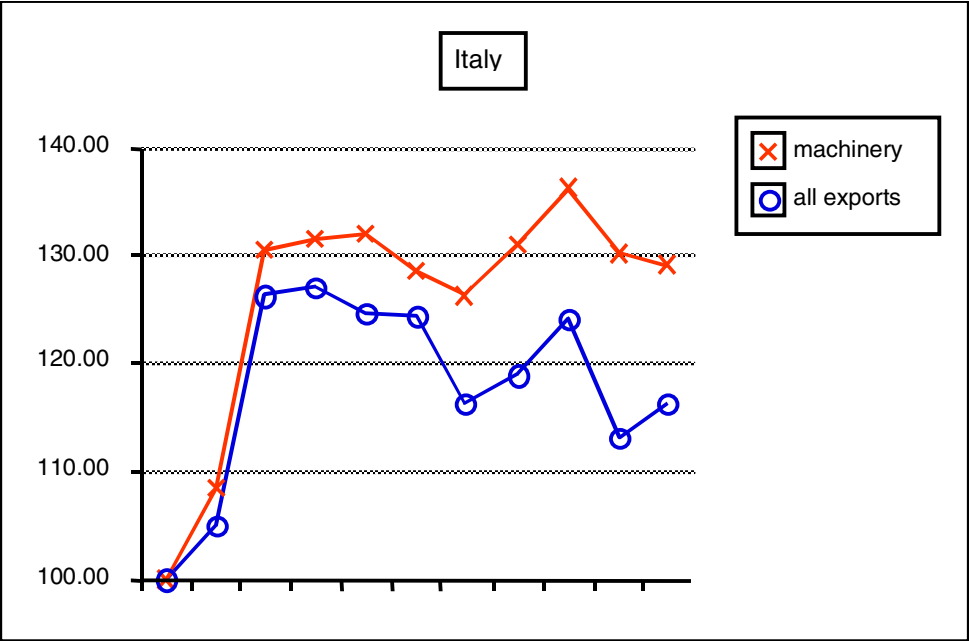
balance in these industries throughout the period, suggesting that there was no loss of overall competitiveness of German products.

It is important to bear in mind the major exogenous shocks which affected the four countries asymmetrically during the 1990s. Germany experienced a major blow to its competitiveness when the Deutsche Mark rose in value as a hedge currency following the collapse of the European Monetary System in 1992; an initial boost to, and then a major drag on, performance following first the euphoria of unification and then its costs. In common with France and Italy it then underwent the constraints of preparation for entry into the Single European Currency until January 1999, which had serious deflationary consequences for all sectors. Since then all three countries enjoyed gains in competitiveness consequent on the low international exchange value of the euro in its early career. Italy had an opposite experience to Germany following collapse of the ERM, achieving a competitive boost from devaluation after it was forced to leave the mechanism; it obviously did not have the German unification experience; but it then had a similar record to Germany in preparation for and subsequent movement of the single currency. France's experience was similar to that of Italy, but without a competitive gain following the ERM collapse. The UK shared this last with Italy, but then went a different way from the other economies as the country did not join the single currency. It was therefore not vulnerable to the recessionary policies of achieving the membership criteria, but by 1998 was beginning to suffer from the high level of sterling in the foreign exchanges.

It is difficult to disentangle anything specific relating to the machinery industries from these major macroeconomic disturbances. One way to approach the question is to examine how these industries fared in a particular country compared with the country's overall trade performance. The thesis that local production systems are advantageous for machinery industries leads us to predict that these industries will perform better than the national average in Italy and, to a lesser extent, in Germany. French machinery industries should perform least well in relation to overall national performance. Figure 1.4 shows changes in the export performance of the machinery industries and of all industries since 1980. Italy was the only country where the machinery sector out-performed the whole economy, with an increasing gap in more recent years. Of the other three cases the German machinery industries under-performed less than in France and the UK. However,

Figure 1.4: Machinery exports and all exports, 1980-1998, four countries, 1980 = 100





the worst relative performer was the UK rather than France. Overall the evidence is consistent with the thesis of the *advantages* of local production systems. Germany and Italy remain considerably stronger relative performers to France and the UK in the 'embedded' machinery and machine-tools industries, with Italian experience out-ranking that of Germany.

The case studies

To learn more we need to shift to a micro-level analysis, where we can consider directly processes of adjustment and adaptation, and the role of LCCGs within them. To study these it is more useful to consider cases in detail, not necessarily relating them to cross-national comparison. For example, assume that we learn that British machinery firms make use of associations when they need technical advice. This can be used to adjust stereotypes of collective goods provision in the British case. But it can also contribute to knowledge of the kinds of resources firms use to make adjustments which, if put together with similar recourse to associations in other countries, will suggest a significance of associations regardless of cross-national comparisons. Our case studies are therefore presented, not so much as international comparisons, but as four examples of adjustment to crisis within a sector where it is known that in the past LCCGs have been important in the maintenance of clusters of dynamic SMEs.

Three of our cases concern the machine-tool industry. One is located in the area around Stuttgart in Baden-Württemberg which has featured in much of the literature about embeddedness. Both the industry and the region experienced both the heights of German economic success during the late 1980s and early 1990s, and much of the subsequent crisis and decline.

The machine-tool industry in and around Birmingham and Coventry in the English West Midlands is also an historically important area for the sector, and experienced a major boom in the 1950s and 1960s alongside the growth of the motor industry. The sector is certainly highly concentrated geographically. From the outset therefore it does not fit the stereotype of the British economy as lacking in clusters. The question then arises of what, in this case, maintained the cluster? What is its internal governance structure? What are its LCCGs? And what role do these play in the story of the industry's decline and subsequent partial recovery?

The French machine-tool industry shows far fewer signs of clustering than the other cases. It is dominated by large firms, and the sector, never strong, is the

smallest of the four countries under consideration. This chapter necessarily operates at more of a national level than the others. What collective goods are available to firms in such a case? Does centralized state provision substitute for more local sources of collective competition goods? Given what we now know of the German system, the comparison between these two countries becomes one of the locus of delivery of state-provided resources.

Italy is a strong performer in machine tools, though not as impressively as in various kinds of machinery for special industries. The Italian machine-tool industry is concentrated in Lombardy, which earlier writing on local production systems had tended to ignore. The Italian north-west was stereotyped as Fordist, and it is only in recent years that researchers became aware that this was not the full story (Burrioni and Trigilia 2001). The paradigm case of the early literature, paralleling Baden-Württemberg, was always Emilia-Romagna. This lacks a machine-tool industry of any importance, but does have important examples of clusters in other kinds of machinery for special industries. Since our starting point is this region rather than a particular sub-sector, we therefore take an example of one of these: the packaging machinery industry around Modena and Bologna. This inhibits any very detailed comparisons with the other cases, but cross-national comparison it is not the main aim here. All these industries suffered shocks in the course of the 1990s. To the extent that they either managed these shocks or succumbed to them, was the presence or absence of local production systems helpful, irrelevant or harmful to the outcome? And in what ways, if any, did local systems for the delivery of LCCGs change in the process?

2. Collective Goods in the Local Economy: The Packaging Machinery Cluster in Bologna

Henry Farrell and Ann-Louise Lauridsen

The debate about the industrial districts of central and north-eastern Italy has evolved over the last 25 years. Initially, many saw them as evidence that small firms could prosper contrary to the arguments of the proponents of big industry. Debate focussed on whether small firm industrial districts had a genuine independent existence, or were the contingent result of large firms' outsourcing strategies (Brusco 1990, Bagnasco 1977; 1978). This spurred discussion about the role of local and regional government and political parties – small firm success might need services from government, associations, or local networks (Brusco 1982; Trigilia 1986). The difficulties that many industrial districts experienced in the late 1980s and early 1990s, together with the greater flexibility of large firms, led to a second wave of research, which asked whether industrial districts had long term prospects (Harrison 1994a; Trigilia 1992; Bellandi 1996; Cooke and Morgan 1994). The most recent literature examines the responses of industrial districts to these challenges; it is clear that many industrial districts have adapted successfully to changing market conditions, but only to the extent that they have changed their modes of internal organization, and their relationship with the outside world (Amin 1998; Bellandi 1996; Dei Ottati 1996a;1996b; Burroni and Trigilia 2001).

While these debates have generated important findings, much basic conceptual work remains unfinished. There is still no real consensus about what forces drive evolution in industrial districts and lead to their success or failure. Some scholars focus on the role of local government and associations in providing 'real services' to small firms in industrial districts (Brusco 1992), whereas others focus more on cooperation or collaboration between the firms themselves (Piore and Sabel 1984). The literature is split between those who are more interested in policy, and those who are concerned with small firm interaction. While some authors seek to examine both, they have had difficulty in creating a single analytical framework. Further, the division between the two has been intellectually unhelpful in discussions of the regional economy of Emilia-Romagna.

In this chapter we argue that the source of the success and failure of industrial districts is local collective competition goods (LCCGs) (Crouch et al. 2001). The collective competition good perspective allows us to focus more directly on the factors underlying firm success; small firms are unlikely to succeed on international markets if they do not have access to outside resources. By employing this perspective, we can understand how both cooperation between firms themselves, and government assistance, may be important to districts. More pertinently, we may characterize districts with reference to the varieties of governance through which these goods are provided, and the different institutional forms associated with these forms of governance. Finally, and perhaps most importantly, we can better understand the *dynamics* of industrial districts. As authors such as Becattini have usefully emphasized, industrial districts are works in progress – they have succeeded exactly insofar as they have been able to change appropriately in response to new challenges. These responses are largely dictated by the particular mix of governance modes found in a given industrial district. But, as Le Galès and Voelzkow (2001) have observed, governance in a specific situation is not simply a functional response to collective needs; it may be the result of political struggles between actors with differing objectives and interests (Knight 1992; Locke 1995). Thus, even though LCCGs are vital to the success of local economies, their provision may be shaped by particular interest as well as collective need. The individual and collective interests of actors, and power relations between them, may change over time; and these changes will themselves lead to shifts in the mix of modes of governance, which in turn will affect the amounts, and sorts, of LCCGs which are produced; and thus, finally, lead towards economic success or failure.

In order to substantiate this case, we analyse the recent evolution of one well known industrial district, the packaging machinery cluster in Bologna, in Emilia-Romagna. Our analysis seeks to address changes in the 'Emilian model' as a whole, using this district as a test-case. By employing the collective competition good perspective, we can analyse changes in regional state policy, in associations, in relations between firms, and in how these interact. The evolution of this industrial district has been driven by both the emergence of new challenges in the packaging machine sector, some of which require a collective response, and shifts in both the interests of actors, and the power of actors to achieve those interests.

The packaging machinery cluster in Bologna

Bologna is the capital city of Emilia-Romagna, which has a strong and variegated mechanical engineering tradition (Bianchi and Gualtieri 1990). It is concentrated in the 'core' provinces of the region: Bologna, Modena, Parma and Reggio-Emilia, with a small centre for machine tool production in Piacenza, linked to the large industrial firms of northern Italy (Table 2.1). Mechanical engineering in Emilia-Romagna contains a wide variety of local specializations. Thus, food processing in Parma has an associated cluster of producers of food processing machines, whereas the celebrated tile industry of Sassuolo has grown in association with specialized makers of ceramics processing machines and kilns. Machine production is often dependent on local clusters of production in other sectors. However, some machine producers find most of their customers on national and international markets. Some clusters are moving from the one situation to the other. For example, producers in Sassuolo are now selling their machines internationally, to the dismay of local tile manufacturers, who perceive themselves as guinea-pigs for the development of technologies which will ultimately aid competitors. Other clusters of machine manufacturers have always had an international presence, including packaging machinery in Bologna.

This cluster of production, sometimes erroneously described as a machine tool cluster has its proximate roots in the development of the packaging industry after World War II, previous to which there were only two firms producing packaging machinery in the province, Acma and Sasib (later joined by GD). These three were to serve as 'mother firms' after the war, as technicians working in the firms started up their own companies. Acma alone gave birth to ten important new companies which were to play an important role in the cluster. This proliferation depended on two factors. First, burgeoning cross-sectoral demand for packaging machines meant that there was a wide variety of market niches, and room for many producers; technicians could strike out on their own without succumbing to competition from their parent firm or other firms. Second, despite this variety, the mechanical skills needed to produce packaging machines for one market segment usually transferred with relative ease to another.

Table 2.1: Mechanical Engineering by Province in Emilia-Romagna (numbers employed)

<i>Province</i>	<i>All Machinery</i>	<i>Special Mach.</i>
Piacenza	5,634	1,366
Parma	9,221	5,323
Reggio-Emilia	16,963	2,609
Modena	24,643	4,533
Bologna	27,372	12,340
Ferrara	5,910	1,110
Ravenna	3,696	1,323
Forlì-Cesena	3,240	927
Rimini	3,349	2,237

Based on 1996 Industrial Census Data, Istat

The industry grew both in number of firms and number of employees during the 1950s and 1960s, despite occasional industrial unrest. However, the *autunno caldo*, the period of industrial and political unrest which spanned the end of the 1960s, had important consequences for the structure of the cluster. Trade unions gained victories which impacted on both the internal and external organizational structures of large firms in particular. The result was a radical shift in the form of production. As can be seen in Figure 2.1, there was an explosion in the number of very small firms working in specialized mechanical engineering in Bologna between 1971 and 1981. During the same period, employment among such firms nearly tripled, growing from 672 to 1,863. The number of one-person firms grew over tenfold, from 10 to 105. The same time-period saw only moderate increases in the number of medium sized and larger firms.

This enormous expansion was almost certainly a reaction to changes in labour arrangements. As one small firm association representative put it:

When certain factors lead to problems for the firms ... - the choice was above all to 'terialize' - i.e. to put work outside the firm - to put out production, planning, offices, in order to optimize costs.

More rigid conditions within medium sized and larger firms encouraged them to subcontract work, wherever possible, to small subcontractors. These latter were better able to avoid regulation and trade unions. Thus, firms were encouraged radically to decentralize production, and to respond to burgeoning demand by putting work out, rather than hiring new workers. Small artisanal firms sprang up,

often specializing in one or a few phases of the production process. Designs were sent out to these firms which then created pieces to specification, and either returned them to the buyer firm, or sent them on to other subcontractors for final processing. The buyer firm usually retained control of the strategic phase of assembling the final product.

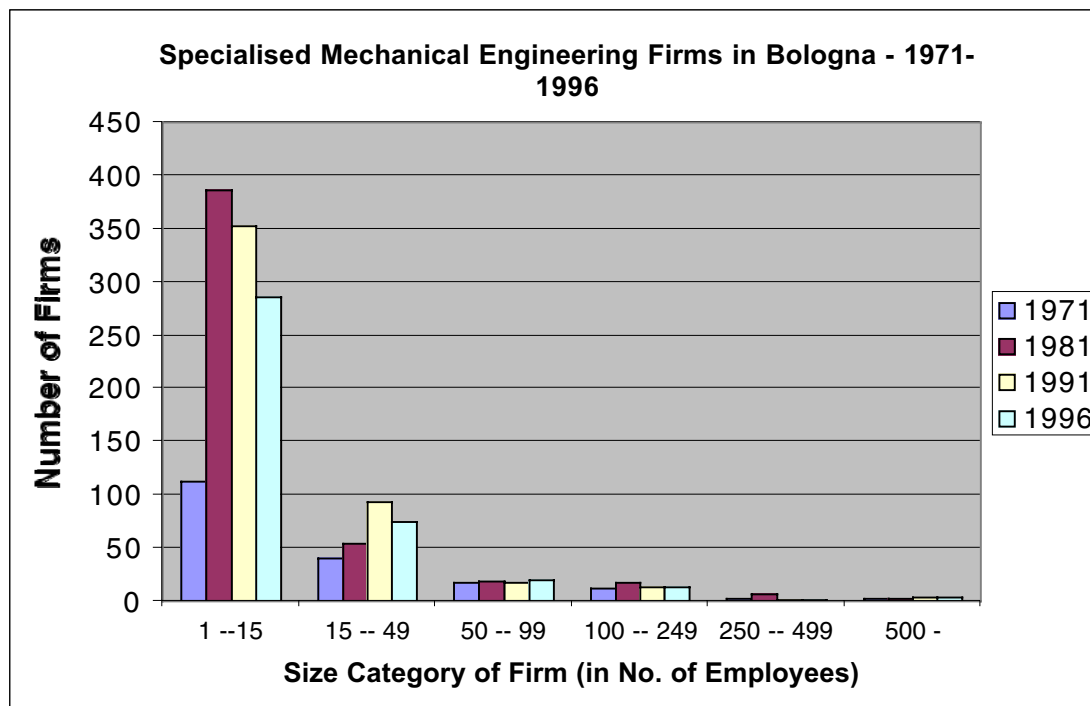


Figure 2.1: Number of firms by size category in Bologna, 1971-1996.
Source: Based on Istat's Industrial Census Data 1971, 1981, 1991, 1996

This system of production, as in other Italian industrial districts, helped packaging machine producers to become highly successful on international markets. The period in which firms shifted to decentralized production saw substantial growth in employment in specialized mechanical engineering in Bologna, from 8,296 in 1971, to 12,451 in 1981 (Istat Industrial Census Data). Afterwards, employment in the sector seems to have gone into very slight decline, falling to 11,573 in 1991, and 11,354 in 1996, broadly congruent with an overall decline in manufacturing employment in the region.

Meanwhile, the industry saw nearly continuous growth in turnover during the 1990s. The serious crisis that hit German machine producers between 1991 and 1993 seems to have had no equivalent in Emilia-Romagna; although machine producers

in the region saw some fall in turnover in late 1991 and 1992, the devaluation of the lira within the EMS in September 1992 appears to have boosted sales in this heavily export-oriented industry. The following years saw continued growth in turnover, reaching a peak of 20.3% between 1994 and 1995. More recently, however, the sector has had some difficulties as a result of the more general turbulence on export markets in 1998 and 1999. In particular, firms producing tobacco machinery have had problems, due to a substantial drop in demand from traditional customers (large cigarette producers), together with a nearly total drying up in demand in new export markets such as Indonesia and China during the Asian financial crisis. While some firms and local economic actors believe that these changes might herald future difficulties, the general consensus appears to be that the problems were conjunctural rather than structural. Furthermore, the continued prosperity of the packaging machine industry in the recent past suggests that its competitiveness on export markets was not fundamentally dependent on successive devaluations of the lira - which in any case has now disappeared within the single European currency.

Today, the packaging machine cluster appears to enjoy a position of relative stability. Emilian producers dominate the Italian industry, providing almost 70% of total employment in the sector (see Figure 2.2). In 1995, the national industry's sales were 2.5 billion dollars, of which 1.97 billion dollars came from exports. Within Emilia-Romagna, the province of Bologna predominates in terms of both the number of companies (61% of the total number in the region) and number of employees; some (69% of total regional employment in the industry).

The packaging machine cluster of Bologna is not an industrial district according to the statistical definitions used by many authors (Sforzi 1996; Burrioni and Trigilia 2001); it accounts for only a relatively small share of total employment in the province. The province of Bologna has roughly 900,000 inhabitants; like many areas of Northern Italy it has suffered from demographic decline over recent years. It has a strong manufacturing sector, which accounts for nearly 38% of total employment, within which the machine industry, not including basic 'metal bashing', accounts for 22%, including 'other specialized machines', which accounts for 10.3% of total manufacturing employment. Thus, while the specialized machine industry does not dominate Bologna as, say, textiles do Prato, it does play a substantial role in the city's economy. Furthermore, the specialized packaging machinery industry was an important motor force driving Bologna's economic success in the post-War period.

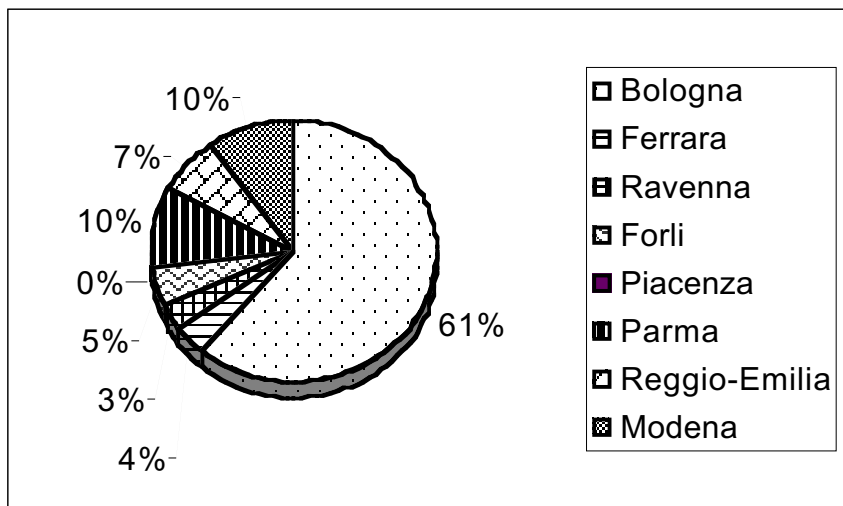
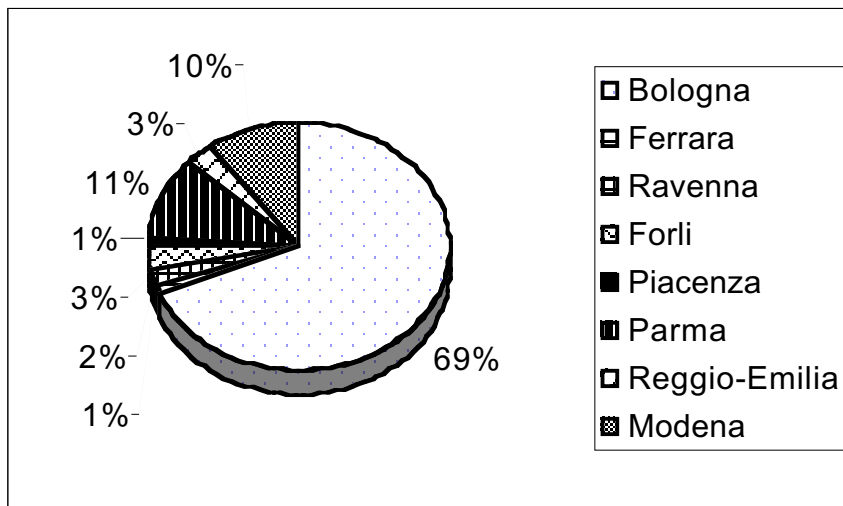


Figure 2.2: Geographical distribution of employment (above) and firms (below) in the packaging machine industry in Emilia Romagna by province.

Source - Curti and Grandi (1997)/Istat's 1991 Industrial Census

'Packaging valley', as it is dubbed, has a high degree of internal coherence, and densely structured relations between local firms, suggesting that even if it does not fit the statistical definition of an industrial district, it may possess the governance characteristics associated with the industrial district model (see Table 2.2).

Table 2.2: Employment in Province of Bologna, 1996

Total	All Manufg.	Mach.	Spec Mach.
316,951	119,420	27,372	12,340

Source: 1996 Industrial Census Data, Istat.

The particular mode in which LCCGs are provided has clear implications for the organization of production in the district. In the next section we spell out the relationship between these collective goods and modes of governance at greater length. Before so doing, however, it is appropriate briefly to examine LCCG provision in three important areas – training, technology transfer and provision of information on foreign markets.

Packaging machinery manufacture in Bologna differs from machine tool manufacture in Germany in its lack of emphasis on formal, standardized training. On the one hand, engineers play no role, except in the very largest firms: design work is done by draughtsmen and technicians. On the other, there is no formal national apprenticeship system worth speaking of. Traditionally, the *apprendistato* contract, such as it is, has been used to deny full employment rights to younger workers, rather than to ensure proper training in skills. While this may be changing – new requirements require that apprentices spend a certain amount of time in the classroom – it is too early to assess the impact of the reforms.

As is often true in Italy, there are local solutions to national deficiencies: in this case commune-funded technical training institutes. One such body, the Aldini-Valeriani Institute in the commune of Bologna, plays a vital role in training technicians (Curti 1994). It has deliberately sought to provide the skills needed by packaging machine manufacturers, and to keep up with emerging technologies. The main problem faced by this institute is demographic: it has faced a 50% fall in its catchment pool of potential students in recent years. Unlike other technical training institutes, it has managed to remain attractive to young students, but the end result has been a dearth of young qualified technicians in the industry. The competition among firms for recent graduates of the Aldini-Valeriani is sometimes vicious, resulting in opportunistic poaching (see below) and very high salaries for individuals with qualifications. Even so, firm owners and local associations believe that many young people are no longer attracted to careers as technicians: they prefer instead to learn about information technology. The Aldini-Valeriani has sought to diversify its courses to cater to new needs, while local business actors have sometimes toured schools to persuade young students of the benefits of working as a technician.

There has been a recent – and quite important – initiative to provide further training for technicians already in employment. Discussions among relevant actors led to a scheme, spearheaded by the Agenzia per lo Sviluppo Tecnologico dell’

Emilia-Romagna (ASTER), a part of the regional economic development body, to train technicians in the industry in areas such as control systems, quality evaluation, reduction of production time, and integration of machines in the total production process. This scheme, run by the University of Bologna's engineering faculty, in association with the Unione Costruttori Italiani Macchine Automatiche (UCIMA), the relevant trade association, proved to be extraordinarily popular; twice the anticipated number of technicians signed up for training. At the time that research was conducted (mid 1999), it was anticipated that the scheme would be repeated in following years.

Technology transfer constitutes another potentially important area for packaging machinery manufacturers. While there is some regional provision of aid through the system of the Ente per la Valorizzazione del Territorio (ERVET), the sorts of linkages between institutions to be found in Germany, and even Britain and France, have few parallels in Emilia-Romagna. The provincial government provides some aid to small firms seeking to introduce new technologies, but its funding possibilities are extremely limited. Cooperation between universities and firms on technical issues has traditionally only been possible where personal friendships existed between businessmen and professors (Bertini 1998). There is no equivalent of the Steinbeis or An-Institutes of Baden-Württemberg, to provide a formalized means of linking the two environments, nor even British-style encouragement of 'entrepreneurialism' on the campus. This said, recent institutional changes, and the pro-active policy of the current rector of the University of Bologna, may lead to improved university-industry links in the future. Further, the Aldini-Valeriani Institute provides an informal variety of technological transfer, introducing new technologies to the district through its training programmes.

The lack of outside aid in technology transfer has been less of a problem for large firms than for small ones. Larger firms in the district often rely on their foreign branch offices to keep an eye out for potentially useful technologies; one large firm in the district has recently licensed an important patent from The US National Aeronautics and Space Administration (NASA). Smaller firms may become involved in pilot projects conducted by ASTER, or make use of the facilities provided by Democentre, another part of the regional economic development system, to acquaint themselves with recent innovations. More usually, however, they observe each other, and their foreign competitors, at trade fairs, in order to find new advances. Technological progress in the manufacture of packaging machinery tends to be

incremental rather than accelerated, and it is frequently possible to understand a new mechanism by examining it, and then to employ it in one's own machines (many advances are difficult to patent). Furthermore, there is high turnover of technicians in the district: firms sometimes rely on their new employees to tell them the technological tricks of their former employers.

Finally, provision of information on foreign market opportunities usually takes place through market mechanisms. There are two potential public sources of such information: the Istituto nazionale per il Commercio Estero (ICE), and the quasi-public chambers of commerce system. The first of these is only sometimes helpful. Although local firms have received help from ICE, they observe a substantial difference between the ICE offices located abroad, which are often helpful and responsive, and the central offices in Rome, which tend not to be especially interested in firms' needs. Further, some foreign offices appear to be more helpful than others. The chambers of commerce also provide some information on foreign markets, albeit usually of quite a basic variety. There was little evidence of firms making use of chambers for such information.

In the absence of public provision, firms usually turn to market provision of this CCG. They usually rely on one of three sources of information. First, the very largest firms have extensive sales organizations of their own, and branch offices in the more important foreign markets. Thus, these firms have people in important customer countries who can inform them about relevant market and regulatory developments. Some smaller firms which have become highly dependent on the larger ones may also sell through these organizations. Second, some smaller firms appoint agents in foreign countries, who receive commissions for any sales generated. Third, there are several firms in Bologna which are specifically devoted to sales and export of other firms' machinery – these 'commercial' firms play a highly important role for many small enterprises. Typically, such a firm will have a long-term relationship with several manufacturers, selling complementary machinery, and will seek to find orders on foreign markets, and then negotiate a package deal on behalf of the manufacturers, receiving a percentage of the sales price as its reward. These sales firms are crucial to the success of smaller firms in the district, yet tend to go unrecognized by national, regional and local government – they do not receive the sorts of export insurance assistance that their German equivalents do. Furthermore, the associational structure of the district is poorly suited to their needs: while they are unable to take advantage of associational assistance provided for

manufacturers, the relevant organizations for commercial sector companies also has little relevance for them.

The State, governance, and LCCGs in the packaging industry

If, as both Ganne (1992) and Le Galès (2001) have suggested, the state lies behind the pattern of local economic development in France, it also plays an important, albeit very different, role in Italy. The Italian political economy is fundamentally conditioned by the weakness of the national state, and the relative importance of local and personal forms of social organization (Trigilia 1996). Indeed, 'private dynamism' and 'public disorder' can be seen as two sides of the one coin (ibid). As Locke (1995) argues, the relative confusion of the national political economy goes hand in hand with an extraordinarily wide degree of variation between local economic systems. The 'Third Italy' has enjoyed considerable economic success. Other regions have stagnated, although local economic systems are beginning to spring up in the Mezzogiorno (Burrioni and Trigilia 2001). Others again have been dominated by large firms, although here too small firm systems are beginning to play a significant role.

The weakness of the state not only creates regional variety but affects the form that local economic organization takes. The state can act to affect the provision of LCCGs in three important ways. First, it may use its Weberian monopoly on legitimate violence to regulate, mandating rules which actors on its territory must obey. This may involve 'beneficial constraints' (Streeck 1997), which force actors to contribute to LCCGs. Second, it can use revenues to provide grants or other resources to alleviate LCCG deficiencies. Third, it may act together with private actors in a cooperative mode, seeking to solve collective competition problems together, and providing monetary, enforcement, and persuasive resources to this end.

The Italian state only partially approximates the Weberian model. First, as Regini (1997) has observed, its power to regulate is limited:

It has been widely observed that even when public policies apparently assign a leading role to state regulation, ... mechanisms for circumventing them are often set in motion; or else the state rules are only weakly and inefficiently implemented.

In contrast to Germany, where macro-economic policy and heavy regulation lead to high predictability in economic life (Cooke and Morgan 1998; Streeck 1996),

Italian state regulation imposes a heavy burden on economic actors without any guarantee that rules will be applied consistently. Neither state bodies nor courts are perceived as impartial or efficient. More recently, the Italian state has been affected by Europeanization, which binds the government, making it a more credible actor, and has transferred many regulatory functions upwards, in a 'hardening' and 'hollowing out' of the state (della Sala 1997).

The picture is somewhat more mixed when it comes to the second and third modes of provision of financial resources, and cooperation with private actors. There are important differences between different levels of the state. Italy has four main levels of government: national, regional, local, and provincial. Some national state-sponsored bodies provide LCCGs that are of use to local producers. For example, the Sezione speciale per l'Assicurazione del Credito alle Esportazioni (SACE) provides export credit guarantees for risky markets, and ICE, information on these markets. However, the provision of these goods is patchy. Firms in the packaging machine cluster in Bologna believe, whether correctly or incorrectly, that SACE assistance tends to go to big firms with good connections in Rome. Even larger local firms have had difficulty in securing aid.

The regional level of government is closer to local firms, and should logically play an important role in small firm policy. Indeed, this is partly the case. However, the importance of the regional level to Italian economic and social life has sometimes been exaggerated. On the one hand, authors such as Nanetti (1988), Putnam (1993) and Cooke and Morgan (1998) accord it a central role in their analysis of Italian economy and society. On the other, Trigilia (1991) and Dente (1997) suggest that the region is still a relatively weak level of policy and interest articulation, and that local government and local loyalties are still much more important.

Regional government policy in Emilia-Romagna has been the subject of much academic debate (Leonardi and Nanetti eds. 1990; Cooke and Morgan 1998). Attention has focussed on the regional planning process, and the role of the regional economic development organization, ERVET. Emilia-Romagna, like other regions in Italy, has prepared economic plans at frequent intervals since its creation (Bellini 1990; 1998). These plans have helped set the terms of regional economic debate. They also have been shaped by tensions between the regional and local levels, which are downplayed in much of the literature. In the period when the Communist party was prevented from playing a role in national government, Emilia-Romagna demonstrated that Communist rule need not lead to economic disaster. Thus, the

success of the industrial districts of Emilia-Romagna was welcome. However, these districts also posed political problems, precisely insofar as they were organized on a small geographical territory. Not only did this suggest that industrial districts were local rather than regional, but many parts of Emilia-Romagna had no industrial districts, and thus had different economic needs. The response to this dilemma was twofold. On the one hand, regional planning authorities sought to replace the localist networks characteristic of industrial districts with national and international networks, where the region would continue to be a privileged sphere of regulation. On the other hand, for purposes of regional economic policy, planners identified industrial districts in outlying provinces which clearly had very different forms of economic organization, in order to avoid the perception that industrial policy was favouring the heartland of the region at the expense of the rest. The region also sought to use the planning process to subordinate provinces and communes to its authority. At one stage, it sought (together with other regions) to have the provinces replaced outright by new planning districts; when this initiative failed, the regional government contented itself with ensuring that local and provincial economic plans would have to be both compatible and consistent with the overall regional framework.

The most recent planning document, *La Regione Globale: L'Emilia-Romagna nell'Europa del Duemila* (Regione di Emilia-Romagna 1999), is a continuation of these trends. It too speaks of industrial districts which do not fit the commonly accepted definitions of the term, as for example the seaside tourism industry and large-firm chemical industry of Romagna. It points to the districts as important sources of economic growth, but suggests that they need to be embedded in global rather than in local networks. The renewed emphasis on global networks is linked to important policy changes. First, planning officials speak of how regional policy may help give local firms the necessary credentials to participate in these networks. Here, officials suggest that it is important that they do not rely on 'old' personalized trust relationships, but rather acquire externally validated certification through International Standards Organization (ISO) or similar schemes. Second, officials are seeking to respond to the difficulties experienced by certain Emilian industrial districts by helping them reposition themselves as nerve centres in international production networks, hiving off lower-end manufacturing to other parts of the world, while retaining higher-end manufacture and design. Third, there is a new emphasis on helping internationally oriented leader firms within the district, rather

than the district as a whole. In principle, these leader firms are supposed to diffuse an outward focus to less open firms in the district. In practice, it may be expected that many weaker firms will fail, be subordinated to, or be absorbed by, their more successful competitors or buyer firms.

These changes in broad outlook are reflected in policy changes within ERVET, and are also linked to genuine changes in relations between firms. ERVET, the independent agency and holding company charged with overseeing economic development in Emilia-Romagna, has received considerable attention in the academic literature (Leonardi 1990; Amin 1998; Mazzonis 1996; Bellini 1990; Cooke and Morgan 1998). It has also recently been undergoing substantial changes in both its goals and the methods used to attain these goals (Cooke and Morgan 1998). ERVET, as it is currently constituted, has two elements. First, it coordinates the planning and implementation of much of the region's economic policy. In the 1970s, it was perhaps the most important nexus of regional economic decision making, with enormous informal clout. Recent years, however, have seen ERVET assume a much less political role, and concern itself more with the implementation aspects of policy.

Second, ERVET provides a framework for a number of regional service centres, the majority of which were set up to meet the LCCG problems of industrial districts within the region, such as the Centro di Informazione Tessile dell'Emilia-Romagna (CITER), in the knitwear district of Carpi, which is now experiencing difficulties. Other centres were set up to provide general services to firms in the region, rather than to particular districts. For example, ASTER is involved in technology transfer across a wide variety of sectors, while Democentre provides demonstrations of new technologies, and the Centro Regionale di Ricerca, Verifia Qualità Prodotti, Processi e Certificazione Sistema Qualità (CERMET) provides testing and certification services for the machinery sector in particular. Despite their general orientation, some of these centres retain a largely localized clientele; *campanilismo* remains a strong force guiding business relationships.

ERVET has seen changes on two fronts. First, there has been an ever stronger push towards marketization of its services. The centres were set up in a period when there was a perceived deficit of certain services for SMEs. Now, many of the centres set up with regional funding are facing increased competition from private sector organizations which offer many of the same services. There are also more overt forces pushing ERVET service centres to adopt a more market-based approach. Until

relatively recently, ERVET's funding from the regional government had been ring-fenced, giving it considerable freedom from external pressures. However, the continuing hostility of business organizations such as Confindustria to regional industrial policy led to a re-opening of the debate on regional economic development strategies, and a new approach in which funding to ERVET and its service centres is more directly tied to specific projects. The more rigorous approach to regional funding has pushed the centres to seek new sources of funding, from either the market or the European Union. Nowhere is this more obvious than ASTER, the technology transfer agency, which has recently reorganized itself so that its divisions map the different areas of funding available under the EU Fifth Framework Programme. ERVET officials foresee that as funding becomes less and less tied to the region, the centres will adopt an increasingly national, and indeed international, orientation, seeking to market themselves to firms outside the region. Thus, ERVET is moving away from a traditional 'state' mode of governance to a more market based approach on the one hand, and an approach conditioned on the need for EU level funding on the other.

Second, as previously discussed, there has been a fundamental shift of regional economic policy. Insofar as ERVET still acts as a regional development agency, it now focusses on linking firms into international networks rather than local ones, and on ministering to leader firms within the district, rather than to the district as a whole. It seems increasingly necessary to work in a very differentiated manner with particular attention to the leader firms, because it is these that are succeeding in globalizing themselves, and in remaining in the market.

These two changes go hand-in-hand; officials within the regional government and ERVET believe that it is exactly the leader firms who have the potential to participate in international networks. This marks a fundamental shift in the Emilian model of provision of real services – the emphasis is now on helping leader firms to survive on international markets, and on helping medium-sized firms to grow and adapt to a leadership role, rather than on supporting the network of small firms as such. This tendency is most marked in ERVET policy towards districts such as Carpi, which have seen radical changes and internal re-organization. Here ERVET policy aims to help leader firms assume privileged positions in international *filières* of production, rather than remaining embedded in localized ones. At a more general level, centres such as CERMET play a very important role in this strategy; certifying

Emilian firms according to internationally recognized standards and helping them succeed in becoming partners for other firms in the global arena.

The changes outlined above are important for policy, but it remains to be seen how successful they will be. What is clear is that they are having consequences for the interface between policy makers and local firms. In the packaging machinery industry in Bologna, there are complaints that some centres, such as ASTER, are more responsive to the possibilities for external funding than to the actual needs of firms. Projects often tend to be more tailored to EU research frameworks than to the realities of the local economy. However, there are highly important exceptions, such as the previously described initiative to improve training; here was one example at least of ERVET securing outside funding to meet important LCCG needs within the district. One may also point to CERMET's certification and testing services. While CERMET is located in Bologna, it does not provide the informal governance for the district that more 'traditional' real service centres used to. Instead, it provides services on the market, in competition with other providers. What reaction there was among local firms to CERMET was highly positive.

Finally, there are the two lowest levels of government in Italy, the provincial and communal administrations. The former has only marginal relevance to firms, whether in the packaging machinery cluster or elsewhere. While it administers some grants programmes for SMEs, its role is largely technical. The communes, in contrast, may provide highly important LCCGs to industrial districts, including social services, control of land prices, and basic utilities (Brusco 1982; Brusco and Righi 1989). The packaging machine cluster is spread across several communes, which provide such goods; one may point in particular to the Aldini-Valeriani institute (already discussed), which is funded by the Comune of Bologna and is described without exaggeration by firms and other local actors as the heart of the industrial district. This institute also has an associated museum, as well as the Aldini-Valeriani Foundation, created in 1997, which provides a venue where local economic interests can discuss technical training (Curti 1994). While some local actors worry that it has failed to keep pace with the very latest technologies, and that demographic changes have led to a fall off in the number of students, most felt that it still played a highly important role, and indeed was irreplaceable. It is difficult to underestimate how Aldini-Valeriani has cemented the social world of the local packaging industry; most local firm owners have passed through its doors, as have their employees.

Associations and governance in 'packaging valley'

Much of the interest in the 'Emilian model' (Brusco 1982) has been in how small firms' associations provide services to their members. The LCCGs provided, it has been argued, are essential to the success of Italian industrial districts. Such associations allow firms to capture the economies of scale that would otherwise only be available to large firms with hierarchical organization.

These arguments hold considerable merit; it is undeniable that the success of small firms is linked in large part to these associations. Unlike other European contexts, where small firm organizations tend to be weak or concerned more with their representative functions than with providing services to members, Italian associations such as the Confederazione Nazionale dell'Artigianato e delle Piccole e Medie Imprese (CNA) are involved in the day to day lives of their members. Interviewees who had had contact with these associations almost universally expressed a high degree of satisfaction. This said, the governance approach allows us to put these associations in a broader perspective. What is striking is the degree to which small firm associations in Italy seek to respond to the deficiencies of the state. On the one hand, the state fails to provide many important LCCGs. Thus, associations can 'sell' themselves to members by offering to provide these goods. On the other hand, the state nevertheless imposes an almost impossibly high regulatory burden on small firms so that associations act as intermediaries, representing the collective or individual interests of firms to bureaucratic agencies and interpreting the regulatory requirements of the state in a language that small firms can understand. These functions do not exhaust the role of small firm associations, which also provide additional bargaining weight to small firms in their dealings with banks, and may organize cooperation among their members on issues of common interest (but see below). But efforts to alleviate, or counteract, the deficiencies of the state probably account for the majority of their everyday business. Thus, the state not only fails to provide certain LCCGs; it may create the need for the particular good of intermediation with a complicated and unpredictable state sector.

There is a high degree of fragmentation among business associations in Italy. Unlike some other European countries, there is not a neat split between representative associations and those concerned with industrial negotiations; the same organization may represent business interests to government, bargain with organized labour, and provide services to its members. The multiplicity of

organizations sometimes leads to confusion, but also may be one of the reasons why their responsiveness to their members: competition is vigorous.

Organizations may be identified according to political affiliation, or size category of firm, or category of industry, or combinations of these. In the packaging machinery industry, the important associations are the CNA and Confartigianato, both of which have traditionally ministered to very small artisanal enterprises, Associazione di Piccole e Medie Imprese (APE), which has a membership consisting of small-to-medium sized industrial enterprises, and Confindustria, the umbrella business organization, which has members from all size-categories, but has typically been dominated by large firms. The CNA is undoubtedly the most important association in the region in terms of both numbers and political influence; it has 62,700 member firms in Emilia-Romagna, and has traditionally been linked to the Communist party and its heirs, which dominated regional politics until very recently. Confartigianato, which has a more right wing viewpoint on economic and social issues, has far fewer members in the region (although it is the larger association nationally), but still has a very respectable representation among firms in the packaging machine industry. API has some 1,300 members in the Bologna area, and 70% of its members are involved in the metal or mechanical engineering industries in some way.

Finally, Confindustria is primarily concerned with the needs of larger firms, and is perhaps not as politically weighty as its national equivalent, although its regional leadership has had a very substantial role in recent debates. The trade association for packaging machine manufacturers, the Unione Costruttori Italiani Macchine Automatiche per il Confezionamento e l'Imballaggio (UCIMA) is affiliated to Confindustria, and has played an important role in the industry, although some local actors criticize it for: its removal from the day-to-day issues concerning manufacturers; its geographical distance from Bologna (it is based in Milan, and has recently closed down its Bologna offices); and its insensitivity to small firms.

Italy also has an extensive system of chambers of commerce, with mandatory membership and a privileged legal status, which was reinforced in 1993 (Law 580/1993). Chambers may occasionally play an important role in local economic regulation (Perulli 1989) but are more usually ineffective and isolated. While the Chamber of Commerce of Bologna does provide basic information on export markets to its members, has some regulatory functions, and has an associated facility

for organizing trade fairs, it is often regarded as irrelevant by firms and other organizations.

As has been mentioned, small firm associations such as the CNA, Confartigianato and API offer important services to their members, many of which alleviate the heavy regulatory burden of the state. The CNA in Emilia-Romagna handles tax accounting for some 40,000 of its members, and payrolls for 20,000. They also represent their members in labour negotiations. The Italian industrial bargaining system is quite convoluted; while bargains are made on the national level, considerable variation is possible at the firm level. Larger enterprises bargain individually with the relevant trade unions, but artisanal firms are represented by their associations, who negotiate regional agreements to cover all artisanal producers. Labour relations in the recent past appear to have been relatively peaceful, and Federazione Impiegati Operai Metallurgici (FIOM), the dominant trade union in the industry, is eager to explore new forms of cooperation which would help secure jobs in the area, building on the success of the Ente Bilaterale Emilia-Romagna (EBER) (see below). Its efforts have usually been rebuffed by firms and business organizations, who wish to confine the role of unions to labour issues alone. The creation by the regional government of a new body, the Institute for Labour (Istituto per il Lavoro), which examines economic issues from a viewpoint sympathetic to the trade unions, may help unions expand their ambit in the future.

Artisanal and small firm associations also advise their members on European affairs, as EU regulations and quality requirements become ever more important. At the time of research, the CNA in Bologna was putting together a project to help small firms in the packaging machine industry comply with EU quality regulations.

Nowhere is the role of associations in making up for the deficiencies of the state clearer than in the so-called *enti bilaterali*, bilateral bodies set up by trade unions and small firm associations. Cooperation between business and trade unions to provide LCCGs has some history in Italian industrial districts; Trigilia documented early forms of such arrangements in Prato (Trigilia 1989). More formal bilateral arrangements at the regional level came into being through a national agreement between the artisanal associations and trade unions in 1988. EBER began its activities in 1993, and, like its equivalents in other regions, had its beginnings in the failure of the state to provide certain collective goods to artisanal firms. In particular, there was no provision for social insurance for small firms in difficulty, unlike larger ones. In return for a relatively low subscription, all artisanal firms in Emilia-Romagna who

subscribe to EBER have access to funds which allow them to pay 40% of the wages of their workers during crisis periods.

Initially, small firms were deeply suspicious of the arrangements, in part because of the degree of trade union involvement. However, the financial difficulties that many small firms experienced in the 1993-1994 period showed their value; by 1999, some 85% of the eligible firms in Emilia-Romagna were members. EBER also helps member firms meet legal requirements for health and safety, and is assisting actively in on-the-job training. Although it has relations with some state bodies, it perceives itself as far more efficient; while a government body may take up to 60 days to approve an apprenticeship contract, EBER has a 7-10 day turnaround. It helps meet trade union and regulatory concerns in areas like health and safety – problematic for micro-firms, which cannot afford to devote an employee to these issues - by creating a system of trained regional representatives. The most comprehensive study available of *enti bilaterali* suggests that they may provide an embryonic alternative to the failures of the welfare state (Perulli and Catino 1997).

Cooperation between small firms as a source of LCCGs

Perhaps the most widely debated feature of industrial districts has been small firm cooperation. The claim that small firms are motivated to cooperate has been well received by economic sociologists suspicious of economics. Cooperation in industrial districts has been ascribed to the survival of communitarian norms of solidarity, which transcend rational egoism, and allow firms to work together for common ends.

These arguments are by no means incompatible with the governance approach to economic institutions, which stresses how community may provide a means of governance (Streeck and Schmitter 1985; Hollingsworth, Schmitter, and Streeck 1994; Hollingsworth and Boyer 1997a; Le Galès and Voelzkow 2001). Indeed, Streeck has suggested (perhaps tongue-in-cheek) that cooperation in Italian industrial districts, unlike in Germany, is based on community norms and a voluntaristic ethic. However, it is also possible to treat the community form of governance in a more restrictive sense (Farrell 2000; Le Galès and Voelzkow 2001; Crouch and Trigilia 2001), and see it as differing from other forms of governance insofar as it involves more informal institutions, rather than a different set of normative motivations. In many settings, 'community' governance may rest on a set of informal rules to which actors need have no particular normative attachment – they may obey them because

it is in their interests to obey them, rather than because of any sense of fraternal attachment to others in the community.

Our research suggests that the latter characterization of the community form of governance better describes relations among packaging machinery producers in Bologna than the former. There was little evidence of the sorts of strong fraternal bonds between firms of which some analysts of industrial districts speak. Indeed, the opposite usually seemed to be the case. Small firm organizations spoke of the difficulty of encouraging their members to cooperate; small firms were highly individualistic even where cooperation could clearly have been advantageous. It is true that small firm owners were coming together to try to counter the increasing dominance of larger firms in the district, by presenting a common front on export markets. But even here, cooperation was problematic. One owner of an export firm spoke of how difficult it was to persuade the manufacturing firms that he worked with to cooperate. There were clear financial advantages to further cooperation in areas such as supplies and financial services, but individual firms did not want to sacrifice their autonomy. Indeed, individualism was arguably more important than communitarianism to the success of the district; the desire of technicians to work on their own, rather than as employees, had historically driven the creation of small firms.

There was considerable opportunism among firms in certain areas. A severe shortage of qualified workers in the industry meant that firms had little compunction in poaching workers, and in using their new employees to find out about the production methods and techniques used in their former workplaces. Indeed, there was a more general phenomenon of diffusion of technical information through copying of designs. While this may have had some positive effects for the district overall, it also discouraged major investments in research that could not be protected by patent.

Unsurprisingly, there was little horizontal cooperation among competitors or potential competitors. Relations among these were usually seen as a zero or constant sum game; a firm was likely to suffer lost sales if a competitor made advances. While there was horizontal cooperation among firms which made complementary rather than competing products, it was not generalized, but usually based on personal relations. For example, a firm which received an order for one of its machines might tell another firm which made complementary machines about this possible new customer.

This is not to say that there was no norm-driven cooperation whatsoever. The packaging machine industry involved a relatively small number of actors who met together repeatedly in a shared social setting, and sometimes formed friendships. In addition, shared locality had a modest positive effect on cooperation. But what must be emphasized is that cooperation co-existed with opportunism, and that most 'costly' forms of cooperation seemed to be based on shared interest rather than community feeling or deep personal ties. Individual interests did not become merged in the collective interest of the community. Other scholars who are familiar with the district report similar findings; Capecchi (1997) speaks of his disappointment at the relatively low level of cooperation among packaging machine manufacturers, whereas Bertini (1998) states:

I do not share the opinion of theorists of industrial districts that there is an almost fraternal trust ... It is a trust that is based on relationships that become consolidated over time, and that are profitable for both parties.

Where there is clear evidence of widespread cooperation is in the vertical organization of production. As in many other Italian industrial districts, the production of packaging machinery in Bologna is characterized by radical vertical disintegration. Except for the very largest firms in the district, the usual pattern is for all, or nearly all, the parts of a machine to be put out to artisanal producers, who make pieces to a design drawn up by the final firm, and then return these pieces, or send them on to other producers for further processing. The final firm may only perform the final assembly (which is, it must be said, the most strategic stage), and in some cases the buyer firm puts out even this to other firms. The few very large firms, as might be expected, rely more on their internal resources for production, but even these make heavy use of subcontracting, especially during periods where demand is rapidly shifting. Also, specialized subcontractors may often amortize the costs of advanced machinery more rapidly than hierarchically organized firms, which may only need such machinery on an infrequent basis. While this may have had its beginnings in large firms' outsourcing practices, it relies (as discussed below) on previously existing informal community rules, and has demonstrated its merits in economic conditions quite different from those where it had its beginnings.

This form of production requires a very high degree of cooperation if it is to work properly and gives rise to risks of hold-up (Williamson 1985). However, formalized, contractual commitments do not play a major role in relationships between subcontractors and final firms. Instead, informal, 'personal' relationships

prevent both parties from behaving opportunistically most of the time. Subcontractors who behave well and provide good quality at a reasonable price can be reasonably assured of a long term commitment on the part of their buyer firm, even if there may be dry periods when the market is bad. Buyer firms, in contrast, may have a high degree of flexibility from subcontractors with whom they have a long term relationship; these may be willing to work long hours or weekends if necessary to complete contracts that are time sensitive.

Our research suggested that this honesty on the part of both sets of actors could be attributed to informal institutions and their associated enforcement mechanisms. Informal institutions (defined here as sets of rules, following North 1990; Knight 1992; Trigilia 1998), provided orientations to both buyer and subcontractor firms as to what each could expect. These informal norms built on local traditions which mandated a high level of honesty in personal relations, so that subcontracting relationships in the packaging machine district were seen as personal ones, even in situations where it was unlikely that any genuine bonds of friendship existed. Thus, there were rules which stated that certain kinds of opportunism were unacceptable. But the norms might have had little force if they had not been accompanied by enforcement mechanisms.

The social world of packaging was relatively transparent and firms which consistently violated the perceived rules of interaction between subcontractors and final firms would eventually be unable to do business. Thus, social rules and enforcement mechanisms combined in such a way that it was in the interests of firms to behave honestly in most aspects of subcontracting relations. There is evidence that these results may be generalized to other industrial districts; as Brusco and Bianchi seem to argue (Brusco 1992; Bianchi 1993), a focus on informal rules and their consequences may lead us further than the rather vague attribution of cooperation to a cooperative set of values. In many ways, these relations resembled the forms of social cooperation modelled by game theorists (Greif 1994; Calvert 1995), but they were not identical: norms did sometimes appear to affect actors' internal motivations.

These findings have important consequences for the characterization of change. Previous authors have suggested that many industrial districts are moving from a 'community' form of governance in which affective ties predominate, to a more hierarchical and stratified form in which economic interests motivate actors (Franchi and Rieser 1991). Change, for these authors, involves a move towards calculability.

Such a theory apparently lies behind the arguments of Bennett Harrison, who uses the machinery industry in Bologna as a test case for the apparently ineluctable decline of the Italian industrial district (Harrison 1994a). Harrison takes the guardedly pessimistic arguments of earlier writers on Emilia-Romagna and radicalizes them. He looks at how Sasib was bought out by a nationally based holding company, which sought to create a new group of machinery companies which would achieve economies of scale by centralizing subcontracting decisions. This, in Harrison's opinion, was emblematic of changes which would almost inevitably lead to the decline and disappearance of localized subcontracting networks in Bologna. Community ties would be replaced by the hierarchical domination of large firms.

Unfortunately for Harrison's thesis, the forces he identifies as vectors of change did not have long term consequences. It is true that Sasib, along with other large firms in the region, sought to centralize their subcontracting relations on the group rather than the firm level in the early 1990s. However, this policy proved, in the words of one interviewee at another large firm in the district, to be a 'disaster.' It was swiftly abandoned by all the firms which had adopted it.

This said, there is good evidence of a shift in the district to a more hierarchical form of production, which may have consequences in the long term for the kinds of subcontracting based on informal, long term relationships which we have previously described. The district has been seeing a process of consolidation since the early 1980s. Previously, a producer might specialize in one particular machine for a particular stage of the packaging process for a particular sort of product; for example, blister-pack machines for pharmaceutical products. Thus, an entire packaging line might incorporate machines from several different producers. Now, multinational customers firms in sectors such as food, pharmaceuticals or tobacco, are more and more likely to demand 'single solution' packages of machines from a particular firm. This trend has led to a process of consolidation within the industry, as larger firms buy out specialized producers in order to integrate their machines into a broader range, so as to meet customer demands. On the one hand, this means that there is less space for specialized final firms within the industry. Some, in niches which are unattractive to larger firms, are relatively secure. Others are likely only to be able to find markets through subordinating themselves to larger firms in the district, who have a lock on important customers. This means a substantial shift in the balance of power within the district to larger 'group' firms (Farrell and Knight

forthcoming). While smaller firms are seeking to meet this threat, their efforts are being hampered by the fundamental individualism of their owners. It appears that the district is shifting from a 'network of firms', in which no one firm or small set of firms predominated, to a 'networked firm' model in which large, leader firms play an important role (Burrioni and Trigilia 2001).

These events are also having knock-on effects for relationships between final firms and their subcontractors. The larger firms are moving towards more formal and more hierarchical relationships with their subcontractors, in which key suppliers are identified and built up, and very frequently asked to manage the relationship with smaller sub-suppliers. This system will probably see a greater share of the profits of cooperation go to the firms at the top of the system than in the past. One larger firm in the district (not the one quoted above) speaks quite candidly of how it squeezes the subcontractors it has built up when it needs to; it treats them, in Semlinger's (1993) term, as 'flexibility reservoirs'. While this is not necessarily representative of the district as a whole, it is clear that even those large firms which seek to adopt a more cooperative attitude to their subcontractors have little compunction in using their leverage to further their own particular interests.

In part, this matches Harrison's pessimistic predictions and Franchi and Rieser's romanticism, but only in part. The vectors of change are quite different. Even if informal community rules have played an important role in subcontracting relations, these rules are more based on calculability than identity, so there is no simple destruction of *Gemeinschaft* by *Gesellschaft*. Furthermore, the forces that appear to be driving institutional change are twofold; the individual interests of actors, and the power of actors to achieve those interests (Farrell and Knight forthcoming). Individual actors who are powerful enough to bring through changes that are beneficial to themselves are likely to do so, regardless of whether or not this helps the overall prosperity of the district. In this case, large firms which are seeking more formalized relations with their subcontractors are not doing so because they are interested in the collective interest; they are doing so because this is to their individual advantage.

While this might be in the collective interests of the district, it might just as well be that it has negative consequences in the long run. Large firms are able to do this because of their increased bargaining power, suggesting that change in the industrial district is better seen as the contingent result of alterations in the bargaining position of actors, than the ineluctable effect of macro-level social forces. The changes that we

identify appear to be real, and will likely structure the district in the short-to-medium term. But it is also possible that shifts in final customer markets will again favour smaller enterprises over larger ones; the evolution that we have identified is by no means set in stone, and may be revised if external circumstances are such that there are changes in the interests or the bargaining power of the relevant actors.

Conclusions

In the above, we have examined the mix of governance institutions in three important areas affecting the industrial district of packaging machine producers in Bologna, and indeed the 'Emilian model' as a whole – the state, associations, and relations among firms. The governance approach gives us tools to understand both continuities and changes in these areas. Regional economic policy and service delivery are moving from a mode in which the state provides funding for projects and cooperates with local actors, to one in which it has a secondary role in centres that are more and more market-oriented. Policy goals now focus not on the delivery of LCCGs to industrial districts as such, but on providing key leader firms with the necessary credentials for international networks. In relationships between firms, we see the continuation of a 'community' based system of informal rules in certain interactions, but also how this system is threatened by external forces privileging large enterprises, allowing them to assume a more dominant role. As a result inter-firm relations do not take place among a community of equals, but hierarchically.

More cogently, the governance approach allows us to examine the local (and regional) economic system as a totality. The different modes of governance are clearly inter-related. This is most obviously so in the way that the relative inefficiency of the state sector impinges on the others. Associations both provide LCCGs that are not provided by the state, and seek to intermediate between small firms and a system of regulation that these firms often find incomprehensible. Furthermore, they, are responding to changes in the constitution of the state, adapting to EU requirements as these become more important for producers. Small-firm subcontracting relations tend to be informal; this reflects the weaknesses of the state legal system. But on another level, the regional state responded to changes in inter-firm relations, in the shift of policy from building up districts as a whole to work with 'leader firms.' In part, this reflects genuine changes in the organization of the packaging machinery district.

Yet the governance approach also allows us to focus on the *political* nature of change. It would be a mistake to conceive of the governance system of the packaging district of Bologna in purely functional terms, in which the strength of one mode of governance may automatically compensate for the weakness of another in guaranteeing economic success. Instead, the mix of governance, and changes within it, can be attributed to shifts in the political opportunities open to various actors, whether they be firms, local government, regional government, or associations. Thus, the regional government's new approach may also be seen as part of a history of struggle between local and regional levels in Italy, in which regional policy actors have continually sought to justify their relevance in a context where local economic ties remain strong. Similarly, recent changes in relations among firms appear to be the result of larger firms pursuing their self-interest, rather than a strategy aimed at preserving the strength of the district as a whole.

Here, the weakness of one form of governance (such as the state) may provide political opportunities for other actors, but does not necessarily imply that these actors will respond in such a way as to meet the collective needs of the local system. This may indeed happen (as is arguably the case with EBER), but one also may envisage situations in which actors pursue their individual interests in such a manner as to lead to a collectively undesirable outcome. Arguably, the new orientation in regional policy is more rooted in political considerations than socio-economic fact; by neglecting the traditional sources of success in industrial districts it may lead to the long term vitiation of their economic dynamism.

3. Refining National Policy: The Machine Tool Industry in the Local Economy of Stuttgart

Ulrich Glassmann

As presented in the introduction to this section, although Germany's machinery industry suffered from serious decline in the early 1990s, it still has a larger share of world trade than the other countries we examine. The aim of this chapter is to analyse the preconditions for the recovery which lay behind this relative success, with special reference to the machine-tool industry around Stuttgart in Baden-Württemberg. To assert that Stuttgart's specialized machine tool firms were able to maintain comparative advantages may sound provocative to authors who have argued that these advantages (including their wider infrastructure such as the training system (Kern and Sabel 1994)) turned into disadvantages during the years of crisis. But our analysis is not primarily designed to explain the overall performance of this sector; it depicts *how* the local economy recovered in relative terms. Many niches have certainly been lost to foreign competitors, leading to declining employment and turnover (Kerst and Steffensen 1995; Lippert 1999).

Using the governance approach we therefore analyse the external challenges to the local economy in the 1980s and 1990s and show how firms and supporting institutions adopted new strategies.

As we discussed in the previous volume (Glassmann and Voelzkow 2001), LCCGs for territorially anchored production systems in Germany are provided according to two basic forms of public governance: federalism and corporatism. We also highlighted the relevance of vertical relationships between large and small firms, and the relatively large size of German SMEs with their corresponding capability for in-house production of LCCGs and their low acceptance of community based (horizontal) cooperation. In this chapter we shall show how local recombinations of governance modes within a national governance framework can occur as a result of temporal, sectoral and regional variations, still assuming that for German firms clustering is not as important as it is for firms in some other countries (Lau 1997). However, there do remain distinct benefits from local clustering, and we shall consider these below.

We shall first examine the historical origins of the machinery industry in Stuttgart to discover the structural path-dependence of the production system. Second, we shall depict the development of the Diversified Quality Production regime (DQP) in Germany after World War II and the role of Stuttgart's firms and

institutions within this national setting. Third, we give a short overview of the city's economic performance in the 1980s and 1990s. Fourth, we shall describe the challenges of the 1980s and the specific responses by firms and supporting institutions, followed by an analysis of the challenges that pressured this regime in the 1990s. Finally, we shall examine the outcome of this transformation processes; in particular, whether the DQP regime had to be abandoned or not.

The following account makes use of in-depth interviews carried out by the author and H. Farrell with firms and institutions concerned with the machine-tool industry in Stuttgart. In order to respect the confidentiality of the firms, citations and quotations from these interviews are referred to in the text by the codes:

BW-F-01/02/03/04/05/06/07/08/10/12/14/18;
and BW-I-01/02/04/05.

Historical origins of the machinery industry in Stuttgart

Until the mid-19th century Württemberg was a backward rural region, lacking the natural resources important to most early industrialization and embedded in agricultural protectionism. Important in achieving change was Ferdinand Steinbeis (Marquardt 1985). Like many of the early entrepreneurs of the region, Steinbeis was a Schwabian Pietist - a form of Protestantism which stressed independence (Bechtle and Lang 1999). As president of the new Central Office for Commerce and Trade, founded in 1848, Steinbeis introduced a new industrial code in 1862, which abolished the guilds. Central regulation of the code made it possible to establish more favourable conditions for firms. (The equivalent organization of trade in neighbouring Baden was still in guild hands.)

The arrival of the railway in 1840 reduced the isolation of Württemberg and Stuttgart and opened a huge market for machines. Imported locomotives had to be adapted for the mountainous environment of Stuttgart and other parts of the south-western German territories. Firms emerged to produce machine tools for the construction of both locomotives and spinning machines.

Steinbeis' ambitious programmes helped to diffuse knowledge of machine construction throughout the region. The Central Office established a workshop where foreign machines were made available for study. Fairs were organized, and the *Landesgewerbeamt* (LGA), which still acts today as an organization of the *Land* government and carries out programmes for the support of SMEs, helped to settle firms which specialized in machinery construction (Semlinger 1993). Technical

colleges were established, and student exchange programmes supported knowledge transfer from beyond Württemberg's borders.

A major breakthrough came with the development of electricity – in Stuttgart represented by the firm of Robert Bosch – and the early days of car construction. Gottlieb Daimler founded the Daimler-Motoren-Gesellschaft in Canstatt in 1890. It produced motors for coaches and ships. Magnetic ignition, an invention of Bosch, was introduced for the production of Daimler's motors, Daimler himself abandoning his own ignition system (Daimler-Benz 1998). Around the turn of the century Bosch and Daimler became the first Stuttgart firms to employ more than 1,000 workers. In 1926 Daimler merged with Benz & Cie. and was transformed into the Daimler-Benz AG with its home base and central administration in Stuttgart.

Many inventions in car construction and other sectors came from the machine tool industry, which changed the inner structure of firms as new machines stimulated rationalizations. (This mutual penetration of sectors even today constitutes a comparative advantage of the area's machine tool firms and is the main reason for clustering.) Locally sourced machine tools introduced new production methods at Daimler, for example the presses manufactured at Weingarten, which enabled production of large parts of the car body with a single machine (ibid). Daimler's efforts at vertical integration, and thus the establishment of hierarchical governance, would have been more difficult to manage without the quality and customer orientation of local machine tool firms. This was probably less a conscious decision by individual firms than the most viable road to success given initial backwardness. And the quality of Stuttgart's machine tools met the standards of the local motor industry.

While big firms created a certain demand structure, machine tool firms did not completely rely on these new industries, but had been watching out for other opportunities in the textile, paper and printing industries - but within a process of 'coordinated specialization' as Herrigel (1987) argues. Specialization in general was necessary to fulfil customer requirements for specific machine tool functions in high quality market niches. A coordination of this process was necessary to avoid competition between the sectorally specialized firms and to secure cooperation. Herrigel shows how this rested on associations like the industry association of the machinery industry, the Verein Deutscher Maschinen- und Anlagenbauer (VDMA) or the Union of German Engineers (Verein Deutscher Ingenieure - VDI). Both are typical examples of German organizations concerned with the production of LCCGs,

especially for training and innovation. The VDI had to organize the education of engineers at polytechnics, since engineering was difficult to establish at university level throughout the 19th century (Keck 1993). Although Germany had 27% of the world production of machinery in 1913 (ibid), the education of engineers was considered a second-rate science.

However, in Stuttgart and Württemberg engineering constituted a way out of agrarian backwardness; the polytechnic school in Stuttgart had been transformed into a *Technische Hochschule* (allowing university level technical education) as early as 1876. The consequent specialization in engineering disciplines helped the industry compete successfully against British and US firms. The relevance of singular engineers and inventors like Gottlieb Daimler, Ferdinand von Zeppelin, Wilhelm Maybach, Ferdinand Porsche or Karl Benz cannot be denied for the region. However, increasingly important was this general scientific approach towards inventions in the field of machinery construction. The University of Stuttgart established chairs for motor vehicle construction and aviation technique in the first quarter of the 20th century.

As Keck (1993) has shown, higher education was generally important in Germany after 1870, but the specific specialization of Stuttgart and Württemberg needed additional instruments of collective goods provision, even in such well established fields as worker training. For larger firms it has always been important and possible to develop such skills via in-house production; in 1925 Daimler had established an in-house apprenticeship school (*Werksberufsschule*) which on average had 200 apprentices obtaining their certificate every year (Daimler-Benz 1998). It has also been claimed that inter-firm cooperation, even between competitors, has also been important (Herrigel 1987; 1996a). This has recently been contested, other scholars denying that regular cooperation among competitors can be found (Braczyk, Schienstock and Steffensen 1996; Kerst and Steffensen 1995). Although we shall show that such cooperation began to rise under the pressure of increasing competition in the 1990s, in general clustering of machine tool firms does not *primarily* result from cooperation among small firms, but from that between large customer firms and SMEs - from the networked firm rather than from networks of firms (Crouch and Trigilia 2001).

Adaptation of the DQP-regime in Stuttgart since World War II

The production range of German machine tools has decreased dramatically since World War II. This means that individual parts now carry a much higher value added. Therefore cooperation was more necessary in earlier days, when a well equipped supply network of many different firms was needed to produce a machine tool:

In the 1970s a machine was probably composed of 500-800 parts. Today a machine of that kind could be made out of 100-150 parts. It has a much higher productivity, a higher capacity and its parts are of higher value, but also they are just buy-in parts (Interview BW-F-01).

Vertical buyer-supplier relations became even more important because of this development, but such intensified vertical relations only made sense where a few important business partners were able to produce high value-added machinery parts. Consequently, firms cooperating vertically pushed each other into high price, high quality market niches, thereby fostering the DQP path for the local industry. On a macro-economic level, Streeck (1991) has shown the connections among such a development in the production regime with a high-wage economy (Vitols 1996), the underlying social understanding of *Beruf* (Streeck 1996), and an advanced welfare state. Stuttgart's governance structure fitted well into this national institutional environment, because its local economy was oriented towards high quality standards, which had been achieved by regional support for qualifications in engineering.

In the Federal Republic the development of technological change in machine tool engineering has been supported by public actors such as the Federal Ministry for Research and Technology (BMFT), industrial associations like the VDMA and the unions - which in the 1970s and 1980s were concerned with social issues raised by technology. Political parties battled over the appropriate public policy instruments to support innovation. Two major approaches had evolved as opposing strategies to shape the machine tool sector as well as other innovative capital goods industries. The conservative parties proposed an *Ordnungspolitik*, whereby the state would just to set the framework for private entrepreneurship. The Social Democrats, then in government, contested this with what they termed *Strukturpolitik* (Ziegler 1997).

Strukturpolitik involved government, advised by experts, anticipating major challenges to industrial sectors and safeguarding their technical development. In 1974 a Commission on Economic and Social Change recommended initiating

programmes on the capacity of tool-making and numerical control for machine tool firms. Although these measures took account of the DQP-regime and the high share of SMEs in this sector, the general policy impact was ambivalent. In the beginning it neglected smaller enterprises. This was due to the fact that many measures by the federal government had neither been sector specific nor in particular designed for SMEs, but aimed at the innovation resulting from cross-sectoral demand for new technologies. These had been termed key technologies (*Schlüsseltechnologien*). Their technical development was supposed to be supported by indirect-specific measures, by which grants were offered to those firms expressing an interest. Very often it was large firms which made use of these grants, because their in-house capacities for the production of collective goods gave them resources that SMEs lacked. Consequently the federal government strengthened the role of large firms as flagship enterprises, while a complementary strategy for smaller firms was pursued at *Land* level and by associations.

The VDMA and VDI supported the struggle of SMEs to develop customized products which met the demand of new technology, and these efforts were accompanied by programmes of the *Land* government. In particular the restructuring of the Steinbeis Foundation (described in Glassmann and Voelzkow 2001) played an important part, because it received enough funding to act autonomously (Semlinger 1995). In addition, the Landesgewerbeamt (LGA) provided support specifically designed for SMEs, while *Land* polytechnics and universities specialized in particular engineering disciplines. In these ways the *Land* government integrated the local production base further into the existing technology transfer and knowledge transfer infrastructure, achieving a better supply of collective goods for SMEs.

The net consequence was even stronger ties between SMEs and large firms. The mutual penetration of different sectors - diagonal cooperation - was deepened in the mid-1970s by research projects (also funded by the federal government) of the Fraunhofer Institute for Production Technology and Automation (IPA), an institute for applied research located in Stuttgart. Thus the government made use of the established external support infrastructure for the production of collective goods, thereby creating what might be termed the German version of *servizi reali*, though these goods had not been produced only for the local production system. Geography has never been a restriction for the German system of collective goods provision, just an opportunity to pool resources. The territorial and sectoral dimensions of the production system are quite balanced, which can be demonstrated by the relevance

of further innovation in the industry, initiated elsewhere and then later adapted by firms in Stuttgart.

For instance, in 1975 the Institute for Machine Tools at the Technical University of Berlin cooperated with one of the largest German lathe producers, Gildemeister, to develop an '...integrated operating system for numerically controlled lathes...' (Ziegler 1997: 132). In one of our firm interviews we discovered that these machines had later been bought by a small machine tool firm in Stuttgart from Gildemeister, which itself had obtained government aid up to DM 1mn. for the development. The firm which had first bought the new machine arranged a press conference and invited other Stuttgart machine tool makers, in order to present the latest development on numerically controlled lathes for which the firm in Stuttgart then developed parts of the machine tool system (Interview BW-F-10). From this event developed many new firm contacts including a long term relationship with Gildemeister. However, these had been pure market relationships, beginning at a fair for machine tools. No horizontal ties had been established.

German machine tool firms tried to acquire LCCGs through corporatist interest networks in which solutions for newly emerging collective goods problems were jointly articulated and solved. Such arrangements existed on the level of the federal and *Länder* governments with a corresponding associational support that is typical for Germany (Mayntz 1989). These arrangements were needed in particular when the federal government realized the necessity for further support of SMEs in the machine tool industry. The first programme carried out according to the research demand of smaller machine tool firms (i.e. up to 1,000 employees) was implemented in 1979 by the prominent *Arbeitsgemeinschaft industrieller Forschungsvereinigungen* (AiF). This is an intermediary organization responsible for such tasks at SME level (Hirsch-Kreinsen 1993: 195). The FDP-led Ministry of Economics contested the ignorance of SMEs' problems of the SPD-led Technology Ministry, and did not force firms to follow a particular strategy for innovation. Technical options were to be chosen by firms themselves, respecting their standard of technology and specialization within the industry. This conflict between the policies of two federal ministries was less a result of different party control of the ministries than a general problem resulting from the fact that the Technology Ministry was concerned with structural policies. Although intervention in this field was originally a task of the *Land* government, the federal government expanded its competences, but aimed at large enterprises only. It took time until the federal government realized that it could

not claim responsibility for support measures in technology transfer and at the same time neglect the demand of smaller firms.

In the early 1980s measures were implemented for the development of products using microelectronics, which aimed at long term innovation in defined key technologies. DM 450mn. were spent within two years for a federal programme which was finally designed for SMEs (Ziegler 1997). The machinery industry had run into severe crisis in Germany, including Baden-Württemberg. But it recovered soon after 1983, probably also because the innovation process induced the production of new flexibly usable machines. The subsequent outstanding local production regime of Stuttgart's machine tool industry was in reality based on national policy initiatives.

From the beginning therefore the local economy of Stuttgart was a networked firm economy dependent on large car and electrotechnical firms as well as general support from the federal government. The specialization of firms was customer oriented and technology- and quality-driven. This road to success certainly fitted the science-based approach and individualistic mentality of the south-west German territories. The consequently developing *Sondermaschinenbau* which produced machines in high price and quality market segments and did not compete with mass products still flourishes today, probably much more vital than many scholars had predicted in the 1990s.

Performance since the early 1980s

Any lessons learned from past research on the performance of local economies is unlikely to predict their future prospects; one cannot easily draw conclusions from the social organization of the economy concerning the immediate market benefit this organization creates. Many argued that Baden-Württemberg would benefit extraordinarily from its rich support environment in technology transfer (Piore and Sabel 1984). However, when the crisis of the early 1990s shook the region, the argument was turned around and the same organizations previously enumerated as promoters of outstanding economic success were now creating lock-in effects (Cooke and Morgan 1998). By the end of the decade many firms had gone bankrupt, but others survived surprisingly well and witnessed a brilliant recovery. These trends change so quickly that it does not make any sense to use them as indicators of long-term success or failure of the social institutions in which markets are embedded. Institutions adapt their capability to support a local economy with LCCGs after a

phase of hard learning and thus with a time gap which may often cause further downturns. What we have to explain is the specific solution Stuttgart chose in order to remain in the league of successful economies.

The cluster we examine is confined by the borders of the Stuttgart region, which contains six *Landkreise*: Stuttgart, Böblingen, Esslingen, Göppingen, Ludwigsburg and the Rems-Murr-Kreis. In 1982 there were 444 machinery firms in this area; 480 in 1992; 441 in 1994). Esslingen, which was among the areas where the industry emerged in the 19th century, still has the highest percentage of machinery firms in the region, more than 120 having been identified there. Unfortunately we do not know at this aggregate level how many of them are machine *tool* firms. Many have diversified their production. For instance, we found a firm which produced lathes as well as packaging machines. Smaller suppliers may not specialize in tool systems but only on less complicated parts, and thus supply machinery firms with a varied product range. Especially because of transportation costs, such smaller suppliers often limit their activities to the region; even integrated machinery parts were sourced with '95% from firms operating in a distance not greater than 100 km' (Interview BW-F-01). However, such approaches varied and seemed to depend on the size of firms and their market strategies. Bigger firms had sometimes already changed from regional to global sourcing in the 1980s (Interview BW-F-18).

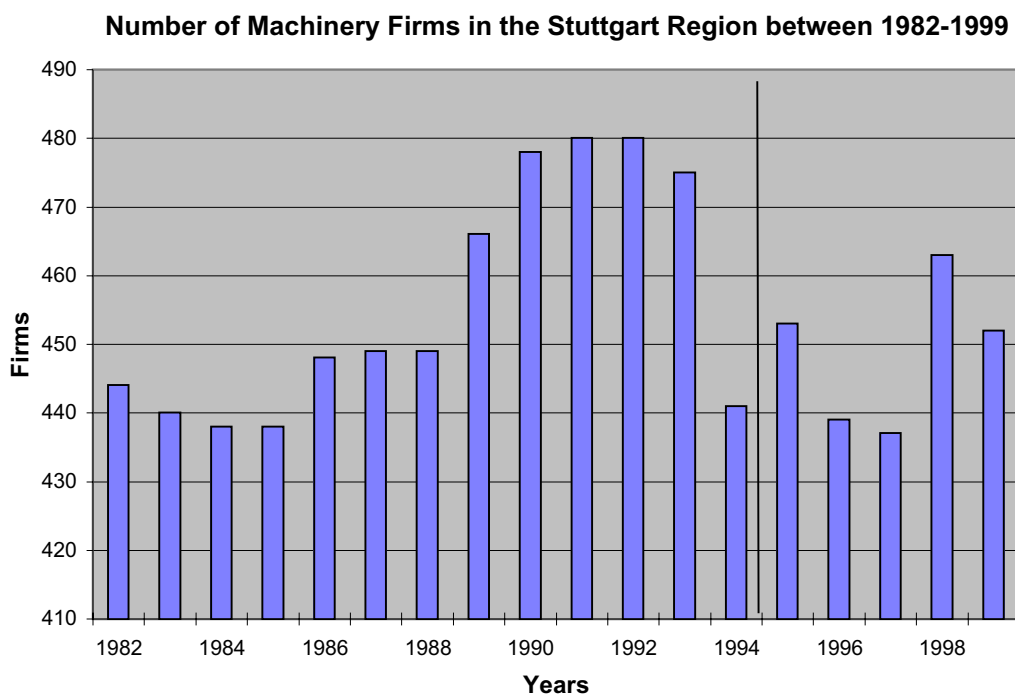
Quantitative data analysis shows that in 1990 machinery firms sourced 12.3% of machinery parts from within the *Land*, while about 30% of the generally supplied components and services for machinery firms in Baden-Württemberg were machinery parts (including steel and ADP in both cases) (Heidenreich and Krauss 1998: 226) (see Figure 3.1). This might not seem much for an Italian industrial district, but it is evidence of close local buyer-supplier relations in Germany, where firms still rely heavily on in-house production (Knodt 1998; Hirsch-Kreinsen 1993).

While trade with firms in foreign markets should have alarmed observers of the branch in 1991, the reunification boom compensated for this in 1991 and 1992. Then, in 1993 turnover of machinery firms in the Stuttgart region shrank from DM 19 bn. in 1990 to DM 16 bn. (see Figure 3.2). Changes in statistical classification make it impossible to compare data before and after 1994; a much higher level of turnover and employment in 1995 may be partly a statistical artifact. However, we can analyse developments from 1995 onwards. With the exception of 1999 turnover of machinery firms in the region has continuously increased. In fact, the relative

increase of turnover between 1996 and 1998 is comparable to the growth between 1988 and 1990 when it reached its highest level before the crisis.

However, the employment situation has been reversed (see Figure 3.3). While in the growth period at the end of the 1980s employment rose to 85,546 employees, by 1994 it had declined to 67,478; 18,068 workplaces had been lost in four years. Between 1995 and 1999 employment decreased again, causing a further loss of 8,314 jobs.

Whereas in the 1990s too many engineers entered the labour market, today firms are searching in vain for qualified personnel, despite the fact that they employ fewer workers overall. This raises the question where the many workers and engineers made redundant in the years of crisis have gone. Workplace statistics on the machinery sector show that many of them are 'older' workers (over 45) (VDI 1997). For many it might be difficult to re-enter the labour market, either because they are not qualified enough or they simply appear to be too old.

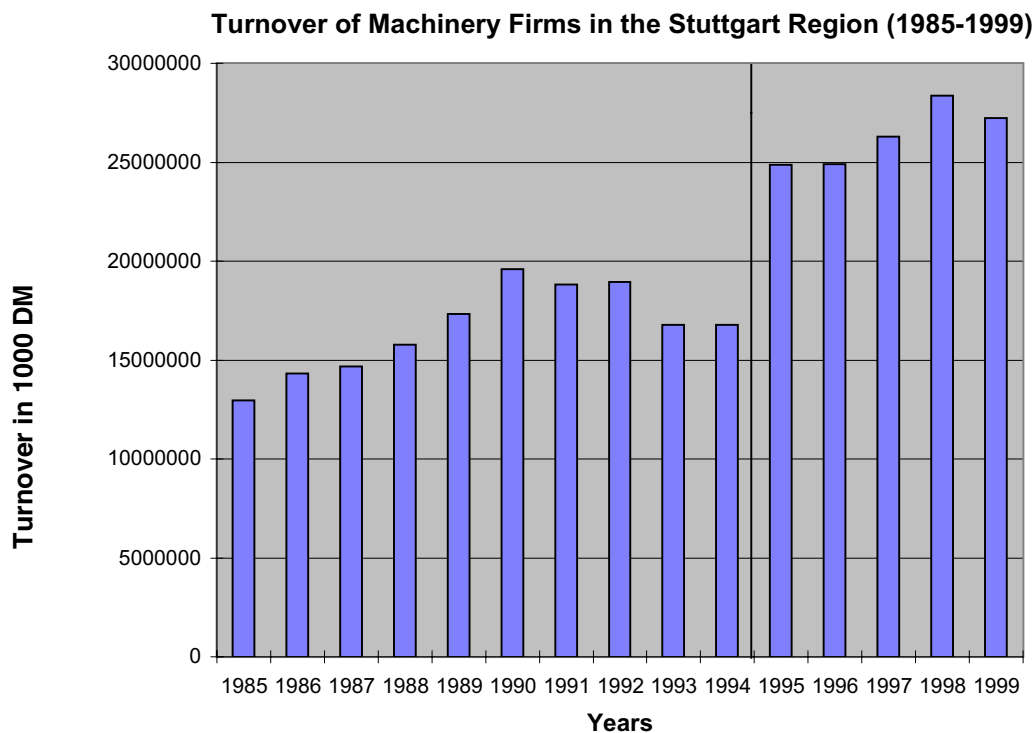


Source: Statistisches Landesamt Baden-Württemberg div. Vol. (1982-1999), Monatsberichte für das Verarbeitende Gewerbe, Baden-Württemberg
 Due to the new classification of sectors, data from 1995 onwards is not directly comparable to previous numbers of firms.

Figure 3.1: Number of machinery firms in Stuttgart area, 1982-1999

Individual firms have recovered. Those which survived the crisis (still 452 firms in 1999) managed to position themselves quite well again on the market, though the economy remained fragile. Bankruptcies continued to increase in Baden-Württemberg until 1997 (Statistisches Landesamt Baden-Württemberg 1999a).

The banks had withdrawn from the industry after the collapse of Deckel Maho, which was later taken over by Gildemeister. SMEs in Stuttgart were therefore forced to leave their capital in the firm. Their survival became dependent on their willingness and capacity to invest in innovation, their capability to restructure according to more efficient standards of production, their niche specialization (previous strong dependence on the motor industry, which also suffered from decline, had proved to be a weakness), and of course the capacity to find new customers in foreign markets, where Japanese or American firms had beaten German competitors with lower prices. To restructure the product segments and to adopt a new philosophy of cost-control became essential.



Source: Statistisches Landesamt Baden-Württemberg, div. Vol. (1985-1999), Monatsberichte für das Verarbeitende Gewerbe, Baden-Württemberg
 Due to the new classification of sectors, data from 1995 onwards is not directly comparable to previous numbers on turnover.

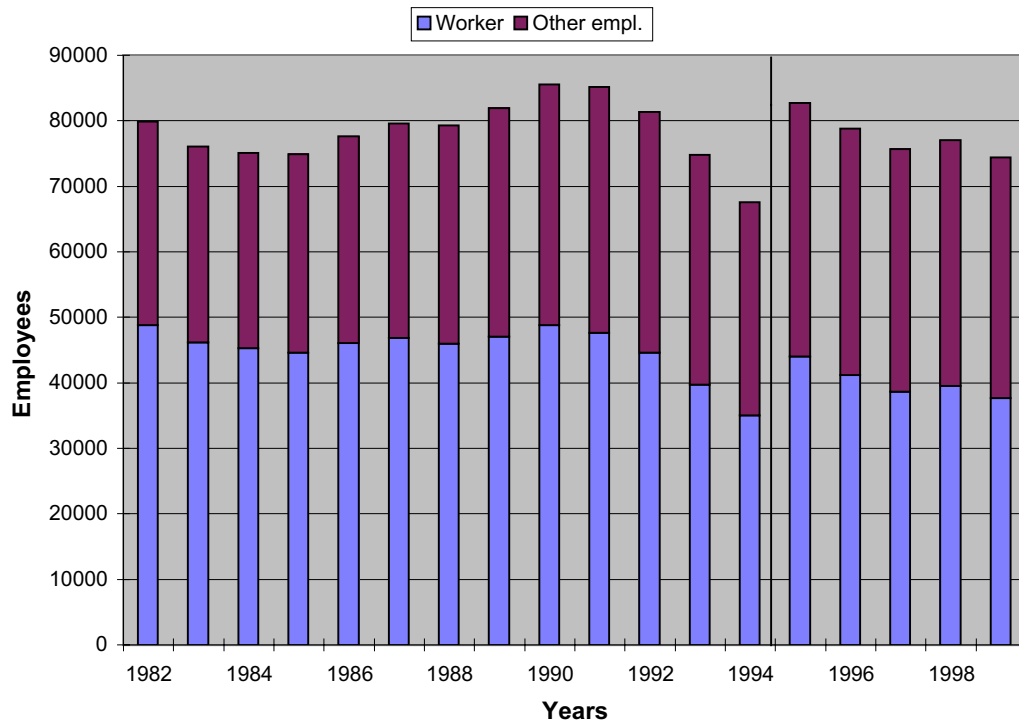
Figure 3.2: Turnover of machinery firms in Stuttgart area, 1985-1999

Why the networked firm model became increasingly important

The 1980s had been turbulent for Stuttgart's machine tool firms. They had begun with a severe crisis and ended with a period of unprecedented economic success, a high estimation of their flexibility and a still growing demand for their high-price, high-quality engineering products. A major challenge occurred with the introduction of microprocessor electronics in machine tools, because this technology had to be integrated into the product as well as the production process. If firms wanted to stay on the path of customized production, the new technology had to be individually adapted. Consequently, firms could not make use of a standardized innovation scheme. To what extent and in which ways a firm implemented CNC technology had serious implications for investment in sophisticated R&D, the cost and design of the product, their potential usage and rationalization effect in the production process of the user firms. Entrepreneurs had to take into account the reorganization of the work process induced by the new machines being bought in or developed. While automation was always one of the major intentions behind the development and application of microelectronics, the firms in Stuttgart refused to 'benefit' from such innovations. Their highly qualified workforce was acting in an environment of changing and multidimensional tasks. Cooperation between engineers and machinists was a frequent and integral part of the day-to-day work process. However, inventions in microelectronics made possible a further elimination of such forms of cooperation, as well as a more executive function for the machinist once these programmes were operating (Hirsch-Kreinsen 1993).

Their implementation shifted the production process towards a more integrated system of toolmaking, while individual machines could be designed for flexible use. Until the 1970s relatively inflexible manufacturing lines had been established in bigger firms of related sectors according to Taylorist needs. In the USA machinery firms with a strong orientation towards the military and aerospace sector had promoted a further use of numerically controlled machines as part of a centrally steered manufacturing process. This created rationalization effects through a high level of automation. While the machine tool firms in Stuttgart had also tried to apply innovations from microelectronics to their machinery design, it took longer until this knowledge was diffused in firms and until they implemented shop floor solutions. Finally they chose a totally different path of innovation compared to other countries (ibid).

Employees in the Machinery Industry in the Stuttgart Region (1982-1999)



Source: Statistisches Landesamt Baden-Württemberg, div. Vol. (1982-1999), Monatsberichte für das Verarbeitende Gewerbe, Baden-Württemberg
 Due to the new classification of sectors, data from 1995 onwards is not directly comparable to previous numbers on employment.

Figure 3.3: Employees in the machinery industry in Stuttgart area, 1982-1999

For centrally steered machine tools highly skilled machinists were less important than for machines which allowed shop floor programming. Stuttgart's firms would have lost their production base if they had followed this trend, because the qualification of *Facharbeiter* and their abilities to handle machines on the shop floor secured the high quality of their products. Apart from this, firms would have sacrificed their niche specialization if they had tried to make use of the general innovation path by which CNC-technology was spread in the industry. The aim instead was to make use of this technology and adapt it to the special needs of customized machinery on a high quality standard. In this context, some authors had suggested that German firms might have kept their innovative potential by a strategy of deepening their specialization (Sabel et al. 1989). Häusler (1990) argued against this interpretation, because medium-sized firms restructured for the acquisition of competence in new technology fields, thereby widening their range of

products and extending them towards machine tool *systems* instead of specialized machines. However, the particular German variant of these systems lay in the design of confined automation and of decentralized options to steer them.

From the organizational perspective, firms could not reduce their cooperation in exchanges of information and support between customer firms and specialized suppliers. Instead they had to watch out for cross-sectoral forms of cooperation between electrotechnical firms and machine tool firms. They had also to intensify their vertical relations with customers, in order to follow a less market-based and a more technology-driven path of innovation (ibid). These forms of cooperation fostered the networked firm model in Stuttgart, which favoured collective goods exchange via vertical customer-supplier relations.

Changing forms of governance

In tracing the development of new patterns of governance analysis needs to make use of all the governance modes identified as relevant to local economies (Le Galès and Voelzkow 2001). However, these mainly appear in various hybrid forms.

Some issues were of general and collective concern; for instance the creation of a universal and commonly used programming language. These measures had been carried out indirectly by the state. Cooperation between firms had been established to meet this demand. But the technical adaptation to specialized machine tools required R&D measures implemented by the firm. Unsurprisingly, Hirsch-Kreinsen (1993) reports that R&D measures in the machinery industry had been much higher in Germany (on the firm level) than in the USA in the 1980s. Many firms which we interviewed stated that customer demand was essential for the firm's own learning and the actual adaptation process. Some mentioned that customers gave advice on the R&D process, but not all of them supported this development by providing infrastructure such as laboratories to the firms (Interview BW-F-03).

Many developments therefore had to be made in-house by the firms themselves, because they knew best how to implement this technology. One entrepreneur bought steering equipment from the USA and constructed an automatic drilling machine; he then invited other firms in Stuttgart which supplied this firm and pointed out that there was a complete new market niche evolving from which they could all profit. A popular new invention in the 1980s was the processing centre (*Bearbeitungszentrum*) at which several different phases of the work process could be handled. This firm earned most of its money during the 1980s just by selling a

particular component for processing-centres (Interview BW-F-08). There were more examples which showed that, while some software components came from the USA, their adaptation and the mechanical side of the R&D process were completed in-house in Stuttgart (Interview BW-F-03). But more common was in-house production of CNC machines, cooperation between larger machine tool firms and SMEs, or cooperation between electrotechnical firms and machine tool firms or large customer firms and machine tool firms. The wide variation in the cooperative mode shows that exclusive reliance on in-firm governance was seldom viable or useful. Nevertheless, the scale of in-house contributions to new inventions was impressive. One firm reported that it had produced the first numerically controlled lettering machine. The steering technology was developed in-house between 1980 and 1981, and the machine became a huge success on the world market. Such development for machines has often been financed by external organizations, like in the above mentioned case by the Rationalisierungskuratorium der deutschen Wirtschaft (RKW) (Interview BW-F-04). This organization was founded in 1921 by the ministry of economics together with associations such as the VDI. Carl Friedrich von Siemens was one of its founding fathers.

The RKW is a good example of how governance structures are mixed even within a single organization, because its support measures cannot exclusively be regarded as state action. The RKW was designed to support SMEs with services for rationalization and innovation. Its corporatist structure, the involvement of unions, enterprises and the state has been retained until today. After World War II it functioned as a major instrument for the implementation of Marshall Plan measures for German SMEs. As we have claimed earlier (Glassmann and Voelzkow 2001), it is another good example of a combination of federalist and corporatist governance applied to German support organizations. Every *Land* today has an RKW, while its central administration is located in Frankfurt. In order to understand how the high degree of in-house production of LCCGs has been achieved in Stuttgart's machine tool firms, one cannot ignore the regular assistance of external organizations or larger firms. However, this assistance has seldom been reduced exclusively to a local infrastructure.

Machine tool firms traditionally cooperated with customer firms, because the design of their machines was oriented towards customer-specific needs and thus cooperation between these two groups of firms was indispensable. However, Häusler (1990) discovered the additional need for machine tool firms to switch from

incremental customer specific machinery development towards basic research and radical innovation in the field of microelectronics. As a result he observed a growing need for and practice of diagonal cooperation between, for instance electrotechnical firms like Bosch and machine tool firms like Trumpf in Stuttgart (ibid: 93). As stated above, this was challenged by statistical data on the actual relevance of diagonal cooperation (Heidenreich and Krauss 1998; Knodt 1998). Against the latter we claim that such statistics do not take account of the exchange of collective goods. Another reason why this analysis could be misleading is that machinery parts are more regularly supplied and visible in these statistics than are steering components. The latter may be supplied on the basis of *intensified* cooperation. In our interviews we found that such cooperation was becoming increasingly frequent.

It has not been sufficient for firms to cooperate with customers, because these did not have knowledge of microprocessor technology. The influence on machinery design changed towards a greater importance of visions for automation and flexibility created in universities, big firms and research institutes. Because the money for technology policy and innovation was going to both public support organizations as well as big firms, the embedded networked firm model became increasingly relevant for Stuttgart as a paradigm. In our empirical research we found that such cooperation was essential for the survival of the local economy. Firms which specialized in automatic grinding cooperated with a large electrotechnical firm; if a machine tool firm ran into serious problems during the phase in which engineers constructed the grinding machine and even later, experts from the big firm came to help on a non-contractual basis (Interview BW-F-06). Another interview revealed how both sides gained from such cooperation, because the big firms did not know how to adapt their software products to the specialized machinery - for instance hydraulic presses - while the machinery firms lacked the capacity to develop CNC technology entirely on their own (Interview BW-F-15). After having cooperated both firms would establish a regular supply relationship. Thus, the adaptation of this technology was not a big problem for Stuttgart firms. Workers had been qualified in-house as well as in seminars of the big firms. (Courses for retraining had simply been bought by SMEs and are thus a good example of straightforward market governance.)

However, the shift towards a 'technology-push paradigm' in innovation, which was necessary to sustain the competitiveness of high quality machine tool products, created the later criticized effect of over engineering (Cooke and Morgan 1998). This

resulted from the shift of learning from customer firms towards a more sophisticated approach to machinery development and automation. Both public and private enabling institutions encouraged this path, because customizing alone would have reached its limits as a strategy to avoid competition over prices. Some engineers in our interviews agreed that over engineering was a serious problem later, while others insisted on the fact that customers asked for this kind of development.

Outsourcing was a limited strategy to improve the competitiveness of machine tool firms in the 1980s. It had to be done for reasons of competence, but was regarded as insecure. Flexibility resulted from in-house resources, and less from external networks of small firms (Interview BW-F-03). When very complex parts had to be ordered, they often had been manufactured by firms of the region, in order to secure communication on orders and technical problems. Only the latter form of inter-firm-relationship may be described as a pure market transaction. To explain how LCCGs have been acquired by a market governance mode is not easy, because of the depicted shift towards intensified cooperation. However, this kind of cooperation often consisted of mutual counselling on the part of the innovation process, where a firm was able to construct a new product, but did not know how to apply the technology for market niches. The latter knowledge was part of an informal process of cooperation, but the actual exchange of competition goods, for instance the development of a new steering technology, had to be paid for. Either firms paid external organizations for their assistance or they bought each others competence for a new product. Thus, the examples mentioned can be classified as a form of market governance; nevertheless, both sides provided additional support, since both had to gain from the new development of machine lines and steering technology.

Much support for the adaptation process towards the new challenges in the machinery industry came from public organizations. One of these which has been little studied is the University of Stuttgart. Entrepreneurs mentioned it as a useful resource for any cooperation requiring basic research. Heidenreich, Kerst and Munder (1996) deny that such cooperation could have a large influence on firms' innovation path. In their view universities basically serve as an organization for the transfer of human resources, but our interviews confirmed that many entrepreneurs turn to the university or a polytechnic for the solution of a specific innovation problem. Students obtain their diplomas by working on such problems and are often employed later by the firm concerned. But the influence of universities goes deeper than this. The percentage of engineers of all employees in the German machinery

industry has increased from 5.0% in 1968 to 10.5% in 1995 (ibid: 71), and among these the percentage of those coming from a *Technische Hochschule* has increased as well. The formal degree of training and education has risen considerably.

Both formal and informal ties between the University and Stuttgart firms became closer, following the demand for basic research on the firms' side. The scientific infrastructure at the University now includes an impressive range of specialized institutes with contacts to the local economy.

One of these is the Institute of Machine Tools (IfW), which does regular training of engineers at the University and offers various services like geometric testings on machine tools, measuring technical analyses of drives and axes of machine tools, and their design. In addition to this, the institute carries out research projects. Another example of the local specialization of scientific expertise at university level is the Institute for Steering Technology for Machine Tools (ISW). It was founded as a chair at the university in 1965, dedicated to finding computer-aided solutions for problems of automation of machine tools. Today the institute consists of five organizational units, carrying out tasks ranging from central services and steering technology to system integration, design of mechatronic systems and components in robotics. It is interesting to note how the institute finances these two different fields of applied and basic research. Developments in the former are financed by (local) industry, while the basic research projects are supported by public funds. Thus a multiple organizational structure of teaching and research in both fields emerged, allowing a combination between radical and incremental innovation as well as the diffusion of knowledge in both fields.

In general we found that these activities of the university were positively evaluated by firms, though some had been disappointed by the slow speed of completing research. One owner commented: 'If the university cannot solve the problem, I am sure I cannot do it either' (Interview BW-F-02). Although firms were self-confident that their own niche market know-how could not be beaten by university institutes, for more general problems and completely new innovative solutions they showed a receptive attitude to help from these institutes. This gives an insight into how path dependences might result from the embeddedness of a local economy. If the university is estimated as a high-rank specialized organization which provides viable solutions, entrepreneurs might sometimes follow its proposals even if the international market prefers less complex solutions. However, we have no indication that the university created a specific lock-in resulting from its specialization as a

public organization, because it combined basic and applied research. On the other hand, it did not propose any measures which would have complemented the DQP-regime with more marketable solutions.

One might still ask, to what extent this peculiar infrastructure must be regarded as a local recombination of national governance structures and thus whether it would produce different outcomes elsewhere in Germany. A very close link between university institutes and the local economy had indeed been established in 1989 in Stuttgart, when the Centre for Innovative Technologies (ZFS) was founded. The ZFS is a very good example of collective action in the local economy, because it finances joint projects of common concern for a number of local firms. As a foundation which signed a cooperative agreement with the University of Stuttgart, it coordinates projects which are carried out with the support of a number of specialized institutes, among them the IfW and ISW. These projects are financed by some firms in cooperation with the *Land* government. Money can be obtained from the *Land* only if outcomes of general importance for economic performance of the *Land* are expected, or if the project is of a 'pre-competitive' nature.

The firms which have established this cooperation and form part of it are the biggest machine tool firms of the local economy together with Bosch, Siemens, IBM, DaimlerChrysler and a few others. This again supports our perspective on Stuttgart as a networked firm model. While the above listed incentives for cooperation between public and private actors within local confines suggests that there exists a very special network of support institutions in Stuttgart, the only distinctive feature lies in the high sectoral specialization of these networks, not their general organizational structure. Another example may illustrate this: Among the institutes which cooperate in the ZFS is another university organization, the Institute for Laser Tools (IFSW), which has specialized on the development and application of laser technique in industrial production. It is especially interested to diffuse this knowledge in SMEs. Therefore it cooperates with specialized institutes in this field of innovation and chambers of commerce throughout the whole *Land*. As a result of these activities a Joint Council on Laser Technologies South West was founded.

While the IFSW in Stuttgart coordinates the services of this Council, capacities outside Baden-Württemberg are also involved, and specialized institutes from Hesse are incorporated into the Council. This network is financed by the Federal Ministry of Education and Research (BMB+F) as well as the *Land* government. As an initial step to support innovation, SMEs are given free access to the services of this network

once a year, including advice on the application of lasers, development of new applications, planning of systems, qualification on these new systems. There is also a national competence network just for this specialized technology. Even in such highly specialized niches, Stuttgart has not created unique organizations.

Vocational training and the re-regulation of the training system in the 1980s were other areas where national organizations were fundamental. The employers' federations as well as the unions participated in a complex interplay between firms, public institutions and the workforce, initiating training efforts and co-deciding on organizational tasks of training (Streeck et al 1987). It can be argued that this system responds slowly to needs for change, as new curricula have to be integrated into the courses of the public vocational schools, occupational profiles have to be recreated etc. In our interviews this was less discussed as a problem with respect to the challenges of the 1980s than for more recent ones. In general, entrepreneurs argued that the high skill level of trained *Facharbeiter* made it easy to retrain workers for CNC-machines. Further training is the responsibility of the firm, which prepares workers for its specific niche competence. The results of our interviews here confirmed the analysis carried out by Bergmann et al. (1986), who also pointed out that adjustment of training profiles in the machinery industry was not problematic.

A community governance mode requires vertical or horizontal ties on an informal basis between firms, and some common values supporting their mutual help and cooperation. We found indeed several firms which had friendly relations with others, and which were able to rely on their help. In one case all employees of a bankrupt firm were found work by a neighbouring company (Interview BW-F-14). In another case a firm allowed a competitor to use a certain component for which it did not itself have the know-how (Interview BW-F03). The most recent examples resulted from the pressure on small firms in an environment of increased internationalization. In the growth period of the 1980s most firms saw only risks in giving information on their products or developments to other firms. This changed during the crisis, though cooperation remained on a bilateral base (Interview BW-F-01).

Some firms kept their cooperation a secret, because they did not want their customers and employees to know. Joint developments were than safeguarded by an external bureau, to ensure that neither firm had knowledge of the special competence of the other (Interview BW-F-10). It was difficult to discover any shared values as a base for the joint production of LCCGs. Two entrepreneurs said that

hypothetically it would be possible and useful, especially in the sub-sector of turning machines (highly concentrated in Stuttgart), to develop lines of machine tools together, but this was wishful thinking (Interview BW-F-16): 'Cooperation with other firms is generally difficult, because individualism is very strong in this region' (Interview BW-F-07). In the eyes of many entrepreneurs their firms were not part of a mutually supported local growth process. Where such interdependences existed, they were seen as unavoidable risk factors. Interviewees preferred to act in-house and not give information to external engineer bureaus (Interview BW-F-03).

Because of this unwillingness to cooperate machine tool firms limited their links to subcontractors, using the links only to reduce production range and increase productivity, not to try to qualify a horizontally acting network within the local economy. This does not contradict our concept of the networked firm model, because with this we highlight the vertical relations between large firms and SMEs. Subcontractors of SMEs existed as well, but have not been networked with the machine tool firm. Business relations remained bilateral between subcontractors and the machine tool firm. The flexibility of a network was explicitly denied, while flexibility potential was seen in the pooling of in-house resources (Interview BW-F-08). Interfirm contacts often remained on a bilateral base, and within these confines they were formal, though might become friendly if entrepreneurs knew each other, for example through their studies at the same polytechnic in Stuttgart. The production of LCCGs was a difficult task due to this bilateral character of interfirm contacts, but we shall see that the increase in competition paradoxically changed this attitude.

Offe (1999) has pointed to the fact that a mix of governance modes is always necessary to compensate for the disadvantages of any one. In this way associational governance helped to eliminate the weakness of the community mode. For instance the same entrepreneur who stated that in-house production of collective goods was the most efficient strategy to preserve flexibility for the firm, participated in a joint management project, designed for eight SMEs of the region. Here he had learned about the disadvantages of the entrepreneur as the exclusive and dominant holder of knowledge of his product. He had implemented several of the principles which had been discussed, such as internal transparency of the firm and possible strategies for cooperation (Interview BW-F-08). This workshop was organized by the Fraunhofer Institute in Stuttgart, the *Landesgewerbeamt*, the *Arbeitsamt* and the local chamber of commerce.

In general, however, the local chamber was not regarded as important for the production of collective goods. In an interview with the chamber it was stated that its image problem resulted from the fact that it is primarily occupied with such issues as training (Interview BW-I-05) - collective goods which the German entrepreneur takes for granted from public organizations. In fact, the IHK Stuttgart has always pursued a neo-liberal strategy of non-intervention. In line with the conservative *Land* government in the Späth-era, the IHK allied itself ideologically with the *Land* government and its semi-public organizations like Steinbeis against the unions (Knodt 1998), which had an almost hostile relationship with the IHK in the 1980s and a non-existent one with other support organizations (Interview BW-I-04). However, IG-Metall argues that its strategy of 'interest-based co-management' allowed it to fulfil its original role as a union, while in other *Länder* the closer connection between the governing SPD and the unions produced conflicts of interests. IG-Metall in Stuttgart was present in the typical niches of LCCG provision, for example regular negotiations over wages with the regional employers federation VMI or Südwestmetall, and asserting qualitative issues such as *Erholzeiten* (relaxation time) and ecological questions within industrial relations (ibid).

Industrial associations belong to a third category. As a leading support association, the VDMA and its subgroup for machine tools (VDW) has often been mentioned by machine tool firms as a useful association for assistance with technical data, advice on legal questions, etc. Regional bureaux of the VDMA exist in Stuttgart and decentralized support is offered, but again the association is embedded within a national institutional framework. Another association illustrating how this governance mode compensates for lacking community-based solutions is the VDI. It long ago established a regional organization which is responsible for the old territory of Württemberg, the *VDI-Haus Stuttgart*. Today it is organized as a non-profit association and is able to acquire public funds from both federal and *Land* governments. Its aim is to diffuse knowledge of engineering to all levels of the firm hierarchy. In an interview with the VDI the secret of its success was depicted as lying in the voluntary participation of local entrepreneurs in workshops, seminars and lectures (Interview BW-I-01). Local machine tool firms confirmed, that although they would hesitate to cooperate voluntarily with other firms, they would frequently participate in these seminars of the VDI and exchange information on practical problems regarding innovation and firm organization. Cooperation at the VDI is not restricted to machine tool or machinery firms, but extends into the car industry, car

suppliers, and electrotechnical firms. But still local firms ask the VDI whether it could offer these seminars in-house. For legal reasons it cannot do this. Local entrepreneurs are forced to make use of the general programme the organization offers. We see how legal and formal aspects enforce collective action where associational support would otherwise just be used for a single firm's benefit. This creates the positive by-product, that entrepreneurs talk to each other and discover common concerns. The VDI in Stuttgart is linked to the Fraunhofer-Institut (IPA). Lecturers are invited from the university, and staff members of the VDI also participate in subcommittees of the *Landesgewerbeamt*, which discusses issues of vocational training for the engineering sector. Thus the VDI illustrates how public organizations and associations (excluding the unions) are networked locally and support the cluster with collective goods. However, in the 1990s the market situation changed and this regional support infrastructure had to be adjusted to new challenges.

Strength and weaknesses of the networked firm model

The crisis of the 1990s in Baden-Württemberg has been much debated (Cooke and Morgan 1998; Braczyk, Schienstock and Steffensen 1996; Herrigel 1996b). Eventually however firms recovered. How did they and public actors achieve this?

Challenges for firms - transformation of the local machine tool cluster

Some firms reported that 1993 was the worst year in their entire history of entrepreneurship (Interview BW-F-08). The comparative advantage of high quality products turned into a disadvantage. This was largely the result of a downturn in traditional mass markets. Almost every interviewed firm produced components or machines for the motor industry, either by supplying directly to firms like DaimlerChrysler or to suppliers, or to other machine tool firms which depended on the motor industry.

While in times of growth the networked firm model meant that smaller firms could be supplied with LCCGs by larger ones, in times of crisis this dependence created three negative effects. First, the absolute number of orders for new machine tools decreased enormously. Second, the restructuring of the large firms introduced new systems of control, which meant that price margin now became the main relevant measure by which supplier relationships were kept or cancelled. Third, while in times of growth a customer firm would make its small suppliers think

creatively about innovations, it now only supported innovation if the new product could fit its own existing calculations. An internal restructuring process, which allowed machine tool firms to produce machines within the demanded price margin, became essential. The centre of attention shifted from product-based to process-oriented innovation, for which in most cases the customer firm made itself responsible. The networked firm had the advantage over an informal network of firms that it could steer the innovation process hierarchically. But this meant that the local economy had to implement the cost reductions which large firms demanded. Japanese machine tool firms had entered German niche segments with simple and low cost products, even at the high quality end (Naschold 1996).

As a result, six processes transformed the local machine tool cluster: (1) firms began to restructure their production process; (2) there were massive redundancies; (3) low cost standard machines were added to the current programmes; (4) many firms went bankrupt, while takeovers were organized by the more successful firms; (5) smaller firms began to cooperate more frequently with each other to meet the new criteria for production; and (6) firms invested into new high quality products of their original competence.

(1) The restructuring process of firms was oriented towards the concept of 'lean production'. Flat hierarchies had always been characteristic of Stuttgart's machine tool firms, and a total transformation according to the Japanese paradigm was neither planned nor possible, for cultural reasons which Streeck (1996) has explained for other sectors. Nevertheless, some elements of the lean production concept had been introduced in larger firms, particularly group working. Not all firms saw a need or benefit in this, but those which switched to it reported that the production process was more efficient. However, two problems arose, concerning the qualifications of workers and formal firm hierarchy.

Since workers had been used to operate on only one or a few machines, the concept of group working demanded greater flexibility, not only knowledge of several machines, but also of different aspects of the production process (e.g. mechanical as well as electrotechnical aspects). The existing training system had restricted such mixes of the knowledge base, vocational profiles being designed to represent portable skills for one specialized part of production. The training system needed to create mixed profiles such as the 'mechatronic'.

The problem of firm hierarchy was often that the *Meister* could no longer function as the leading figure in the team. More important was who was able to work with new machines and teach other members of the team. These were sometimes *Facharbeiter* from other firms, newly brought in following restructuring. This of course created hostility within the old workforce, which was not used to accept the authority of informally qualified and formerly external personnel. In one case there was an anonymous threat of violence against a new team leader (Interview BW-F-12). However, workers eventually accepted the new situation because, according to the interviewee, they were fascinated by the new machines.

Some firms had specialized experts for every segment in standard, high and low cost niches, though they were all responsible for the same machine tool system. Due to the central aim of cost reduction, firms integrated such different segments, dismissing two engineers and leaving only one responsible for all types of machines in one segment (Interview BW-F17). Firms tried to become more efficient in connecting the sales department and construction bureau with the shop floor, not only by applying computer programs, enabling data to be sent from the construction engineer's desk to the shop floor machine, but also by cooperating directly. In one firm, which applied the lean production concept most closely, teams were formed for every new contract on a new machine tool. This structure was implemented in the sales and purchasing departments as well as on the shop floor, and both levels cooperated to increase the quality of time management, logistics etc. (Interview BW-F-16)

(2) We have already shown that employment declined. In all firms we were told that the least qualified or oldest workers had to leave. Retraining is now often seen as a key element for future success. All entrepreneurs were satisfied with the training system and stated that additional skills should be created on the basis of *Facharbeiter* knowledge. However, some firms began to employ unqualified workers and train them in-house, often foreigners who wanted to enter the labour market directly. In all cases such workers had been paid at *Facharbeiter* rates. This was therefore a flexibility measure (e.g. in working hours), not an attempt to profit from a dual labour market structure, which has not existed in Stuttgart. Thus firms recovered; in one case the workforce shrank from 1100 to 300 during the crisis, expanding again to 800 by 1999 (Interview BW-F-16). But the new cohort of

employees is younger. Some firms mentioned this generational shift as the most important transformation, which would also change the spirit of cooperation.

(3) During the crisis many firms began to introduce cheaper standard machines in addition to their high quality lines. This was a reaction to the pressure from large firms in Germany and elsewhere. Some firms cancelled local supplier relationships and cooperated with firms from Eastern Europe (Interview BW-F-03). In general more was put out to external suppliers. But two problems followed, especially with partners in Eastern Europe. Sometimes their quality was acceptable, but they could not deliver in time, because their older machines made additional craft work indispensable. Alternatively, they could not meet German quality standards. As a result the quality of Stuttgart machine tools was endangered, but firms agreed to experiment in this way, in order to keep the contract with larger firms. Since they could no longer ensure the quality of their products, they no longer issued guarantees. When problems arose, the purchasers had either to pay for servicing or to solve problems on their own. Very soon it became evident that it was not a viable solution to leave the path of high quality production. Customers agreed that cheap machines created a serious risk for their own quality-oriented production. Supplier relationships shifted back from Eastern Europe to Germany. The degree of outsourcing in general became higher, but where possible and necessary to secure quality standards, SMEs tried to produce again in-house (ibid).

(4) However, this phase of high pressure on small firms undermined the economic base of many. One owner stated that there was no way that one could both innovate and sell products within the demanded margins (Interview BW-F-14). The firm had existed since 1904, but no family member would take over the business in the next generation. Production methods followed conventional paths, so restructuring would have only been possible with a younger cohort of workers. Such firms have not been taken over. But even some larger firms, operating as leaders in niche segments on the international market, have declared bankruptcy. These have been taken over by other firms, mostly Stuttgart competitors wishing to create synergies (Interview BW-F-05). In general, Häusler's (1990) prediction became a reality, that SMEs in the machinery industry would seek a medium sized structure allowing a presence in foreign countries with subsidiaries, and development of a large in-house potential for sophisticated R&D. Those which had enough capital

bought markets and eliminated competition, in order to secure their contracts with large firms and their position as niche producers. One entrepreneur stated that in order to survive on the international market, a machine tool firm in Stuttgart had to have a turnover of about DM 50 mn. a year (Interview BW-F-15). However, this was a firm which stated that cooperation had never worked, and that because of this, the only solution was to buy other firms and markets and integrate them.

(5) Other firms agreed that there was a tendency to control the market by becoming partners of large firms, but that not all firms were powerful enough to pursue this path. Therefore some owners stated, in contrast to those who wished to integrate competitors and suppliers, that they preferred cooperation with other SMEs. Small firms had to fight against the dictatorship of large firms by cooperating horizontally. An example was given in laser technology, where one firm had acquired competence in physics and another in machinery construction, but their products had been similar. In order to achieve a better quality standard and to innovate, they began to cooperate. Interestingly, the owner said that this would never have occurred in the 1980s, when the success of local machine tool firms depended on their in-house competence (Interview BW-F-04). But today firms must be part of either an autonomous network of SMEs or a network established by a large firm.

(6) Firms survived with innovations in high quality machines which had a certain standard base, but which were still customized products at the high cost, high quality end. While in general the restructuring process created better cost-benefit relations, Stuttgart's machine tool firms followed the conventional path of the DQP-regime. This became especially visible in the sub-sector of turning machines, where the two biggest competitors had a similar market idea, which in both cases secured their international market position (Interview BW-F-16 and 05). They were not rescued solely by product design, but also by their openness and flexibility to achieve these results with different manufacturing methods.

New regional policies

In September 1992 the first machine tool firm reported a 40% decline in orders for the third quarter of the year (Interview BW-I-02). In the same year a grand coalition between CDU and SPD took over the *Land* government. During this period of crisis,

until in 1995 the economic situation started slowly to improve, it became clear that policies would have to be decentralized, and that traditional aversions between the unions and the institutions of the *Land* would have to be overcome. In order to achieve this, the social democratic minister for economics, Spöri, initiated a dialogue between all public and private actors. In particular the unions, formerly excluded, were supposed to participate, to elaborate jointly a new concept for industrial policy in Baden-Württemberg (Wirtschaftsministerium Baden-Württemberg 1995).

This dialogue-oriented intervention of the ministry helped to establish regular cooperation between VDMA and IG-Metall. However as will be described later, their cooperation later excluded involvement by the *Land* government, especially after 1996 when party control of the government shifted again towards a conservative-liberal coalition of the CDU and FDP. Nevertheless, it was an achievement of the new policy approach that conventional cleavages between labour and capital broke down a little. Another impact of this new initiative was that policies were supposed to operate on a decentral level. This aim has not been met adequately so far, because the *Land* only claims to be responsible for the stimulation of regional policies, not the regional implementation of *Land* measures. In an interview with members of the ministry of economics it was made clear that an exclusive allocation of resources only to certain regions of the *Land* is impossible (Interview BW-I-02). It would run counter to the principle of equal living conditions. Apart from that the shift from firm-specific support in the whole *Land* to an approach which supported a sectoral recovery made it even more difficult to respect regional peculiarities (Müller-Jentsch et al. 1998).

There has been considerable discussion of the general role of the new *Land* government following the creation of a council for innovation to carry out measures proposed by the Future Commission, but the *Land* has fewer resources available than in the 1980s, having experienced a dramatic reduction of income from taxation during the crisis and having to play its part in subsidizing the *neue Länder*. However, DM 8.2 mn. was granted until 1995 for joint projects aiming at cooperation between customers and suppliers in the machinery industry. Vocational schools received DM 18.7 mn. for measures to improve their infrastructure (Wirtschaftsministerium Baden-Württemberg 1995). The Steinbeis-Foundation acted as an agent for this initiative by offering advisory services to supplier firms in the car and machinery industry.

Measures within the initiative included projects on information flow, new technology, simultaneous engineering, cost-reduction, cooperation and strategic alliances, support of export measures, training and retraining, and liquidity bonds. All were based on classical instruments of public intervention, but were specifically designed for the machinery industry, elaborated with the help of firms and associations and finally bundled as joint projects of the industry. Thus, not only was financial aid given, but platforms were created for firms to cooperate or for pilot-projects to start. These cooperation initiatives aimed to include up to ten SMEs and one research institute, but they have been regarded as only models and not as general support programme, for which there would be no funds.

It is interesting to note, that while these initiatives come and go, a more stable cooperation has been established by associations, not under the rule of the government but under that of large firms, which have obtained a key position within this network of public and private partnerships (Interview BW-I-02). Trumpf in particular has dominated the discourse on future initiatives and still moderates associational cooperation instead of the *Land* government.

The changing role of associational bargaining

As noted, the crisis of the machine tool sub-sector caused a reorientation of associational actors to cooperate during the *Land* grand coalition between 1992 and 1996. However, these arrangements were still different from a normal tripartite structure. They were largely initiated by the IG-Metall in Stuttgart, and included cooperation between the union and the industrial associations, especially the VDW subgroup of the VDMA, rather than with the employers' federation (Müller-Jentsch et al. 1998). In 1992 IG-Metall initiated regional conferences, where structural as well as cyclical problems of the local machine tool industry were discussed. This initiative aimed at a new approach towards decentralized industrial policy. Local firms had to be represented, and this was achieved through works councils. Again Trumpf appeared as a central firm. Its adaptations of new production methods have been valued as a paradigm for restructuring.

Although the *Land* government later tried to regulate this partnership, negotiations remained on a bilateral base. Study groups were initiated, always with a parity board of members from IG-Metall and VDMA, in which problems of machine tool firms were further analysed, paying particular attention to new products, joint research, regional markets, the organization of work, qualification

measures and strategic alliances (ibid). A report of the work was publicly launched in Stuttgart, containing proposals for the restructuring process, in particular with relation to group working.

This dialogue progressed falteringly, because IG-Metall in Stuttgart was not used to the dual role of shaping industrial policy on the one hand and collective bargaining on the other. Cooperation broke down as soon as the industry experienced a cyclical upturn in 1995. What remained was only a centralized bipartism between the unions and industrial associations.

In 1995 negotiations over wages became again a difficult issue, and IG-Metall pursued its traditional aim. Nevertheless, the need for decentralized intervention and LCCG provision had been much more accepted by the unions than for instance by the Handelskammer. Since IG-Metall did not wish to give up its wage-bargaining power because of its involvement in cooperation, it insisted that regional industrial policy measures - and thus the production of *local* collective competition goods - were not primarily its responsibility. It argued that a reformed regional association should do this kind of work (Interview BW-I-04). The union agreed to co-finance the association with the chamber and the *Land* government. The outcome has been a compromise on the *Wirtschaftsförderungsgesellschaft* (WRS) as a sub-group of the regional association of Stuttgart.

Another phenomenon which deserves attention in this context is the erosion of firms' membership in employers' federations. The decrease of membership in the VMI and Südwestmetall between 1990 and 1995 has been analysed by Schroeder (1997). His analysis of Baden-Württemberg showed that the exit rate is especially high among machinery firms - 61% of all firms leaving VMI, though only 23% of members belonged to this sector. The consequences for workers are ambivalent, because wages usually continue to follow the associational agreements. On the other hand, the wage differential among engineers increased during the 1990s (VDI 1997). One hypothesis suggested that machinery firms in a supplier relationship with large firms leave the employers' federation more often than others, but this has been refuted by Schroeder (1997: 236). Resignations have been concentrated among medium sized (100-499 employees) rather than small firms, probably those which had restructured according to new standards of cost efficiency. They may have calculated that they would have more room for autonomous action on working hours and working time flexibility, wages not usually being an issue. Even

employees without certified skills, but qualified in-house and do the same job, receive equal payment.

Conclusions

Our aim was to demonstrate how a German local economy in a traditional sector can remain successful. We found that from its historical origins the Stuttgart machinery industry established a production system based on high qualification of workers and engineers, and sophisticated R&D oriented towards large customer firms (especially the car industry), accepting the rules of a high wage economy, and thus creating a governance structure which we conceptualized as the networked firm model. The basic challenges of the 1980s consisted of the integration of microprocessor electronics for customized machines, which allowed decentralized operation and programming. Although this demanded radical innovation, the local economy dealt with it by cooperating with larger firms and public funds and institutions, especially institutes which combined basic and applied research. Even traditional and more centralized institutions like the training system adapted vocational profiles according to the new knowledge base in machinery construction.

However, the 1990s challenged the local economy with efficiency standards mainly created by large firms that now demanded better cost-benefit relations from their dependent SMEs if they were to remain in the supply chain. The networked firm model revealed its ambivalence in an environment of increasing global competition. The power of large customer firms as among the most important private providers of LCCGs enabled them to put pressure on smaller firms. Therefore the latter saw the need to cooperate more horizontally to solve their collective action problems. However, since the local economy could not rely on a tradition of informal self-help, it needed additional support from associations and public institutions.

The need for decentralized political intervention grew dramatically. While the unions supported this approach, they preferred public agents acting on their behalf and co-financed by them, to avoid compromising the traditional field of wage-bargaining. Many machinery firms, which considered that there was a need to decentralize the industrial relations system, left the employers' federation. While the restructuring process of firms, which has been supported by the traditional support infrastructure and the *Land* government, has been successful in that the DQP-regime

remained alive and firms recovered through quality oriented innovations, the local economy has witnessed a concentration process among those firms which created new subsidiaries abroad, maintained in-house production of LCCGs, and intensified their cooperation with larger firms. These latter produce according to the rules of the DQP-regime and remain stable. Smaller firms will not survive on this traditional path, unless there is more decentralized bargaining over working hours and wages. While solidarity among small firms may increase and solve collective goods problems, both small and large firms have dismissed a large number of unqualified workers. Older engineers and unqualified workers cannot be reintegrated into the labour market of the local economy, if the DQP-regime remains the only means for the local production system to produce for the world market.

It seems that the German system of production still survives and only produces local refinements of the national policy, not autonomous and completely diverging systems of production on the local level. But the (welfare) costs of maintaining this model seem to have reached a new peak. So far, the advantages of clustering for firms in German local economies have lain in the mutual learning and exchange of competition goods between larger and smaller firms. If now some of them become excluded from this process, they will have to reorganize cooperation on a decentral and horizontal level; but so far public support for this is only half-hearted.

4. Machine Tooling in the United Kingdom

'I built this factory up from scratch and have never asked anyone for help, I'm not going to start now'

(West Midlands machine-tool firm owner-manager)

Colin Crouch and Joe O'Mahoney

The machine tool industry began in the UK and from there spread around the world to create a \$35 billion business. Since its initial point of pre-eminence, British production of machine tools has dropped to about eighth in the world and since 1960 employment in the sector has fallen by 90%. The traditional view of the decline of British manufacturing has focused upon both external determinants such as the loss of the Empire and the rise of American and Japanese manufacturing, and internal issues such as the short-termist economy and the rise of the services sector. The extent to which the machine tooling sector fits with this explanation has received renewed attention recently with a revisionist analysis of the 1951 to 1990 period by Zeitlin (2001). He emphasizes actual choices rather than structural determinants as leading to the demise of the sector, and in particular the pre-occupation of both successive governments and industry experts with securing domination of the sector by a small number of large firms.

This chapter analyses the decline of the sector in the UK. In the first section a brief history of the industry finds that part of the explanation lies in both globalization and the familiar British story of a low-cost strategy, short-term investment patterns, and general neglect of manufacturing. However, it does not conclude that the outcome was inevitable. As Zeitlin argues, within the structural framework elements of political decision-making can be shown to have had a clear detrimental effect - not least in failing to tackle the supply of LCCGs through any other means than concentration within giant firms. In the second section, we examine the current interplay between structural weaknesses and political institutions in the West Midlands part of the industry. This regional study argues that, despite some evidence to the contrary, the institutions which might support industrial networks are still weak. Little is done to capitalize on the potential advantages of clustering beyond what the market provides, apart from certain consequences of hierarchy, both within conglomerates and in supplier relations.

Machine tools in the UK: an historical perspective

The early industrialization of the UK explains the predominance of British machine tooling in the 18th century (Fermer 1995). Much production was geared around heavy engine machines and skilled labour was cheap, so there was little demand for specialized batch or one-off machines (Rolt 1971). By the mid-19th century American manufacturers and the so-called 'American system' dominated the precision end of the market, attracting orders from industries which required smaller, faster and more precise engineering (Sciberras and Payne 1985). By 1913 German exports of machine tools too outstripped British, by a factor of four. The period before the Second World War saw a growth in diversity of machine tools. The needs of the automobile and aircraft industry required robust and powerful machines, requirements which were met by the growth of high-power and electric innovations, especially in the USA. The decimation of the German and Japanese economies following the Second World War held mixed blessings for British manufacturing. While competition was reduced during this period, the need for investment in the Japanese and West German economies proved to be the lynch-pin of their later success.

The British industry now began to be restricted in its expansion by shortages of skilled workers. Zeitlin (2001) points out that the sector was continually competing in the (limited) skilled labour market with the motor and defence industries. Despite repeated criticisms from the industry, academic experts, and trade unions, the fundamental weaknesses of skill shortages, lack of investment in research and development and the resulting pursuit of generalized (rather than high-performance or precision) machines, were not tackled adequately.

Lack of investment (see Table 4.1) in the post-war period was manifest in the failure of Britain to compete in terms of research and consequently innovation. Despite the early adoption of numerical control systems in the 1950s, the incorporation of the computer and associated technologies into machine tool design was more difficult in the low-investment environment of UK manufacturing. The most dramatic innovation after the 1950s was, without doubt, the introduction of computer numerical control (CNC). High levels of investment, especially in Japan, combined with a market strategy of quality rather than cost meant that other countries were swift to adopt and apply CNC technology. The sluggish take up within the UK was not only due to the failure of machine tooling industries to produce CNC machines, but also because the home market itself was very much

geared around low-cost, low-quality production. Even in 1992, the UK did not possess one manufacturer of the control mechanisms needed for CNC machine tools. The failure to develop new products was, according to Parkinson (1984), one of the major contributory factors to the malaise of UK machine tool production.

**Table 4.1: Investment in machine tools
in % of industry GDP, 1960-1990**

<i>Year</i>	<i>Britain</i>	<i>Germany</i>	<i>Japan</i>
1965	18.5	28.5	32.0
1970	18.8	27.6	39.1
1975	19.7	19.7	32.8
1980	17.9	23.4	32.2
1985	16.9	19.6	28.0
1989	19.6	21.3	31.5

Source: Shaw (1992)

Following a series of reports in the 1960s, improvements in investment and the encouragement of qualifications in the sector were undertaken by both government and the industry itself. However, the UK still lagged behind West Germany and the USA in these areas, and its relative improvements were far behind the emerging economies of Japan and later Taiwan and South Korea. These trends were exacerbated during the major restructuring of the 1960s. Debate over the industry's structure concentrated on whether it should be concentrated in the hands of a few large enterprises or, as the unions and eventually the Labour Party considered, be amalgamated within one large state-owned firm. It seemed taken for granted that amalgamation of some kind was the only means of providing the research, marketing and skills infrastructure which the industry would need. It was virtually taken for granted by most experts and government committees that the presence of small and medium-sized enterprises (SMEs) constituted a weakness to be overcome, not the basis of a possible future strategy (Zeitlin 2001, chs 11, 14).

Strategic industry-wide rationalization of businesses which was later encouraged by the Industrial Reorganization Corporation (IRC) did little to improve specialization and nothing to improve efficiency, despite a dramatic increase in research and development expenditure (Zeitlin 2001). The IRC held strongly to the established view that improvement could come only through a rationalization of the number of firms in the business, including a large state-holding (ibid). It did not

seem to notice the constant drift of R&D facilities away from the West Midlands, where most production was located, towards London and the South East (Lissoni 1993; WMDA 1998: 8, 23, 35). While this was true of many of the region's industries, it was particularly so in machinery. Several of these were dependent on the defence sector, which located its R&D facilities close to the Ministry of Defence's own laboratories, heavily concentrated in the South East (Buswell, Easterbrook and Morphet 1985).

By the end of the 1970s the global position of British machine tooling manufacturers was unrecognizable from that of a century previously. The following decades saw the transformation of the British industrial landscape by de-regulation, privatization, intensified competition and the promotion of the services sectors. However, none of these changes led to a revision of views in either government or the sector itself over the best means of furnishing competition goods, with the exception of the policies of government during the 1980s to encourage Japanese entry into certain customer industries (especially motor vehicles), in the hope that this would encourage improved supplier chains. Simultaneously, global competition was opening the British market up as never before, not only to existing competitors, but also to the emerging economies of Korea and Taiwan, who could compete effectively at the cheaper end of the tooling market. The decrease in British employment in the machine tooling sector within this period in relation to that of Germany is traced in Table 4.2.

Table 4.2: Employment in the machine tool industry (000)

<i>Year</i>	<i>Britain</i>	<i>Germany</i>
1960	81	n.a.
1970	65	121
1975	49	109
1980	46	98
1985	24	88
1990	20	103
1995	13	68
1997	14	64

NB: German data 1970-1990 amalgamate those for the Federal and Democratic Republics of Germany

Source: Shaw (1992), CECIMO 1998

The low point came at the end of the 1992/3 recession: only 125 machine tools firms had survived, employing under 12,000 workers, compared with 46,000 in 1980, and producing only ECU 572 million worth of tools. Thereafter however there was a change in fortunes. The end of the early 1990s recession signalled a recovery for British manufacturing generally, and from 1996 machine tools and the rest of the machinery sector responded to the recovery of their customer industries with a marked improvement, both absolutely and relatively in relation to other European economies, as was shown in Chapter 1. By 1998 these industries had regained their 1992 share in world trade, though renewed decline soon followed as the value of sterling rose against the newly established single European currency. Given the scale of the decline of the sector during the 1980s, it can be surmised that those firms which survived were resilient, and either were always, or rapidly learned how to become, highly competitive. The so-called 'lame ducks', which were often assumed to be a burden on British industry so long as government policy sought to sustain aggregate demand, had disappeared, leaving only the tough to flourish in the new market place.

The institutional context

The consensus of much of the literature on British manufacturing in general is that it has been subjected to short-term financial, rather than longer-term technological, criteria (Bessant and Grunt 1985); and that firms have been in aggressively competitive relations with each other. Zeitlin (2001) has related this general situation to the machine-tool sector in particular. The convergence of British industry at the lower end of the quality market, combined with poor innovation and development due to short-termist investment criteria, is seen as explaining how the opportunities offered by CNC in the 1960s and 1970s were missed. On the other hand, some authors have argued that, given the inevitability of British relative decline from the advantages of early industrialization, the UK economy has in fact survived and adjusted quite effectively. Also, in recent years the short-termist shareholder-driven model has become that most admired by the newly important global financial markets, which prioritize flexibility and ease of exit. This has led to some positive investment flows to economies which, like the British, follow closely the approved model.

Government policy, particularly during the 1980s and 1990s, has often been described as encouraging the intensification of competition at the expense of inter-

firm co-operation, while withdrawing even more than in the past from direct provision of services itself. The high numbers of foreign owned firms (e.g. Cincinnati Milacron and Yamazaki) may have contributed to this outcome; Malecki (1982) found little evidence that Japanese and other direct inward investors brought R&D facilities with them. They kept these in their home countries, just as UK-based firms themselves kept such resources close to their London head offices and not in the regions of production (WMDA 1998: 23).

On the other hand, Crouch and Farrell (2001) have argued that there have in at least some sectors been functional equivalents of cooperation and favourable government policy in the UK. University research departments and other serendipitously located institutions have sometimes provided non-market centres for the co-ordination of collectively available competition goods, amounting to forms of economic governance. These have enabled points of considerable strength to develop within the UK, especially in high-tech science-driven sectors. These developments have mainly affected 'new' industries located in South-East England and East Anglia (see Proudfoot, this volume), rather than the more 'traditional' sectors concentrated in the midlands, north and Scotland (Crouch and Farrell 2001); though as we shall see below, they have not been entirely absent from the West Midlands machinery industries.

It is also important to note that, contrary to some stereotypes, UK government policy since the 1980s has not just been devoted to clearing away market impediments. Government departments, in particular the Department of Trade and Industry, have been active in promoting various self-help quality improvement devices among firms, including production of a battery of quality benchmarks (e.g. British Standard BS 5750, International Standard ISO 9000, Investors in People and Quality Assurance).

At local level Training and Enterprise Councils (TECs) were established to encourage co-operation and the pooling of expertise among firms, and were used as channels for government policy initiatives (Bennett and McCoshan 1993; Crouch and Farrell 2001: 202-4; Crouch, Finegold and Sako 1999: ch 6).¹ In particular, it was hoped that a local contact point of this type would help bring SMEs close to government initiatives for improving performance. There is also some evidence that higher quality standards have been demanded of companies by the buyers of parts and tools, such as the QS9000 programme of Ford and General Motors (O'Mahoney 2000). As a relatively low tier in the supply-chain, machine tooling companies are

often the last to feel either the benefits or drawbacks of such standards, and the extent to which these have trickled down to them has remained under-investigated.

Some observers have argued that the logic of the traditional short-termist, low-cost, low-quality approach has forced the machine tooling sector into an unworkable path of competing on price with the emergent economies of India and Asia (*The Engineer*, 1998). On the other hand, we have the evidence of the recovery in the late 1990s, which it could be argued occurred when the combination of eliminating inefficient firms through tough monetary policies with locally delivered, voluntarist national policies of bench-marking and emulative performance improvement had become fully effective. We need both to decide whether we are observing relative failure or relative success, and to decide how to explain the performance that is observed. Did finance-oriented short-termism finally come into its own as the shareholder-value model of the corporation came to dominate the world economy following the combined revolution of deregulation of financial markets alongside new information technology in the late 1990s? Has this rendered LCCGs and local production systems in this sector irrelevant for success? Or did the more institutional innovations of the 1980s and 1990s finally pay off? Or was there just a continuing relative failure, which the institutional policy initiatives were too weak to assist? In particular, what part was played by SMEs in the process of change?

In this paper we can address some of these questions to the extent that they operate at the level of local production systems. Table 4.3 shows the geographical location of all concentrations of more than 20 small and medium-sized units producing machine tools in Great Britain in 1991 and 1996. (During 2000 TECs were abolished and their functions incorporated into regional learning and skills councils.) It will be seen that there are very few of these concentrations, and most of them are found in two locations: Greater London and a number of areas contiguous with it in the South East; and the area around Birmingham in the West Midlands, which we have already mentioned as being the industry's heartland in the UK. The highly populous combined South-East and Greater London region contained 460 of the units in 1996, employing 4,349 persons. The considerably smaller West Midlands region had 522 units and 5,483 employees.

Table 4.3: Concentrations of small machine-tool production units, 1991 and 1996

<i>Area</i>	1991		1996	
	<i>Units</i>	<i>Empls</i>	<i>Units</i>	<i>Empls</i>
South East				
Aylesbury	36	514	37	377
Banbury	3	25	*	*
Colchester	28	323	*	*
Guildford	29	565	23	164
Hertford	37	504	51	347
Hitchin	*	*	22	113
Medway	34	436	23	235
Slough	29	546	25	329
Southend	23	438	38	266
Watford	51	604	48	670
Greater London				
Heathrow	55	979	70	804
London	104	1336	123	1044
South West				
Bristol	26	270	32	325
Poole	*	*	23	53
West Midlands				
Birmingham	159	2908	212	2435
Coventry	76	1277	118	1325
Dudley	52	1267	87	722
Walsall	35	954	73	677
Wolverhampton	*	*	32	324
East Midlands				
Leicester	41	1290	66	772
Nottingham	42	673	37	369
Yorkshire and Humberside				
Bradford	27	517	*	*
Calderdale	27	930	34	1034
Leeds	34	951	29	350
Sheffield	37	1317	50	862
North West				
Liverpool	33	409	27	207
Manchester	49	1042	69	669
North				
Newcastle upon Tyne	*	*	22	211
South Tyneside	37	195	*	*
Sunderland	25	292	*	*
Scotland				
Glasgow	23	544	27	429

Units = no. of units 200 or fewer employees, excluding all areas with 20 or fewer units

* signifies a number of units of 20 or less

Source: Crouch and Farrell 2001; unpublished data of UK National Statistics Office

In an analysis of employees in small units in the industry as a proportion of total employed persons in a Travel to Work Area (TTWA), Coventry in the West Midlands emerged as the only one to have a significant concentration (Crouch and Farrell 2001: 171). Within the West Midlands, machine-tool production in 1991 was largely concentrated in four contiguous TTWAs: Birmingham, Coventry, Dudley and Walsall. Between 1991 and 1996 (the first year of the recovery of machinery production) each of these had seen increases in numbers of *units* considerably larger than the national average (Table 4.4). Total numbers of *persons employed* declined in all except Walsall, where there was a very small increase. But this decline was considerably less than the national average. It is in this area, and particularly around Birmingham and Coventry, that a viable British local production system in machine tools can still be found. Our research has therefore concentrated on this location.

Table 4.4: Machine-tool production in the main West Midlands centres, 1991, 1996 and 2000

	1991		1996		Change, 1991-96 (%)	
	<i>Units</i>	<i>Emp's</i>	<i>Units</i>	<i>Emp's</i>	<i>Units</i>	<i>Emp's</i>
Birmingham	160	3339	213	2903	33.12	-13.06
Coventry	78	1773	119	1651	2.56	-6.88
Dudley	55	2368	87	722	58.18	-69.51
Walsall	35	954	74	977	111.43	2.41
All UK	2106	53535	2565	36261	21.79	32.27

	2000		Change, 1991-2000 (%)	
	<i>Units</i>	<i>Emp's</i>	<i>Units</i>	<i>Emp's</i>
Birmingham	223	2022	39.37	-39.44
Coventry	92	935	17.95	-47.26

Source: own calculations based on unpublished data of UK National Statistics Office

After 1996 there was a major change in the designation of TTWAs in British statistics, and it is difficult to make more recent local comparisons. However, we can plot the development of the Birmingham and Coventry areas until 2000. There was a continuing small growth in numbers of units but decline in persons employed in Birmingham, but in Coventry both units and, even more so, employees declined considerably.

Before starting this local study, and while remaining at the national level, we should give some attention to an hypothesis important to the theory of local production systems. This should predict that SMEs (here, proxied by small units) which are located in clusters should stand a better chance of growth or survival than those which are relatively isolated, specifically that change between 1991 and 1996 in both the number of small units and the number of their employees should be positively related to the absolute number of such units in the TTWA in 1991; more formally:

$$(1) (E_{t+1} - E_t) = f(U_t)$$

and

$$(2) (U_{t+1} - U_t) = f(U_t),$$

where E = the number of employees in each unit and U = the number of small units within a TTWA. Small units are defined as those employing 200 or fewer persons.

The number of small units within a TTWA can decline for two opposite reasons: the disappearance of units; or the growth of units to more than 200 employees. Because of the latter, it would be inaccurate to measure the growth or survival of a cluster of firms solely in terms of the fate of small units. It would also be an error to exclude TTWAs with 20 or fewer machine-tool units from consideration in the statistical calculation. Therefore, instead of making calculations based on the TTWAs reported in Table 4.3 we need to consider all 193 areas where there was at least one unit in the industry in 1991, irrespective of the number employed.

In carrying out such a test we found that there was no support at all for the employment equation (1), but there was a positive correlation for the units equation (2) which was significant at the 10% level ($R = 0.1277$, $R^2 = 0.0163$, $F = 3.18$, $F \text{ sig} = 0.0761$). This gives moderate support to the thesis of the advantages of clusters over isolated sites, but also suggests that units achieved their success or survival partly by reducing their numbers of employees. This latter is of course consistent with much that is known about the 1990s restructuring process in many industries and countries.

Machine tooling in the West Midlands

In addition to the existing literature, the following account of the current state of the west midlands machine tools industry draws on our own case study research. This included the formal questionnaire reported on below, and also a series of over 20 visits to firms, trade associations, central and local government agencies, universities, and other research and consultancy groups concentrated within Coventry.

By the 19th century the West Midlands led the UK dominance of the machine tooling sector. The reputations of Coventry and Birmingham as highly skilled crafts areas had already been established due to the preponderance of ribbon, watch and gun manufacturers, and the increasing demand for mass-produced products as well as specialist machines served only to improve the reputation of the region as possessing a diverse and highly skilled workforce. At the turn of the 20th century, the skilled labour market and the numbers of small-scale precision metal works attracted in increasing numbers the expanding industries of the bicycle, and later the car.

Famous companies such as William Morris, Courtaulds, Alfred Herbert and Rootes were established, drawn by the plethora of skilled workers and excellent communications. These, and many other industries fed the demands of the automotive trade by adopting the 'American system' of mass production. The increasing use of electric tooling and the demands of the war periods enabled the massive expansion of manufacturing in the area and consequently the machine tooling industry. However, even at this stage, the lack of innovation amongst machine tool buyers was having a constraining effect upon some manufacturers: 'recognizing the conservatism of British customers who were used to having machines built specifically to their requirements instead of adapting standard machine tools, Herbert compromised, catering for individual customers' (Lancaster and Mason 1986: 154).

After 1945 the West Midlands recovered quickly and employment expanded into the 1950s. The period 1951-1961 saw over 360,000 jobs created in the area, mostly in engineering (Wood 1976). Many local people still remember this period as the region's 'golden age', when many workers migrated from other parts of the country to work in the engineering factories of Coventry and Birmingham. Employment was, however, highly dependent on the aircraft and car industries, the latter of which comprised almost a third of local employment. The vulnerability of

this dependence was revealed as under-investment began to take its toll. When manufacturing began to decline during the mid-1960s, Coventry was particularly badly hit, despite the presence of major motor manufacturers such as Triumph, Jaguar, and British Leyland.

The knock-on effect to machine tool producers was severe. Throughout the period 1966-73 unemployment increased at a rate well above the national average. The losses were primarily from electrical goods, vehicle production, and consequently from machine tooling. By 1980, unemployment in Coventry was, for the first time in decades, higher than the UK average. Between 1972 and 1982 employment at the top fifteen firms fell by 50%. While manufacturing output in the UK declined by 14% in the period 1979-1983, the west midlands figure was around 20%. In some companies, such as Rover, it was as high as 37%; over 72,000 jobs were lost in the Black Country alone. The 1980s were particularly hard on Coventry, as it had few service industries to make up for declining employment. As Britain's largest city after London, Birmingham was the primary services centre of the region, making diversification into this sector difficult for Coventry.

As we have seen, manufacturing in the area revived well during the mid 1990s as the UK economy recovered earlier and more rapidly from the collapse of the start of the decade. However, by the end of it there were new signs of crisis. With the value of sterling being maintained by the Bank of England at a level designed to restrain inflation in south-east England, export prices of British manufactured goods were again becoming uncompetitive. During 2000 the German car firm BMW (which had earlier bought Rover from its Japanese owners), and the US giants General Motors (owners of Vauxhall) and the Ford Motor Company (which had maintained manufacturing plants in the UK since the 1920s) announced that they would gradually cease production of motor vehicles in the UK. With the exception of some small but profitable Japanese factories, this marked the end of bulk motor vehicle production in the country. Ford's main plant was at Dagenham, near London, and Vauxhall's at Luton in the South East, but Rover's factories were concentrated in the West Midlands. It seemed that the industry which had sustained the region and its machine tool sector in particular throughout the post-war years was almost gone.

General engineering remained, as did important defence contracts. There is also another, quite different and highly specialized industry: jewellery, which forms a true industrial district of very small firms within Birmingham city itself. With a

few exceptions, West Midlands machine-tool firms serve either the automotive/defence sector or jewellery.

We have seen that there was a statistical association between the size of a cluster of machine-tool producing units and chances of surviving the early 1990s recession. Can we find substantive reasons to support this link? Did the perseverance of machine tool firms and manufacturing in general in the region result from self-regeneration of a few individual firms which survived from an earlier much larger number, or from institutions of regional or local support?

Local institutions for collective competition goods

Institutions for supporting the practices, knowledge and networking of machine tool companies either with each other or up and down the supply chain, are divided between those which are designed specifically for the machine tooling sector and those which are intended for industry generally. The latter easily outweigh the former. We shall consider both, following the modes of governance approach initiated by Hollingsworth, Schmitter and Streeck (1994) and applied to the analysis of local production systems by Le Galès and Voelzkow (2001). As will soon become apparent, an interesting aspect of the story is the development of amalgams of two or more governance forms at any one time.

State agencies: As already noted for the UK generally, official policy towards the machine-tools industry long concentrated on producing amalgamations and reducing the role of SMEs. There was a radical change in this, not from central, but from local, government, and initiated from the political left. During the 1980s sections of the Labour Party reacted against the centralizing tendencies of the neo-liberal Conservative government by breaking from their own centralist traditions and trying to establish autonomous local economic policies, particularly in Greater London, the South Yorkshire area around Sheffield, and the West Midlands. There was some conscious emulation of the Italian left's construction of economic strongholds in Emilia Romagna. The West Midlands Metropolitan County Council (MCC), which covered the whole area around Birmingham, Coventry, Dudley and Walsall, established the West Midlands Enterprise Board (WMEB), with representatives from local government, businesses and trade unions. It followed the lines of a similar board in Greater London.

The Board acted partly as a venture capital broker for medium-sized firms, mainly in manufacturing, which it felt were neglected by most British financial institutions (WMEB 1986). It helped secure private investment for firms with proposals which it approved. Approval was based, not just on the marketing viability of the proposals, but on firms' willingness to remain committed to the West Midlands, to constitutional industrial relations, and to other social policy goals. It also sought to aid SMEs with such needs as technology transfer and training. It concentrated on a limited number of sectors, including components suppliers to the motor industry and therefore an important segment of the machine-tool sector.

Partly to prevent the growth of this kind of local economic policy autonomy, in 1986 the government abolished the powerful level of local government concerned: the Greater London Council and metropolitan county councils. However, the seven successor district councils of the West Midlands MCC sustained the activities of WMEB until the mid-1990s, though it increasingly became more a straightforward source of venture capital than a distinctive political initiative.

During its most active years, in the late 1980s, WMEB established a distinctive analysis of the problems of machine-tool and other engineering SMEs. It pointed to the weakness of R&D resources available to these firms, and to the negative role that might be played here by the otherwise welcome overseas inward investment. Foreign investors, it pointed out, tended not to bring R&D to the West Midlands, only the less knowledge-rich production activities (WMEB 1988). On the other hand, it saw potential opportunities for local SMEs as large motor industry corporations out-sourced research, design, engineering and testing activities (ibid: 20). It also tried to steer investment towards machine tool SMEs having difficulties adopting CAD/CAM systems (WMEB 1987). It believed that changes in schemes for government support for CAD/CAM adoption were favouring large firms and producing a growing technology gap between them and their smaller suppliers.

In 1984 central government established its own regional development body, the West Midlands Development Agency (WMDA). This was primarily representative of firms and central government, though there were local government and union representatives. It was part of a number of such agencies established around the country. Their prime mission was to encourage overseas inward investment. However, the West Midlands Agency has sought also to recognize the problems of local SMEs; including their fears that they were being neglected by the concentration of central government policy on the needs of inward investors (WMDA 1998: 39),

and that both these investors and London-based British firms were shifting R&D facilities away from the region (ibid: 6).

Within central government itself, the most important institution for industrial development is the DTI, which attempts at both national and regional levels to encourage best practice and innovation. An example of central provision in the engineering sector has been the 'Achieving Competitiveness through Innovation and Value Engineering' (ACTIVE) campaign. While aimed at process engineering construction in the oil and gas industry rather than the machine tooling sector, the latter is affected by the professed aim of developing effective supply chains. This is therefore a government strategy for encouraging competition goods through the hierarchies of networked firms. Projects of this kind, in which 'partners' are encouraged either to bid competitively for centrally provided funds or to pay a subscription for centrally provided consultancy/ benchmarking are typical of the policy model developed during the 1980s and 1990s at the DTI.

The DTI also has programmes for networking, which affect the machine tooling sector in several ways. Firstly, it encourages international co-operation between sectors in different countries. An example of a forum established to achieve this is the Innovation Relay Centre. In all, 63 of these centres were established throughout the European Union area by national governments in order that the funding provided by the Fifth Framework Programme for Research and Technological Development might be more effectively competed for. The Midlands Innovation Relay Centre is the regional support centre for the West Midlands and surrounding areas. While the asserted aims are to 'aid the process of technology transfer across Europe, to promote the exploitation of results and to provide assistance in applying for EU research and technological funding'. Its diary from January to April 1999 shows that the institution is primarily concerned with providing information concerning EU funding, and encouraging talks from industry-associated MPs and ministers as well DTI experts in innovation and technology.

A newer initiative by the DTI is the Foresight programme, which aims to provide a centrally managed pool of information to help firms reshape their business strategies to meet future changes. The industrial panel is called Manufacturing 20/20 and attempts to get businesses to share their expertise in anticipating change in markets, technological developments and training needs. In December 1998 the Machine Tooling Trade Association (MTTA) proposed the development of a 'technology map' for future developments in machine tool research which would be

joint funded with the DTI and the Advanced Machine Tool Research Institute (AMTRI).

A more regionally based institution associated with the DTI is the Business Link programme. The Business Links are centrally licensed, but locally based, institutions which provide information, help develop business plans, help implement quality systems such as the BS EN 9000 of the European Union, and help buyers find the most competitive suppliers within the region. Business Link in the West Midlands amalgamated with the Coventry and Warwickshire TEC (CWTE), which, like many others during the 1990s had earlier merged with the independent Chamber of Commerce. The resulting amalgamate was named 'The Chamber'. Further changes will be produced by the regional centralization of TECs from 2001 onwards.

While initially a government initiative, this policy mechanism developed as a novel combination of state, associational and possibly community governance forms. Chambers of commerce are formal representative associations, while if TECs and Business Link got off the ground they produced action at the informal community level. Thus, The Chamber takes responsibility for: the governmental function of supervising National Vocational Qualifications (NVQs); the associational task of representing members' interests, and organizing benchmarking and conferences; and the informal process of building inter-firm networks. It is difficult to assess whether the reality lives up to the rhetoric on this last. As Crouch and Farrell (2001) found more generally, networking meetings organized by TECs and Business Link often took the form of social gatherings rather than working sessions. The events diary for The Chamber in 1999 comprised short courses, management 'master classes', and breakfast meetings. These last were the main functions of the Manufacturing Network 2000, which organized a Breakfast Club at which the 55 members paid £289 each year to attend breakfast talks and to discover what services were available to them. Business Link subsidized 66% of the costs.

Specifically for SMEs, the DTI has been working with Business Links to create 'The United Kingdom Benchmarking Index'. This attempts to overcome the problem that many SMEs do not have the resources for successful benchmarking. A computer-based system uses data collected on a national scale to allow companies to compare their performance in key areas such as finance and operations, business excellence and manufacturing with similar firms elsewhere. However, defining and measuring success is problematic. One of the representatives on the Birmingham

TEC said the amount of support available for industries to network or indeed to improve, was 'laughable,' and that building up long-term networks between manufacturers was 'not practised widely, or well'. At a regional level, the West Midlands Development Agency (later renamed Advantage West Midlands) aims at encouraging inward investment, improving skills and competitiveness and physical regeneration. Although in 1999 the West Midlands won the highest number of overseas investment projects of any English region, the agency appears to do little to encourage intra-regional horizontal networking of firms.

However, it is working with the West Midlands Regional Supply Office and local Business Links to promote purchasing and supply chain development. Meetings with buyers, seminars on Japanese techniques and overseas promotions are designed to develop better supply chain developments. In 2000 a bid was made for European funds to strengthen these activities. However, partly due to restructuring and difficulties in getting information, it is difficult to ascertain either the effectiveness of these projects, or the extent to which they have affected the machine tool sector. Similar to many of the other quasi-government organizations we have studied, Advantage West Midlands often appears to be more concerned with propagating knowledge about its own existence than with substantive content. Not only was much of its publicity concerned with its own proposed name change, but it was criticized in Parliament for its jargon-packed publications.

Associational functions. Business associations of various kinds are important in the region, and have at times been the focus of more collective approaches to economic regeneration. The collapse of west midlands manufacturing in the 1980s produced one such response in the Birmingham Employers' Forum. It commissioned a report from the accountants and management consultants Price Waterhouse to devise an economic recovery programme for the region (Price Waterhouse 1987). This identified the whole range of private, public, academic and associational resources of the area, and proposed a series of strategies, all of which included encouragement of co-operation or means for enabling SMEs to access LCCGs. It clearly identified poor access to these as one of the region's main problems, drawing attention, *inter alia*, to the difficulty of west-midlands machine tools firms in moving out of the low-skill, low-technology product markets in which they were becoming trapped (ibid: 24). Not much came from the initiative, and by the 1990s this kind of activity had been largely replaced by such initiatives as The Chamber.

The project of The Chamber which seems most valuable to SME suppliers in the region is called 'Accelerate'. It is primarily an EU funded project run between The Chamber, Coventry Centre for Investment, Birmingham TEC, and Birmingham and Coventry Business Links. Since it is not an initiative of the DTI, it seems best to regard this as coming under the formal associational functions of The Chamber. Conducted in two phases (Accelerate One and Accelerate Two) the aim has been to 'promote world class manufacturing in supply chains for the automotive industry'. The total package amounted to £29 million, £11 million of which was a grant from the EU. Phase One, which ended in December 1998, was an analysis of the needs of 500 small first, second and third tier supply companies, potentially including some machine tooling firms. Benchmarks were developed for these companies and support was generated for clients to form contracts with their suppliers. A third of the costs were met by the £11 million from the EU with the remainder being met by the companies involved. By December Accelerate One had helped 120 supply development contracts in Coventry and Warwickshire and 400 in the West Midlands generally. The project used £9 million of the money available.

The second phase of the project is smaller and began in May 1999. To date there is little published information about Accelerate Two, which is a supply chain development programme run by the Coventry Centre for Investment. The money available is less tied to specific programmes of improvement and more available to the companies for their own needs. For some of the advisors involved, this programme was symbolic of the movement away from cost-based supply chains to more developmental partnership approaches of the kind associated with large Japanese firms and introduced to the UK through the transplants of Japanese direct inward investment. For others, the money was wasted, as many of the companies used available funds for short-term gains rather than systemic improvements.

Within the machine tool sector there appears to have been little take-up of the programme. This may be unsurprising, as it was primarily geared around second and third tier suppliers, though an alternative explanation from one regional advisor was that 'local companies are so suspicious they will not take money even if it is thrown at them'. While this might be an overstatement, it does suggest that SMEs are unused to making use of, and perhaps reluctant to use, the resources at their disposal, within both Accelerate and in the local chamber.

More autonomous of the DTI than the Business Link and TEC developments are trade associations. The two which have had the biggest impact upon the machine

tooling industry are the Society of Motor Manufacturer Traders (SMMT) and the MTTA. The latter is clearly directly involved with representation, research and information for the industry. It organizes exhibitions, conferences, statistical services and technical assistance so that best practice, benchmarks and training can be disseminated more effectively to its members. With the DTI it launched in 1997 the 'Step Change' programme to encourage best practice management strategies and continuous improvement. It has enabled several machine tool businesses to adopt a more strategic approach to quality initiatives within the workplace.

The SMMT has also affected the tooling trade, in particular in encouraging the large motor industry firms to develop their supply chains (an amalgam of associational and corporate hierarchy governance modes). When asked about which institutions they used to develop their supply chains, local car manufacturers Rover and Peugeot both named the SMMT, and the related DTI Forum Action group. Adding the state to the governance amalgam, the DTI has been providing support for the SMMT in the form of developing best practice manufacturing techniques, including development of the supply chain. Measure Four of their Quality, Cost Delivery programme is termed 'Delivery Schedule Achievement' and focuses upon pressurizing suppliers to achieve '100% on time delivery and quality'. Thus the encouragement of quality benchmarks within supplier factories (such as Ford and Chrysler's QS9000) are aimed to have a cascading effect upon the supply chain. Although the SMMT forum is primarily aimed at high volume suppliers, in interviews both providers and buyers of machine tools have commented upon the increasing pressures upon them in terms of quality and delivery. The SMMT is being used by the DTI as a 'best practice' example of a trade association. The technical director of the MTTA, has been invited to DTI/SMMT discussions aimed at developing a similar model for the machine tooling sector.

Some associations exist as hybrids with market or other institutional forms. Important here are organizations for assisting engineering companies with research and development. The two main (non-university) institutions in the UK are the Institution of Mechanical Engineers' Rapid Prototyping and Manufacturing Association (IMERPMA) and AMTRI. AMTRI was one of a number of government sectoral research institutes which was privatized in the 1980s. They work on a partly commercial basis with machine tooling companies which require development of new products, but also seek funding for such projects from the DTI. AMTRI is also involved with the Foresight and Manufacturing 20/20 project (mentioned above).

IMERPMA, on the other hand is funded by its members (two thirds of whom are businesses, the rest being academic groups) to develop prototypes and organize seminars.

In the West Midlands several universities are involved with local manufacturers, the MTTA and AMTRI. Particularly important is the Warwick Manufacturing Group of the University of Warwick, located in Coventry itself, which has the largest tooling centre in Europe. In the neighbouring East Midlands region the newly developed Manufacturing Research Centre at De Montford University in Leicester is also significant. According to buyers of machine tools and the MTTA, these centres provide essential equipment and expertise in developing joint bids for funding from the EPSRC, the DTI and CRAFT.

In general, the use of universities as resource centres appears to be an increasing phenomenon in the West Midlands for many large companies, sometimes with funding from the Department of Trade and Industry (DTI). The Accelerate programme mentioned above, for example, used three local universities as 'delivery centres' for best practice.

Community governance. As other observers have commented (Crouch and Farrell 2001; Zeitlin 1995), informal community modes of governance are not often found in British industry, though as we shall see below from our more direct evidence on firms in the West Midlands machine tooling sector, they are not entirely absent. Their encouragement has also been the target of some of the government and formal associational initiatives described above. However, these seem more interesting for their creative attempts at institutional hybrids rather than as instances of strong community networks. Research by the WMDA among local business leaders highlighted the lack of collective action within the West Midlands to identify new challenges and opportunities, particularly the lack of shared 'competitor intelligence', and the relative (though not total) absence of co-operation in vocational training and in identifying export markets (WMDA 1998: 38, 39).

Corporate hierarchies. The governance functions for SMEs of the corporate hierarchy mode are expressed mainly through supply chains, as in Japanese (Sako 1996; Crouch, Finegold and Sako 1999: ch 7) and north-east Italian (Burroni and Trigilia 2001) examples. Apart from government programmes for the encouragement of Japanese imitation already mentioned, there is some evidence that large companies

such as Rover, GEC and Peugeot have by themselves begun to learn from their Japanese competitors about supply chain management. This appears to have been relevant to some machine tool manufacturers, and was commented on by several of our interviewees. Thus, the fostering of long-term relationships in terms of investment, orders, communication, innovation and information technology is increasingly being practised by companies in the West Midlands. Several tooling and tubing companies have commented on the increased interest that large companies are taking in their day-to-day operations.

The market. Given the prior existence of a strong cluster, market forces may serve to perpetuate and even reconstruct it. Economies of scale, reputation and the importance of sunk costs will prevent destruction of a strong specialism, provided there are enough units in it to start with. Some firms will, given large numbers, find solutions to new problems, and the creative destruction of the market will ensure that these survive, even if large numbers of others fail. Even without overt co-operation, where there are clusters of firms doing the same business, there will be informal discussions among those involved in separate firms, exchanges of tacit knowledge, aided by the movement of personnel between firms.

This process is a hybrid between market and informal community. According to economic theories of the pure market no information is exchanged without payment, and the acquisition of knowledge, as a commodified good, is regarded as unproblematic. Therefore a geographically isolated firm purchasing expertise from specialized consultancies should be at no disadvantage in relation to clustered firms. In fact, it should be at an advantage, since its information has been acquired through a market and therefore a more efficient source than an unquantified, casual and even implicit network. The existence of clusters therefore suggests that something other than pure markets are at work.

The views of the industry

In order to understand which of these governance modes and institutions are most important in sustaining the industry in the West Midlands a questionnaire was sent out to all surviving 74 machine tooling SMEs in the Birmingham and Coventry area. (This figure in no way corresponds to the statistics given for manufacturing units in Table 4.3. The current data, which were drawn from trade association records, concern actual firms rather than the indeterminate idea of 'units' used in UK official

statistics.) Although these production units appear as individual firms, they are in fact often wholly owned by larger groups and are only occasionally fully free-standing enterprises. The questionnaire asked which institutions were used by the companies when tackling a specified list of challenges. Firms were asked both about their past experience, and their expected uses in the future. Despite several direct follow-up requests to firms to complete the questionnaire, only seventeen companies responded, giving a 23% response rate. Although the response rate was poor, for those who did reply it clearly made sense, in that in only seven cases out of the total 264 replies to individual items in the questionnaire did respondents reply that they had never experienced the problem concerned. It had been hoped to make a separate analysis of firms serving the automotive and jewellery industries, but the response did not include enough of the latter to make this possible.

Table 4.5 shows the overall reported and anticipated uses of agencies of various kinds. Agencies have been grouped according to the various models of governance:

government (government agencies, together with government agencies mentioned by respondents under 'other');

associations (trade associations and chambers of commerce, including trade and employer associations mentioned by respondents under 'other');

community (similar firms, facilities on trading estate);

hierarchy (head office; supplier firms; customer firms);

market (consultants; trade fairs);

research (universities, and various research centres mentioned by respondents under 'other').

Looking first at reported past uses, we can conclude that west midlands machine tool companies perceive themselves as receiving little help from outside their own corporate organization. The most common answer by far was that the company 'worked it out for ourselves'. When those who 'consulted head office' are added to this category, 49% of respondents chose intra-company responses. This was valid for all activities about which firms were questioned, but especially so in researching new markets, patents, and equipment, and acquiring training and new employees. External consultants were used for training, qualifying for IiP, BS5750 etc., and legal advice. The trade association (the MTTA) was primarily used for expressing policy concerns and acquiring information on new markets, production methods and technology.

Table 4.5: Most common institutions used to support machine tool manufacturing, Birmingham and Coventry area

	<i>% used in past</i>	<i>% would use in future</i>
<i>State agencies</i>		
Used a government agency	2	2
<i>Associational functions</i>		
Went to our trade association	13	21
Went to the Chamber of Commerce	5	5
<i>Total</i>	<i>18</i>	<i>26</i>
<i>Community governance</i>		
Consulted similar firms	6	5
Used facilities on trading estate	0	0
<i>Total</i>	<i>6</i>	<i>5</i>
<i>Corporate hierarchies</i>		
Consulted head office	7	6
Consulted a supplier firm	2	4
Consulted a customer firm	1	3
<i>Total</i>	<i>10</i>	<i>13</i>
<i>The market</i>		
Bought it from consultants	18	15
Used a trade fair	1	2
<i>Total</i>	<i>19</i>	<i>17</i>
<i>None of these</i>		
Worked it out for ourselves	42	36
Other	1	1

These small-firm survivors seem to correspond to the stereotype of west-midlands manufacturers: independent, and using few resources outside themselves. It would also be reasonable to surmise that the 77% of firms who did not respond to our questionnaire were even more likely to be introverted than those who replied. Next after self-reliance came use of normal market procedures, confirming the pattern of very low use of LCCGs. However, associational resources were almost equal in importance with market forms.

The picture changes slightly when firms were asked about future intentions, associations increasing, largely at the expense of self-reliance and overtaking market mechanisms in importance. It is difficult to tell whether this represents a recently improved profile of the associations or wishful thinking.

More can be learned from the detailed analysis of types of issue or problem set out in Table 4.6. The topics concerned are grouped according to types of issue:

technical (research and development of a product; improving production methods; introducing new technology; researching a patent; improving production methods; acquiring new equipment; ensuring standards; securing access to services; achieving benchmarking standards);

marketing (securing orders; information about both domestic and overseas markets; establishing arrangements in new foreign markets; acquiring information on product costs and demand);

labour (equipping work force with new skills; recruiting new workers; dealing with a labour dispute);

policy lobbying (seeking to raise a policy question with national or local government);

other managerial issues (management problems; raising capital; seeking legal or accountancy advice).

Associations are mainly and particularly used for political lobbying; very little indeed for technical questions. This reflects the general changing role of associations in the UK away from technical and other substantive services, though their role in helping with marketing questions was significant for our respondents. Research facilities have some role, as one might expect, for solving technical questions, but much less than hierarchy or market, and less than might have been assumed from the involvement of Warwick University's engineering departments with larger firms and some other sectors, and of Wemtech. This latter, based at the University of Birmingham's Science Park and managed by groups from local industry and education, has the mission of easing the access of SMEs to high technology (WMEB Consultants 1992). British west midlands SMEs in machine tools do not seem to take the same kind of advantage of such collectively available facilities as do their German counterparts. Labour and general managerial issues are mainly dealt with through firms' own resources and services purchased in the market. Our findings here echo those of the WMDA survey of local business leaders, which posed the puzzle of the co-existence of a multiplicity of public and private agencies for assisting firms with new challenges, and the lack of much use of these by SMEs (WMDA 1998: 40).

**Table 4.6: Institutions used to support machine tool activities
(detailed analysis; %)**

	<i>Tech</i>	<i>M'king</i>	<i>Labour lobbying</i>	<i>Policy manag.</i>	<i>Other</i>	<i>All</i>
<i>State agencies</i>	0.90	6.56	4.44	0	3.57	3.03
<i>Associations</i>						
trade assoc.	7.21	26.23	6.67	63.16	3.57	15.15
cham. of comm.	3.60	4.92	6.67	31.58	0	6.06
<i>Total</i>	<i>10.81</i>	<i>31.15</i>	<i>13.34</i>	<i>94.74</i>	<i>3.57</i>	<i>21.21</i>
<i>Community</i>						
similar firms	5.41	1.64	4.44	0	3.57	3.79
trading estate facs.	0	0	0	0	0	0
<i>Total</i>	<i>5.41</i>	<i>1.64</i>	<i>4.44</i>	<i>0</i>	<i>3.57</i>	<i>3.79</i>
<i>Hierarchy</i>						
head office	9.91	4.92	2.22	0	3.57	6.06
supplier firm	5.41	3.28	2.22	0	7.14	4.17
customer firm	1.80	4.92	2.22	0	0	2.27
<i>Total</i>	<i>17.12</i>	<i>13.12</i>	<i>6.66</i>	<i>0</i>	<i>10.71</i>	<i>12.50</i>
<i>Market</i>						
consultants	15.32	8.20	22.22	0	35.71	15.91
trade fair	3.60	3.28	0	0	0	2.27
<i>Total</i>	<i>18.92</i>	<i>11.48</i>	<i>22.22</i>	<i>0</i>	<i>35.71</i>	<i>18.18</i>
<i>Research facilities</i>						
universities	0.90	1.64	0	0	0	0.76
other	6.31	0	0	0	0	2.65
<i>Total</i>	<i>7.21</i>	<i>1.64</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>3.41</i>
<i>Did it ourselves</i>	<i>36.94</i>	<i>32.79</i>	<i>44.44</i>	<i>5.26</i>	<i>9.29</i>	<i>35.23</i>
No problems	2.70	1.64	4.44	0	3.57	2.65
<i>Total</i>	<i>100.01</i>	<i>100.02</i>	<i>99.98</i>	<i>100.00</i>	<i>99.99</i>	<i>100.0</i>

Overall these results are consistent with the general view of traditional British industry as lacking strong institutions for LCCGs, except for the important role of corporate hierarchy and supplier chains. The geographically clustered character of

this industry seems therefore to be sustained primarily through a mixture of market and hierarchy.

The questionnaire was supported by extended visits to seven sites in order to get a more qualitative feel for the processes involved in these responses. Free-ranging interviews were carried out, usually with the owner or owner-manager of the firm. These conversations suggest that many companies are having difficulty meeting the increasing quality requirements of their customers. On the other hand, the interviews also indicated that there are still large numbers of traditionally skilled metal workers in the area.

All owners felt a reluctance even to enter into communication with competitors, let alone co-operate with them:

'we've had such a hard time in this industry that we have only survived by being cut-throat. I'd bomb the competition if I had the chance, but only because I know they'd stitch me up if they could'.

The questionnaire responses suggest that this particular approach is not universal, though several of the owners interviewed (especially the owner-managers) appeared to be proud of the fact that they had never turned to the outside for help. One commented: 'I built this factory up from scratch and have never asked anyone for help, I'm not going to start now'.

At the more formal associational level, the MTTA was mentioned twice in terms of providing useful information and once for its Step Change programme of 1999. This new programme might help explain the differences between past use and expected future use of associational resources noted above. The general feeling conveyed was that although knowledgeable institutions such as the MTTA were sometimes consulted, most outside agencies were viewed with suspicion and cynicism. Consultants, though heavily used, were generally seen as a necessary evil.

Some firms spoke favourably of the development of 'preferred supplier status', supply-chain ties forged with buyers of machine tools. Many of the companies visited in this research which were signing up for BS 5750, ISO 9000, IiP or various Quality Assurance programmes had often done so either to gain access to the money provided for training, or simply to gain accreditation for their company brochures. As a relatively low tier in the supply-chain, however, machine tooling companies are often the last to feel either the benefits or drawbacks of the recent move towards formal quality standards.

The interviews also confirmed the role of internal company hierarchy as well as that of the supplier chain. For example, R&D was seen as a concern for head office - which, as noted above, is usually located in the South East, outside the region of production. This may also help explain the low reported use of local university research facilities by these small units.

The findings suggested that low use made of official mechanisms was not the result of the firms' own attitudes to such help, but of problems in accessing it. Companies felt themselves isolated from government assistance. All the owners interviewed had, at some point in the last five years, applied for funding from the DTI, IiP or the TECs, but only one had succeeded in his aim. Several owners commented that their industry was not fashionable in England anymore, and complained that the UK government had allowed China, India and Korea to 'steal it away from us'. Two pointed out that much of the funding which they could receive was geared to achieving IiP or BS 5750, or for training the workforce. One maintained that much of this funding was wasted because it 'was intended to line the pockets of consultants rather than help our company'. In some ways this comment is insightful. Rules for IiP, BS 5750 and the first stage of the Accelerate programme all *required* the use of consultants. Previously, the DTI's Enterprise Initiative (phased out in the early 1990s) had provided financial support for SMEs wishing to make use of specialized consultants (WMEB Consultants 1992). State agencies therefore appear in close relation to market mechanisms.

As we have seen, it would not be at all true to say that there was no official interest in the sector during the 1980s and 1990s. However, the emphasis was on activities which could provide short and medium term financial rewards, in the form of successfully competing for funding from Europe or the development of saleable prototypes. The owners we spoke to often felt that these activities were undertaken mainly for publicity reasons, and were again too often geared to the purchase of consultants' advice in the market.

These findings confirm the conclusions of Heppel and Voelzkow (2000) from a comparative study of approaches to financial assistance to troubled industries by German and British governments. While the former tried to form corporatist coalitions of involved interests, British government tended to establish competitive bidding systems. In other words, a policy instrument frequently seen as a means of tackling market failure was converted into as close an analogy with the market as possible. Therefore even the state form of governance may actually take the form of

the market. A complex amalgam of market, state and corporate and supply-chain hierarchy therefore seems to constitute the prevailing governance form of the west midlands machine-tool cluster.

Conclusions

The British machine tooling industry has followed the downwards trajectory of British manufacturing since its ascendancy at the turn of the century. The traditional lack of investment in development resulting from short-termist financial institutions and the positioning of manufacturing at the low-cost end of the market ensured that the foundations of the tooling sector were to be fragile. More recently the globalization of the tooling market and the decimation of British manufacturing during the 1980s contributed further to decline. Our research was carried out during a moment of strong recovery, and before the high level of sterling resulted in the announcement of further closures in the midlands motor industry during 2000. The number of firms is probably declining again. This is no longer an important activity for the British economy.

Whether the lack of a top-down strategy in these areas will be compensated by a bottom-up initiative led by research centres and buyers cannot yet be ascertained. However, in the Coventry area at least, there are signs that the defence industry and what remains of the automotive sector are starting to demand greater quality and performance from their suppliers, while cost-effective development appears to be improving. Although the manufacture of machine tools is fairly low down the supply-chain, there is some evidence of a growing interest in networks among firms themselves and increasing though still very low involvement of local government and universities. If any form of LCCG provision seems likely to increase as a result of recent policy effort and also from change in the structure of the industry, it will be the growth of the networked firm, operating through the hierarchy of supplier networks, acting alongside government initiatives which themselves acquire a quasi-market form.

5. Machine Tools in France: A Century of Failure to Build a Competitive Industry

Patrick Le Galès and Nicolas Gaubert

The long story of the failure to build a competitive machine tool industry in France is an interesting puzzle for economic historians and economic sociologists alike. Many explanations have been put forward, from the more cultural ones i.e. machine tools are not a noble industry for elitist French engineers of the 'grandes écoles' to neo-classic economists criticising the role of the state in the economy.

In France the machine tool industry usually means metal machine tools, and is the symbol of the failure of state industrial policies. State programmes to develop a national industry were started from the first national plan of the post-war period and lasted until the last grand attempt after 1981. When the Socialist came into power aiming at reviving the declining fortune of French industry, machine tools were a priority. The left started an ambitious '*plan machine outil*' to restructure the industry and reorganize SMEs into larger firms able to compete on international terms, one of the last examples of 'industrial Meccano' (Bauer and Cohen 1985). The language used to describe the outcomes of this strategy (i.e. *déroute, naufrage*) has epitomized the failure of a dirigiste state-led industrial policy. In the language of this project, the LCCGs provided by the state on that occasion proved inappropriate to restore the fortune of the sector. In many respects, the industry remains the symbol of the failure to develop competitive SMEs in the German way.

The chapter first analyses the governance of the industry by stressing the interdependence of the sector with other industrial sectors and the state that led to its collapse. It then considers how firms were then reorganized following market modes of regulation and using LCCGs produced by transnational machine tool firms from Italy, Japan and Germany. The reviving fortunes of firms during the past seven years reveal: the relative success of this strategy; the remaining dependence upon the success of leading French industries (the motor industry in particular); the virtual absence of clustering processes; and the attempt to develop the production of LCCGs organized by business leaders and public agencies.

Lack of fit with the dominant governance pattern

A minor sector of SMEs organized around the defence and motor industries

Some key figures illustrate the long term weakness of the industry in France. As early as 1913, French machine tool production was already 1/6th of that of Britain, 1/11th of Germany and 1/22th of the USA. By 1922, 75% of machine tools used in France were imported, especially from Germany and the USA. The classic French-German comparison stresses the lasting differences between the two countries. While at the time of post-war rapid economic growth the French industry represented up to 20% of its German counterpart, the collapse of the 1980s put it back at 10% (Perrin and Real, 1974; Maurice and Sorge 1989). Recent improvements do not mask the main point: the machine tool industry has been a minor industrial sector in France for most of the past century.

A brief analysis of the structure of the industry and its mode of governance within the French context provides some explanation for this state of affairs. Firstly, the sector is mainly organized in small and medium sized firms with a strong inheritance of craftsmen moving on to become small entrepreneurs. The machine tool sector illustrates the fate of SMEs in France (Lescure 1996, 1999; Lévy-Leboyer 1996): their diversity, their family structure, the weakness of intermediary institutions to strengthen their environment, the role of the state first to protect them before the war and then to organize their decline after it (Aniello and Le Galès 2001). Generalized criticisms of French SMEs also applied to those in machine tools: lack of innovation and marketing, too much dependence upon large state-owned firms, lack of an internationalisation strategy, too small, too isolated, too conservative, controlled by the founding family, with weak financial capacity and R&D to organize development (Segrestin 1996). Within this broad picture the opposite characteristics are also to be found: the remarkable resilience of some firms which found niches and became well known for specific products, their adaptation to the French model, the resources they mobilize in specific contexts (Ganne 1990; Courault and Trouvé 2001).

Secondly, following the analysis developed in Crouch et al (2001), the machine tool sector was not among the priorities of the French state. It mainly developed around two sectors: cars and defence. In the late 19th century, craftsmen and small firms could not respond to the demand of the economy and imports soared. The first collective organizations of the sector were created to limit exports in 1840 and then 1865 in part because of the pressure of trade unions, The Société d'Outillage

Mécanique et d'Usinage d'Artillerie (SOMUA) was created in Puteaux, within the Paris region. From then on, the defence industry was a main market for machine tool firms. Eager to ensure independence for weapons manufacture, state owned defence leading firms usually favoured French entrepreneurs. In the tradition mentioned in *Laissez nous faire et protégez nous beaucoup* (Hirsch and Minard 1998: 135), laws were passed to force defence and aerospace firms to buy more expensive French machine tools in return for being able to require machine tool entrepreneurs to respond precisely to their needs, to produce limited series, and to concentrate on their demands. Machine tool business organizations always put first the defence of the *intérêt général de la France* to get support and prevent imports.

This tradition led to some concentration of the industry in regions where the defence firms using those machine tools were more important, the Paris region and the Loire *département* around Roanne and St Etienne. However, the main point is the large dispersion of SMEs, which did not depend on their local environment (with the exception mentioned above) for the production of LCCGs - from Dufour in Moulin in the centre of France to Ernault in Cholet, within the textile and shoes industrial districts.

A second major sector has been a long-term client and itself machine tool manufacturer: the automobile industry. At a very early stage, Renault in particular started to build machine tools to satisfy its own needs. Peugeot and then PSA did the same. Nowadays, Renault Automation and Peugeot Citroën industries are among the ten leading French firms in the sector.

The problem of non-territorialized state collective goods

Within a context where a large body of LCCGs was provided and organized by the state, the machine tool sector was not central: first because it was a minor and considered as such by the industrial elites (in contrast to what Salais and Storper (1998) call *Industries de la grandeur*); and second because the structure of SMEs did not pave the way until very late to the organization of national champions. In that sense, Cohen (1998: 313) makes an important point when he analysed the failure of the machine tool sector in France as:

L'explication la plus probable de la faiblesse relative....des industries mécaniques avancées, d'automatisme, réside dans le mode d'orientation (militaire), de financement (faible part de l'industrie privée) et de réalisation de

la recherche développement (gros laboratoires publics) et dans la constitution après guerre en France d'un bloc étatico-industriel.

Again within the French context - where business associations were weak, intermediary organizations suppressed since the 1789 Revolution, local economies dismantled after 1945 - when a sector was not supported by the state, it did not have much chance of a strong development path. National choices made in favour of aerospace, steel, automobile, energy, then telecommunications did not contribute to the making of a national champion in the machine tool industry.

However, that statement has to be qualified. That does not mean that machine tool were not part of the attempt to revive all industries in 1950s France. Within the soft planning of the economy steered by state elites, machine tools were seen as a sector to revive. Committees met around the Commissariat au Plan to revive the industry, and the plan Hirsch (1952-1957) particularly aimed at modernizing production. Machine tools used in the industry were too old, and that was seen as a problem for the aerospace and automobile industries, and also for electrical goods, electronics, and shipyards. Too many imports were seen as a threat to the independence of the defence industry. But plans to develop the industry and to build a national champion never succeeded. French machine tool firms remained organized to satisfy the specific needs of their large national clients, vertically integrated as subcontractors, benefiting from a quasi captive domestic, and with little concern for international, markets (except Europe to some extent), low prices, marketing, or local collective provision of competition goods. Perrin and Real (1976) show that the machine tool industry in France was never active on all segments of the markets but concentrated on the needs of large domestic industrial clients.

As Maurice (1985) suggests, the machine tool sector is interesting because of the dense and complex set of relations between machine tool makers and their clients, and also between skilled workers, mechanical engineers within the firms, and research and development engineers outside. Clients of the industry are heavily dependent on reliable machine tool for their production. Reliance and long term relationship are important, hence the inheritance of the artisan tradition that remains in this industry, very different from the Fordist models of production usually associated with the French industry.

This world of machine tool is also foreign to French political and administrative elites, a factor so decisive to understand the history of the French industry.¹ French administrative and economic elites were more interested in the sophisticated game of 'industrial meccano', the rationalisation of an industry, international markets and the top down promotion of innovative technology and research within national champions rather than in the more obscure yet decisive world of machine tools. When programmes were designed to build a competitive machine tool industry, the same types of norms, procedures, and to a more limited extent resources were used and made available. This is therefore a case where LCCGs were available for the sector, but which were not particularly relevant to the firms of the sectors involved.

When Maurice and Sorge (1989) compared the machine tool industry in Germany and France through the lens of societal analysis (Maurice, Sellier, Silvestre, 1986), they pointed to surprising findings: by contrast to the rest of the industry where France was the model of Fordist organization, the machine tool sector was stronger in specialised markets, building limited series of machines for particular clients. By contrast, the sector appeared as more industrialised in Germany, where it was more specialised in middle and large series on international markets. Following Maurice's earlier work (1985) they stress the difference between two models of organization. On the one hand, in the French context, a major feature appeared to be the gap, sometimes the contradiction, between production itself, organized around SMEs in the artisan tradition, and the research and development side, taking place either within a large client firm or in another part of the first firm separated from the production process. By contrast, in Germany, Maurice and Sorge stressed the close interrelation and co-operation (including in geographic proximity terms) between production on the one hand, R&D and design on the other. That seems to be the case even for the larger machine tool firms such as Gildmeister (Maurice and Sorge 1989: 12). They therefore identified a 'societal contradiction' which has prevented the development of the sector in France: namely, the gap between the realm of French elites, of the management world of large industry, on the one hand, and that and that of craftsmen and SMEs on the other. When machine tool firms developed, they organized themselves in a way that revealed the wider societal gap. These gaps and conflicts had long-term consequences, as they prevented the development of relevant LCCGs, such as R&D, for SMEs.

¹ International comparisons such as the classic work of Maurice, Sellier, Silvestre (1986), or English and American authors (from Kuisel, Schonfeld, Hall, Hayward to Ziegler or Lévy) have underlined

Those contradictions of the sector were not so salient during the post-war economic miracle. Although imports were always a worry and machine tool business organizations always bitterly attacked cheaper foreign machine tools, firms were growing and the sector enjoyed considerable growth for three decades. The rapid industrialisation of France (cars, defence, steel, but also electric and electronics firms, energy, aerospace, telecommunications) boosted demand for machine tools. Machine tool firms developed as subcontractors to large industrial firms and specialised in limited series, with little geographical concentration. By the late 1960s French machine tool production was 20% of Germany, and equal to Japan. Although mainly oriented towards the domestic market, it also won markets in Europe.

However, the competitive edge was not so strong and imports remained dominant. In terms of LCCGs, this is not so surprising. Most of the relevant goods - R&D, market development, access to information - came from large French industrial firms.

By contrast, not much existed outside this frame. As mentioned before, the state tried to launch programmes to revive the industry, to build a national competitive industry, but failed to do so. General collective competition goods were made available by the state; they were not relevant for this industry. At the macro level, the close relationship of state administrative elites and large industrial firms produced a collective good, which was rapid economic growth fostered by dynamic industrial modernization strategies. The machine tool sector benefited fully from this positive environment and in a modest way contributed, to the success of French industry. But its own competitiveness was not consolidated beyond integration within the French model.

To some extent, economists could argue that in the long term some of the collective goods made available and used by the firms – such as the captive domestic market - worked against the strengthening of their competitiveness. By contrast, there was hardly any community regulation of the machine tool sector. As noted, there was a very limited exception in the Roanne and St Etienne region, where the proximity of state owned defence firms and machine tools firms could lead to shared labour market and information exchanges, though again within a vertical integration framework. Formal associations were even less present. Existing associations were mainly concerned with the limitation of imports to give them time to develop a competitive industry and to protect their domestic market.

this point with even greater strength, as have Salais and Storper.

Machine tool sector governance therefore relied on a mix of state and organization (in the sense of vertical integration). A large body of family SMEs was mainly co-ordinated by hierarchy, instruction-based relationship, and vertical integration under the control of directors of large firms and administrative elites, who happened to be socially the same group. But hierarchy is not the whole story. A lot of adjustments and co-ordination took place through contacts between professionals in the machine tool firm and within the customer firms. Dispersal and fragmentation produced a complex and varied pattern of relations within the vertical integration.

Le naufrage 1970s/1980s

All those features of the governance of the tool sector, including the contradictions and weaknesses, came to full light during the industrial crisis, which led to the collapse of the industry over two decades. The story of that collapse has already been written. The following account only briefly underlines the main points (Bauer and Cohen 1985; Cohen 1989; Ziegler 1997). First, most leading machine tool firms collapsed. Second, the state launched a series of ambitious programmes to first save and second develop French machine tool firms that could not prevent more collapse and decline.

French machine tool firms faced the difficulties of all French large firms. In the vertical integration model, tough restructuring in the motor and then defence industry had serious implications for machine-tool firms. They turned to foreign imports and diversified their subcontractors to improve performance and reduce costs. The aerospace sector in particular turned to better and cheaper foreign machine tools, when for years they had mainly used domestic producers. Most importantly, the machine tool sector was slow to adapt to the new technological environment, the development of microelectronics and computer numerical control (CNC). By the late 1970s Japanese firms had taken 40% of the French market with the new generation of machines, reliable and cheaper.

Within ten years most well known firms had collapsed, were reorganized within larger groups, which also collapsed, or were bought by foreign firms. Prestigious names of the industry went bankrupt: Forest, Dufour, Ernault, and then Liné, Graffenstaden, Firms were dismantled, some plants being sold to other firms. The state tried to steer the restructuring process. By the late 1980s employment had dropped from the 30,000 of the early 1970s to 11,000 (Leborgne, 1987). The number of

firms employing more than 500 workers declined from 15 to five, and average firm size declined from 145 to 82 (figures from the Machine tool builders association quoted by Ziegler).

Governance failure

When the crisis became clear, as early as 1974, the administrative elites of the state started to react and to restructure the industry. Three governmental programmes to support the industry were implemented within 10 years. The restructuring game was played by the enlightened force of the top French administration against the archaic forces of SMEs in the classic model of French *dirigiste* industrial policy; and the game was lost. Ziegler's telling comparison of the German and French machine tools sectors analysed the industrial crisis and the failure to adapt to technological changes:

The challenge posed by the machine tool sector in the 1970s was how to encourage an industry of mostly small, specialised, and geographically dispersed producers to adapt the new technologies of computer control to their products. For the firms, this process often meant incremental improvements rather than radical innovation. For policymakers, the challenge was not so much to develop technology as to diffuse it. This task led policymakers in both countries to formulate a number of similar goals. They tried to cultivate sector-specific research capabilities with the help of non-state agencies. They worked with the industry to provide funds for the use of microelectronics in these products. They tried to bolster demand from other sectors for these new products. And they promoted educational efforts to train and retrain workers with the new combination of mechanical and software skills that were needed by the industry. (Ziegler 1997: 92)

The state orchestrated three ambitious plans for recovery, the *plan d'Ornano*, (named after the right wing minister of industry under Giscard d'Estaing at the time of the crisis) and the *plan machine-outil* from 1981-1982 implemented by the newly elected socialist government, which was to be followed by the *plan productique* in 1983. Cohen (1989) takes this example as the symbol of the *Etat-brancardier* (stretcher-bearer state), inventing all sorts of agencies, programmes and procedures to save and restructure French industry. In brief, the administrative elites in charge of the industry used the same norms and policy instruments they used in other cases (from steel to shipyards), among them the classic policy of support for economy of scale through size and the making (once more) of national champions. These measures

included: restructuring of firms brought together within a larger holding; concentration organized by subsectors of the machine tool industries (i.e. the old logic of *pôles*); large investments in capital through state agencies; financial incentives to adopt the most recent and sophisticated technology; organization of networks of research centres for the industry; provision of training responding to the particular needs of the industry; incentives to state owned industries to buy French machine tools; obligation on the Ministry of Education to buy large numbers of machines for training purposes in order to secure a market for the new generation of machines; resources and expertise to boost exports. The scale of public support was quite large for the sector. In December 1981 the state planned the spending of 2,3 billion francs over three years, in order radically to reshape the sector, and in particular the 25 largest firms. The financial support was provided once contract between the re-organized firms (including mergers and new holdings) and the state was agreed.

All this was done in consultation with business representatives, but only the major ones, not the large bodies of SMEs and more or less without the trade unions although skilled workers are so central in the sector.² This illustrates the classic model of top town *dirigiste* industrial policy to restructure an industrial sector which was successful in other sectors until the 1970's, but which did not take into account either the previous governance of the sector, nor the existing structure. However, the three plans brought in large amount of capital and other LCCGs (training, research, and organization).

The machine tool plan failed for various reasons:

First, some firms spent a lot of time negotiating and eventually did not join some of the new holdings.

Second, the restructuring took place at a time of serious economic recession and the money was mainly used to help the survival of leading firms instead of their restructuring.

Third, bilateral discussion between state officials and state representatives did not contribute to any collective mobilisation by business. In the terms of this book, either the collective goods made available were irrelevant or the timing was wrong. Some were irrelevant because machine tool innovations were complex, and bringing together classic machine tool technology with recent developments in

microelectronics and computers required skills and developments which were far beyond reach of French firms. Choosing breakthrough innovations proved successful in some industries, but a complete disaster in the case of machine tools. Here, Ziegler (1997) emphasises the role of ideas, knowledge in policy making and, in the French case, the gap between policy elites and machine tool firms leading to irrelevant choices of strategies. By contrast, the German industry followed a more modest 'discussion-oriented strategy' using existing networks of institutions (see Glassmann, this volume) which proved successful.

The failures of the French plans attracted sharp criticisms: top down approach; bilateral negotiation with the centre instead of support to inter-firm co-operation; all the energy taken by the restructuring process among firms; support to radical technology change that French firms were unable to control and manage; lost public funding; failure to implement the programme (for instance, schools did not want to buy the training machines decided for them by the top administration); lack of serious policy to tackle the human resource problem; support for opportunist behaviour among those entrepreneurs who best played the restructuring game. Some leading firms were engaged by the state to participate in the restructuring, but used their position to acquire cheap assets or technologies and then change their plan as soon as they could (for instance Empain Schneider or Suez). In many firms, the period 1975 to 1985 led to changes in management, changing production, radical technological innovation, changing objectives and competitors. To complete this long list, the change of government in 1986 also led to a radical change of industrial policy. The neo-liberal minister of industry Madelin stopped subsidising a number of firms, which went bankrupt.

Some interesting issues were addressed in the plan, but implementation concentrated on financial restructuring. For instance, the gap between the existing skills of the labour force in SMEs where training was never a priority and the goal of producing high-tech CNC machines was considered to be a serious issue at only a very late stage. Some of the initiatives to train workers and develop new programmes within the school and higher education system take years to materialise and or to have a positive impact on firms.

In a similar way, the idea of creating collective networks of firms and research centres, joint organizations to develop R&D for the sector produced initiatives that

² In his vivid account of the period, Ziegler (1997) correctly insists not only on the strength of norms, procedures and interests entrenched within the state, but also the role of major groups such as

could be judged only in the longer term. The institutionalisation of research networks including ENSAM (Ecoles Nationales Supérieures des Arts et Métiers) and ADEPA (Agence pour le Développement de la Productivité et de l'Automatisme) led to the creation of two organizations on a regional basis: CERMO (Centre d'étude et de recherche de la Machine Outil) and CETIM (Centre technique des industries mécaniques). For the first time ever, some form of collective action developed within the sector beyond the classic demand of the main business organization to limit imports, to ask for more funds, and to force other sectors to buy French machines. So far the new structures have had only a limited impact. The context of restructuring, the decade of chaos, decline and financial reorganization did not leave much space to develop long term joint research, collective action between research centres and firms. By comparison to long established similar type of organization in Germany, the first years of CERMO and CETIM do not amount to much. But theory teaches us that the institutionalisation process takes time and is often incremental. To develop collective action, actors have to stabilise norms, rules, roles, expectations, and representations. Those organizations were to play a significant role in the provision of LCCGs some 15 years after their creation.

In our language, the machine tool sector requires particular LCCGs, which are not related directly to economies of scale but rather depend upon the co-ordination between firms within the sector, with its customers, and with centres of research and training. This particular pattern explains why SMEs have remained dynamic and successful in the machine tool sector. Even in the French case, SMEs remained innovative, far away from restructuring plans.

The exception to this general assessment is the large enterprise NUM, a firm based in Nanterre, on the west side of Paris. It is France's leading CNC supplier. It used state support quickly to establish a leading position within the French market for command numerical control equipment, and it then gained markets in Europe. It was the only firm that benefited from support for innovative technologies. NUM started in 1964 as the machine tool department of the engineering firm Télémécanique Electrique. The first range of machines was put on the market in 1971 and NUM was created as a company in its own right in 1978 (subsidiary to Télémécanique), with a dominant position in the more technological part of the machine tool industry. In 1979 and the following years NUM absorbed the numeric controller departments of many firms from Matra to Alcatel. At the cutting edge of

administrative and political elites, their relationship, status, identities and their representation

technology in the booming CNC sector, it became the only success story of the time, with the support of the state, which encouraged aeronautics and car firms to buy NUM products for their machines.³ NUM became a world-wide leading supplier of numeric controllers for machine tools.

But in general the restructuring plans were unsuccessful. The vertical integration model did not provide new resources. The main customer firms such as Airbus, Snecma (aerospace), and Alcatel were part of the restructuring game. They faced their own difficulty and did not want to take the leadership to restructure machine tools. Also, when directors from the large groups were sent to head SMEs in trouble, that did not guarantee success. The role of Renault was more ambiguous and positive for a while. First, its own machine tool subsidiary benefited from the plan and developed some relations with other firms. Renault, together with Peugeot, was also involved in capital investment in one of the three new 'poles' of the machine tool industry. However, Renault was soon to face its own trouble as it narrowly avoided going totally bankrupt (thanks to its public status) in 1985. As might have been expected, the dispersion of firms and the logic of vertical integration did not lead to clusters, to increased local or regional inter firm co-operation. The story of the collapse of the industry can be analysed in terms of governance failure.

A new beginning for a residual sector?

The machine tool sector in the 1990's

Already weakened, and despite two good years in 1987 and 1988, the sector did not fare very well during the early 1990s economic recession, but it was of course not alone in Europe in this respect. Three machine tool poles had emerged after the three plans in the late 1980s. The first and most prestigious one, Ernault Somua, had been bought by the Japanese firm Toyoda, the machine tool subsidiary of Toyota, in 1986. Following new problems, the company was sold again in 1992 with the creation of the CATO group, a new holding built around what remained of Dufour, Cazeneuve, and SOMAB. Cazeneuve (making turning lathes) was then able to buy Vernier (milling machines) and Syderic (drilling machines). Second, Intelautomatisme was not well supported by its institutional investors. Suez in particular did not fulfil its promises, and the two firms could not be merged (Cohen 1989). De-merger took

³ Num has built upon the success, being now part of the Schneider group, it bought the Italian firm SERVOMAC in 1989 (variateurs de vitesse).

place, and the whole thing was bought by Fiat's subsidiary, COMAU. Third, MFL, which was seen as the leading holding after the restructuring process, even went to the USA in 1984. It achieved major public funding (over 1 billion francs). However, things went wrong; it went bankrupt, was disbanded and sold in 1988 (including Liné and Berthiez). In contrast, some SMEs, which did not receive state help, such as René Brizard, had been a relative success story as a growing firm in the milling and turning sector. But it faced financial problems in 1991.

The main feature of the period is therefore the end of the ideal model of the national champion of the sector and instead massive foreign investments: the Japanese firm Amada (sheet metal press) bought the SME Promecam; Tornos-Bechler (Switzerland) together with FLD Manurhin bought Wirth and Guffat; Nodier-Emag (Germany) bought Sculfort; Shules (Germany) bought Spiertz. The ministry of industry tried to save what it could in a more modest way. In 1993 it created a financial holding of the remains of MFL, SFPI and a few other firms (e.g. Brizard, Liné, Forest, Berthiez, Vernet, Lurem, Acma). No longer did it pursue restructuring through economies of scales. The lesson has been learned and the importance and dynamism of SMEs in the machine tool sector were widely acknowledged. The idea was rather to build a holding with more financial resources to face short term financial crisis from one partner or the other, and to develop inter-firm co-operation on a non hierarchical basis; in other words an alliance to face financial short term problems without mergers. Employment declined to 8,300 in 1992 and the number of firms to 133.

The end of the 1990s: an improving residual sector

Machine tools were left as a residual sector of the French economy (Table 5.1). Things then improved. The industry took advantage of the growth period of the second part of the 1990s to recover, including the strong growth of French/European aerospace and car companies, its leading customers.

Today the metal machine tool sector comprises 130 firms, employs 6,700 persons and is specialised in three main markets: machinery industry (50%), cars, aerospace and defence (40%), education (10%). It has taken full advantage of the success of its traditional customer firms to develop its own success. The market is differentiated in three main segments: large series of relatively standard machines such as turning lathes, milling machines and drills; more technology driven machines; and machines made to order. For the first time ever, 50% of French

production of machine tool is exported. In other words, the sector has become small but competitive on international markets.

French firms are small; about half the average of German firms. Although government agencies still complain bitterly about conservative family owned SMEs and the problem of size, all statistics rather show the dynamism of these firms and illustrate the new generation of dynamic French SMEs (Aniello and Le Galès 2001). However, although the restructuring process has led to more concentration, the industry remains very dispersed, with some concentration (about 20% of the firms within the Rhône Alpes region), some in the Paris region, and the rest scattered around.

Following the collapse, the French machine tool sector now mainly comprises three types of firms:

- those which have merged within middle sized international group, French or foreign;
- those who go their own way, being specialised in niche markets;
- those who are still integrated within a large aeronautic or car firms.

The provision of LCCGs is now organized in three ways: within holdings and international groups made up of several firms; through collective action organized by public agencies and industry associations; and, to a very limited extent, through a limited territorial concentration.

Radical changes in LCCGs and a new governance model

Provision of LCCGs: foreign owned firms or larger holdings

Although not the easiest point to document, the take-over of leading failing French firms by foreign successful ones has proved crucial for the limited recovery of the sector. Italian, Japanese and German firms have brought in a completely different set of approaches.⁴ First, they provided stability and a lasting strategy in relation with world or at least European markets. They changed the focus and the range of clients. For those local SMEs that used to deal with traditional large French industrial clients, the change of perspective was radical. They had to become competitive on foreign markets and to find customers. The new owners (Japanese, Italian, Germans, Swiss) first provided information and access to European markets in particular. French SMEs were

⁴ The evidence for this section comes from our interview with CETIM, Firms, and the Ministry of industry.

Table 5.1: The French machine tool industry in the mid 1990s

<i>Companies</i>	<i>Nationality</i>	<i>Particularities</i>	<i>Events in 1992-93</i>
<i>Annual turnover: 500 million to 1 billion francs:</i>			
Brisard M.O	French	Machine tool pole constituted after acquisition of about ten coys	Dismantling of group following recapture by SFPI
Renault Automation	French	Renault subsidiary	
Promecam-Amada	Japanese	Amada subsidiary	
<i>Annual turnover: 300 million to 500 million francs</i>			
Peugeot-Citroën Industrie	French	PSA subsidiary	
Cazeneuve-Somab-Ernault	French	Cazeneuve part of Thollon	After successive recaptures of Vernier, Syderic Dufour, partnership with Somab and Ernault (both Toyoda)
Huron-Graffensaden	Italian	Comau (Fiat)	subsidiary (born after dismantling of Intelautomatisme)
NUM	French subsidiary	Telemecanique (Schneider)	
<i>Annual turnover: 100 to 300 million francs</i>			
Traub-Sonim	German	Traub subsidiary	
Gravegraph Fld-Manhurin	French Swiss	Tornos-Bechler Swiss subsidiary	Bankruptcy
Polymatic	French		
Nodier-Enag	German	Enag subsidiary	
Alcera-Gambin	French		Bankruptcy; recapture by Huron (Comau subsidiary)
Worth and Guffat	Swiss		Bankruptcy

able to rely upon their new owners to develop strategies and marketing skills to win markets outside France. If in the late 1990's, for the first time, about half the French production of the machine tool sector is exported, this is very much thanks to foreign firms.

Foreign owners also provided crucial collective goods in that domain: information about foreign markets, know how about contracts, estimates, delay. They brought in their experience in terms of access to R&D, and most importantly the gradual use of new technologies to develop new machines. The management of R&D in those international groups is very different from what was organized in a French context. It took from three to five years for the firms to recover under the new management and to become successful.

During the mid-1990s the organization of partnerships between firms organized in cross-frontier networks became a general feature of the industry (Veltz, 2000). The firm Manitou which builds *chariots télescopiques* for the agricultural industry signed a partnership agreement with New Holland (subsidiary of Fiat) in 1997, first to sell Manitou's machines all over the world. This alliance illustrates the types of collective goods that standard French SMEs miss. A second step was taken when the two firms made joint R&D programmes for the use of electronics in their machines. Gradually, they combined their own strengths to develop new machines and reinforce their technologic and marketing co-operation. A similar example comes from PCI, the machine tool subsidiary of the Peugeot Citroën Automobile group that specialises in machine tools for the motor industry. It started a partnership with the British firm Transtech to build and sell PCI machine tools for UK-based car firms. In exchange, PCI will build and sell Transtec high speed machine tools for the aeronautics industry in France.

The making of the CATO group signals a similar move organized by a group of SMEs which were put together (including Ernault (in Cholet), Cincinnati (Chambost-Allères in Rhône), Cazeneuve (Pont-Lévêque, Isère and Somme), Vernier (Nice), Somab (Moulins)). CATO has become the leading figure of the machine tool sector, with a variety of machine tools to cover the main segments of the industry. It also has the resources to provide finances to the federation of SMEs it integrates. It can also play an effective role in negotiating with national and regional governments support for the type of collective goods it needs (from training to support for export or programmes to transfer technologies). Last but not least, the CATO group organizes for these once failing prestigious SMEs a dynamic global marketing and

commercial network. CATO is therefore a case of loose vertical integration, a flexible integration of SMEs that tries to maximise the strength of innovative firms with the provision of collective goods within an integrated holding.

Collective action within a fragmented sector: business associations and state agencies

Some of the policies started in the mid 1980s proved to have long term impact.⁵ Firstly, the creation of the renovated business organization, SYMAP (Syndicat de la machine outil, du soudage, de l'assemblage et de la productique associée) signalled the collective dynamic among sector leaders, in particular in relation to the provision of LCCGs. Second, some organizations had been started in the 1980's, such as CETIM and CEMO, to organize local and regional networks, bringing together specialised research centres, groups of SMEs, and customer firms in relation within the broad mechanical sector. At the same time, the major reshaping of the French industrial policy provided funds to finance such networks and specific programmes aiming at upgrading a sector, a group of firms, inter-firm co-operation, and transfer of new technologies.

Training is a good example of the new developments. This was not an issue for a long time except in the case of NUM, which made an unusual effort in favour of training the workforce to adapt to constant upgrading of CNC technologies. However, once the ministry of education took into account the call for specific training in the machine tool sector, it took a while to implement the decision, to create a number of specialised professional diploma in technical high schools, but also at the graduate or post graduate levels (for engineers). In line with the new thinking about (relatively) closer links between industrial sectors and training within schools in France in general, the machine tool sector was gradually able to benefit from public investment made in that area. In some places, such as the St Etienne area, business leaders were directly involved in the design of new programmes. At the other hand of the scale, some engineering schools developed new programmes in terms of both applied research and development and training itself in close relation with the industry. What had been seen as a major failure started to take off, i.e. the provision of training at different levels and appropriate R&D centres and networks to support the development of SMEs with a more dynamic business association.

⁵ This point is easier to document because of the access to those agencies and also because of the documents they publish.

The SYMAP and also the FIM (Fédération des Industries mécaniques), again with the support of the ministry of industry, also made an effort to provide information to the profession: figures about the sectors, new developments in terms of research and technology; information about French, European and world markets; information about good management practices in leading firms and about marketing strategies. This translated in terms of publishing (business and professional newsletters such as *CETIM information* and *EMO*), of economic indicators developed for the sector, of information about developments in foreign markets. It also leads to the development of professional exhibitions, the organization of short term training programmes to discover new technologies, and information about new environmental law (from the state or the EU). This is clearly presented as an effort by the main business organization to provide LCCGs for the sector.

There is now a wealth of information provided by the SYMAP in a deliberate attempt to overcome the fragmentation of the sector. Business leaders in the sector represent themselves as tough survivors who have taken a major turn thanks to foreign firms. They know the limits of their size, but they organize in order to foster their competitiveness on the world market. In that sense, although a much leaner sector, machine tools firms seem to build upon the recovery of the 1990s to establish governance patterns that will support their development in the future.

Research is probably the best example of that trend. CERMO and CETIM emerged in the 1980's. The CERMO, the only research centre specialised in machine tools was merged within the CETIM network of regional centres. One centre in Senlis (north of Paris) is the leading centre in the CETIM network for the machine tool industry. According to the ministry of industry, French firms in the sectors invest half as much as Japanese firms in R&D. Again, fragmentation, very small firms and subcontractors are seen as the reasons for this. However, CETIM has gradually taken a leading role in structuring collective action in order to provide LCCGs.

CETIM is funded by a special tax paid by firms. Its machine tool network comprises about 50 firms. Beyond the Senlis CETIM, other regional centres are playing a leading role in the sector, in particular in St Etienne (specialising in high speed *usinage*), and Nantes (machines for the agri-business sector). CETIM has close relations with machine tool business leaders and with regional research centres, engineering schools and universities remote from the main research infrastructure in Paris. In close co-operation with SYMAP, CETIM's first role is to provide

information to its members about technological changes in France and in other countries. It is part of various national and international organizations to elaborate standards and norms for the profession, and provides experts to international and national working groups. Second, and most importantly, it provides information and organizes R&D about new techniques and new technologies: the use of new material (*alliages, céramiques*), electronics, and high speed developments in relation with CNC. SMEs in the sector no longer rely just on the co-operation of large firms to develop R&D programmes and then new machines. CETIM plays a pivotal role in organizing collective research projects, bringing together leading firms, small SMEs, leading clients, experts, and regional research centres more interested by applying technology. They get specific funding for those collective research programmes (from different sources), and the benefits are supposed to profit the whole industry.

For instance, this new governance of the machine tool sector is exemplified by the way it reacts to new technical challenges, such as modular and upgradeable machines. A new generation of high-speed machine tools is now emerging on the market. Their production raises specific issues, and requires new technology. However the way these machines are used in their environment also raises particular problems, in particular in customers firm which have to re-organize their working environment. However, when well adjusted, firms are able to benefit from these new machines to respond to increasing pressure for just in time delivery or short notice contracts from major customers.

The new governance of the sector is demonstrated by the fact that some problems raised by the introduction of these machines has been identified as a problem of LCCG provision. SYMAP has taken the lead to develop a collective research project with CETIM to address this. The high speed machine tool project (*usinage à grande vitesse*) brings together 14 leading customers and machine tool builders from Renault and SNECMA and GEC Alsthom to Comau and Cato, together with a network of 10 regional research centres (including engineering schools and university departments in Nantes, St Etienne, Compiègne). Participants in the programmes sign a contract including norms of behaviour and financial contribution.

This is the most complete example of LCCG in the sector. Most of the time CETIM is less central in the management of ambitious R&D programmes and mainly provides information and develops links between partners, or supports small-scale programmes such as the diffusion of one particular type of technologies. CETIM

spends 42 % of its budget on R&D. Beyond CETIM, other public agencies have taken notice of this new capacity for collective action and seem to be better equipped to provide other kinds of LCCGs to the sector. The ministry of industry finances inter-firm networks and innovative programmes. Within the central administration of the ministry, one person is specifically in charge of the machine tool sector.

The DRIRE (*Directions régionales de l'industrie, de la recherche et de l'environnement*), i.e. regional branches of the ministry of industry, have taken a leading role in providing information, guidelines and support to deal with environment issues. Machine tool SMEs have first to adapt to new rules about pollution, waste, fuels, all themes that they did not deal with for a long time. At the same times, those types of demand are also emerging from the market. Major customers firms have ever stricter requirements. Machine tools firms are therefore required to be far more clean, reliable and safe. Often in co-operation with CETIM, the ministry of industry has provided not only information and guidelines but also specific programmes to help firms upgrading to those new issues. The signing of regional planning contracts between the state and the regional councils has been used as an opportunity by the ministry to develop programmes and funding, together with more for inter-firm co-operation programmes and technology transfers organized by CETIM regional centres. ADEPA provides specialised engineers to firms to implement upgrading programme or to reorganize production processes in relation to technological developments. It played an important role in boost the diffusion of computer assisted programmes for production in general, and in the machine tool sector in particular. As some SMEs have tried to develop very specific machines for their large clients; CAPO has proved essential to integrate conception and construction. Those developments also helped the building of machine tools devoted to the construction of more precise (sometimes unique) metal parts. After the restructuring process, French machine tool firms have embraced those new developments at a far higher rate than ever before. They seem finally to have taken advantage of the right kind of LCCGs provided mainly by other firms and to some extent by professional networks bringing together leading public and private actors of the sector.

Weak territorialization

Clustering and the provision of LCCGs on a local basis are still not much on the agenda of the French machine tool sector. This is not surprising in the Paris region,

where market mechanisms dominate the relationship between firms. However the same is true for instance in Alsace which is a dynamic industrial regional made of a large proportion of foreign-owned firms. When Bureth and Llerena (1993) tried to identify an Alsatian production system in the mechanics sector (including machine tool firms), they found two main types of inter-firm co-operation: the relationship between machine builders and their customer firms (from commercial relationship to day to day interaction about the use of the machine) and technology transfers to upgrade both the machines themselves and the production process. These authors found intense interaction between Alsatian SMEs and firms in Baden-Württemberg and Basel, i.e. within a large region beyond the national frontier. These inter-firm relations take place within transnational groups and market relationships. Second, they found a large set of relations extending beyond this large region. They could not find signs of the making of local industrial or innovation systems. They also notice that the smallest SMEs had more chance to deal with a smaller number of partners on a more local and regional scale. Training was the only exception to this pattern. As far as research was concerned, they identify a complete gap between research made in the Alsace region and the research used by the SMEs.

These findings fit with the general pattern of French SMEs, i.e. either dynamic SMEs more integrated within international market relations or development within foreign owned groups providing LCCGs, or large customer firms providing the same. The increasing fragmentation of old industrial milieux is also quite classic (Courault, Trouvé, 2000).

However, without disputing this general pattern, there is a special case in Saint Etienne. Many firms there are well integrated within a dynamic CETIM. They also take advantage of training facilities. Also, within a declining industrial region, and in accordance with what De Banville and Venin noticed (2000), there is also a skilled labour market and networks of professional who play a role. In the machine tool sector, the diffusion of innovation also takes place either by relations with customer firms or by imitation of the competitors. In this region, cases of innovation following imitation and dissemination through professional networks were noticed.

Conclusions

We have argued that there is a correlation between the governance failures and collapse of the machine tool sector in France over a long period. By contrast, the recent recovery of the sector goes together with attempts being made collectively to

organize the provision of LCCGs and to strengthen inter-firm co-operation in different ways. It is far too early to decide about the future of the sector. SMEs still depend, though less than before, on the success of large industrial customers (aerospace, motors) in France and in Europe, and it remains to be seen how it will face difficult times. Table 5.2 shows the changes which have taken place since the 1970s, demonstrating the complete change of governance of the sector. We have analysed this as the making of what could become a new mode of governance, a new combination of association, market, corporate hierarchy and state (in its new network form of intervention). The long-term development of relationships between research centres and groups of firms illustrate the sea change. The smaller, leaner, more competitive machine tool sector is now firmly organized along a market governance mechanism with some public support. It remains to be seen if the almost total absence of local or regional integration will prove a handicap in the future.

6. Conclusions: Hybrid Governance and Networked Firms

Colin Crouch

The evidence presented by these case studies is confusing, because it demonstrates contradictory convergence processes. During the latter 1990s there was a general, even global, convergence, at least at the level of economic ideas, on the policy prescriptions of neo-liberalism and the strengthening of market forces. This orthodoxy is however ambiguous on questions of the role of SMEs. At one level, the theory of free markets favours these. Not only should free markets contain large numbers of small firms for the sake of competition, but these are also seen as particular centres of enterprise and innovation, stripped of the heavy structures which sometimes encumber giant corporations. On the other hand, some kind of regulation is usually required to protect small firms from takeover by large ones. Even more important, the latter are better equipped to compete internationally in a neo-liberal policy environment which minimizes the possibilities for public provision of competition goods on which SMEs depend if they are to have an advanced innovative capacity. Large firms can provide such goods for themselves, or as club goods within the hierarchy of their supplier chains.

Two opposing policy trends can therefore be seen, and they can be found within each country. As Farrell and Lauridsen show, during the 1990s the left-leaning regional government of Emilia-Romagna began to shift away from its policy of supporting industrial districts as a whole, and started concentrating on helping larger 'leader firms' to build a place in the global market. Alongside this came a policy of encouraging regional suppliers of real services themselves to market their activities and therefore resile from their earlier concepts of having responsibilities for their localities. In many ways this insistence on the market testing of public services was an imitation of policies initiated in the 1980s in the UK. Meanwhile, as Crouch and O'Mahoney argue, the neo-liberal central government in the UK was trying to develop a localized policy capacity so that it could encourage small enterprises - with the strength of the Italian small-firm economy at least implicitly in the background. Glassmann shows that in the Stuttgart area too developments moved in various directions: SMEs simultaneously became more oriented to global as opposed to regional markets *and* discovered scope of co-operation; the range of regional (*Land*) state-provided competition goods expanded, while large firms acquired a greater prominence as in Bologna and Modena. Le Galès and Gaubert's account of

the French case can also be read in two ways. On the one hand, the final break-up of economic leadership by a strong centralized state can be interpreted as part of the neo-liberal turn. On the other hand, what replaced it was by no means pure market governance, but a complex set of institutions including prominently both corporate hierarchy and various forms of state or associational activity.

The model of the abstract components of economic governance regimes developed by Crouch and Trigilia (2001: 224-35) proposes three continua according to which such regimes can be analysed, according to the different ways in which they provide competition goods: endogeneity versus exogeneity, procedure versus substance, and informality versus formality. A move towards a neo-liberal pattern is a move towards exogeneity, procedure and a moderate level of formality.

The cases described in the previous chapters do not fully show such a tendency. There was a certain though moderate trend towards exogeneity, as governments (national and regional), large corporations, and other actors considered that neither the sector itself nor its localized SMEs were capable of resolving their problems. They therefore moved into the sector to displace local actors. However, governments in particular were likely to recognize the importance of working directly with the firms and not at arm's length. There was also a move towards moderate formality: the sheer diversity of new approaches prevented any strict formalism, though the growing role of multinational firms necessarily strengthened formal bureaucratic procedures over the informal ways typical of SMEs. But there was sharp divergence from neo-liberal prescriptions in the strongly substantive nature of the LCCGs being developed to assist modernization. Even in the UK, where neo-liberal policies were most explicitly stressed, firms were not in practice told that they needed only to be exposed to the market in order to improve their competitiveness. Whatever their ideological preferences, all agencies concerned tried to develop substantive provisions and advice.

Considering the realities of productive achievement, as opposed to policy stance and direction of change, the Emilia-Romagna machinery industry remained internationally successfully and comprised of relative small firms; the machine tool industry of the West Midlands remained internationally weak and saw continued tendencies to concentration; Baden-Württemberg machine tools suffered considerable decline and then recovered; the French industry, much less territorialized than the others, remained weak but was finally able to aid its recovery with a variety of LCCGs. Were the different policy actors and industry specialists

converging on some best-value policy model for the future, in which machinery districts would continue to exist as geographical entities, but with large firms playing a larger role than previously the case in central Italy? Such a convergence could take place on the basis of the supplier chain, the smaller firms of a district remaining significant for the leader if they could continue to use the advantages of geography to learn rapidly of its changing requirements and quality improvements. Policy makers in each country seemed to agree on the value of supplier chains. Such a development is fully consistent with the major trend identified in our previous study (Crouch and Trigilia 2001), which saw a general move within local production systems away from the model of networks of firms towards that of the 'networked firm' - the large customer firm and its (partly local) suppliers.

As Crouch and Trigilia (*ibid*) noted, while this model can be very robust and productive, and surmounts many of the problems raised in the provision of LCCGs by making these club goods, it may at the same time threaten some of the primary advantages of truly collective goods. When provided within a networked firm which is itself a national or global corporation, some of these goods may disappear from a particular local region, leaving regions without autonomous capacity for innovation.

It is difficult to establish at this point to what extent the current industrial districts in Emilia Romagna are threatened with a similar fate. Not all skills which develop in an area are drained from it if a network of firms becomes part of the hierarchy of a large networked firm; and it is not yet clear whether the regional government's strategy of more or less abandoning the industrial district model will be decisive. Farrell and Lauridsen demonstrate the continuing activities of commune-level governments to sustain the capacities of districts. They may well be unable to provide the levels of technological, international marketing, and other support which small firms may now need to compete, but they may provide those which maintain them as strong and relatively autonomous members of a supply chain. And Italian local governments, alongside the informal networks of firms themselves, may prove more important than the relatively weak regional tier.

The British case provides some evidence that units located in empirical clusters thrived better during the 1990s than more isolated machine-tool makers. However, many of these 'units' were branches of large corporations, and there was no relaxation of the tendency towards concentration in this and other British industries. Indeed, there is evidence that the new (and in the event short-lived) local policy instruments, Training and Enterprise Councils (TECs), themselves depended heavily

on local managers of large corporations, links with the SMEs which had been their initial targets having proved difficult to develop.

The German model may be more resilient. The relatively large networked firm model has long been more important here than in the Italian case, but these firms have been more embedded into their regional economies than their counterparts in the UK. If today they are becoming disembedded from an individual region, the implications of such a move are less dramatic than would be the case in Italy because, as shown by Glassmann here with reference to machinery, and by Glassmann and Voelzkow 2001 with reference to the economy as a whole, there is a rather homogeneous pattern of LCCG delivery across the whole country. The German system is a national one, locally delivered. The French system remains, by contrast, a national one, nationally delivered. The innovations described by Le Galès and Gaubert certainly mark a change from a centralized model. However, the new flexibility and closeness to the firm of government policy actors, and the new prominence of large, often non-French, holding companies, still do not make use of a strong territorial component. This is because the industry was not concentrated in the first place. It will be interesting to see if SMEs in French machinery production can achieve a strong international presence through such means.

Throughout their histories machinery industries, in common with many others, have faced waves of technological change. These initially challenge and unsettle producers; then some firms use the challenge to advance their capacities, while others fail to respond and usually have to leave the market. From the 1970s onwards there have been successive challenges from computer-based technologies. It is remarkable that the Emilian industries, based on small firms, had a responded better to this than the British and French, which had undergone major processes of concentration, partly on the strong assumption that only large firms could tackle these technologies. This does not necessarily demonstrate advantages for small firms as such: the German machinery industry, whose firms are only slightly less concentrated than British ones, had the best record of all in technological adaptation. What the German and Italian cases had in common against the British and French was the tendency for their firms to be 'networked', even if in different ways.

By the 1990s global marketing and the global organization of production were replacing technology as dominant challenges. Here the advantages of sheer size may become crucial. While this is likely to make conditions increasingly difficult for all small firms, those which are clustered are likely to continue to have advantages

against those which are isolated. Small firms become increasingly dependent on LCCGs if they are to face the new challenges, whether these goods come from associations, local and national government facilities, large customer firms, or other mechanisms.

Access to LCCGs among machinery SMEs

It is therefore instructive to consider the access to relevant facilities among the firms examined in our case studies, on both technology transfer and marketing. To this we add consideration of a third issue often considered important to economic success: training for skilled labour. In relying on the reported preferences and actions by owners and managers of small firms themselves, one must remember that this is always a social group that prides itself on its autonomy and independence. They are therefore likely to play down the importance of collective and extra-firm sources of support.

Technology transfer

In both Italy and the UK technology transfer was a weak point, possibly threatening the continued role of SMEs in the sectors concerned. German and, eventually, French firms faced a better prospect.

In the Bologna and Modena area the well known community networks seemed to operate for technology transfer, but weakly, as though the informal, endogenous level could not deal with such complex matters. ERVET understood the problems clearly, but its solution was to support the larger firms, and even to detach its own technology transfer activities from the region. It seems that the view has been taken that small firms in the packaging machinery industry simply cannot equip themselves for advanced technology.

Baden-Württemberg networks differ from Emilian ones in that technology transfer has long been high on their agenda. The firms involved are medium-sized, even large, rather than small. Also, as many authors have noted, the collective networks are more formal than in the Italian case, with well funded and technologically sophisticated organizational resources capable of delivering substantive competition goods. Less frequently noted, but stressed here by Glassmann and more generally in Glassmann and Voelzkow (2001), is the important role of public institutions, at both federal and *Land* level. These include specialized

research institutes as well as the public universities, which were extensively used by medium-sized firms.

Small machine-tool units in the British West Midlands seemed primarily reliant on their own resources for developing technology; which makes the term 'technology transfer' hardly appropriate. There seemed little evidence of up-take of the facilities offered by the Machine Tooling Trade Association (MTTA); as we shall see below, the MTTA played a much bigger role where marketing was concerned, so this does not reflect a general invisibility of the association. The rich and extensive engagement of the regions' universities with the industry seemed to reach only large firms. Little response was also reported from small units to the extensive activities of government departments and the scope for EU funding. Paradoxically, although SMEs might appear to be more in need of exogenous and sometimes collective substantive facilities, it is large enterprises which really understand how to tap them.

The French industry seemed finally to be coping with technology transfer, using the exogenous, substantive and (compared with the past) informal governance modes of hierarchies of large holding corporations and the various public mechanisms being established.

Marketing

In both Emilia-Romagna and the English West Midlands both our documentary research and our interviews suggest a more promising situation for small enterprises in marketing than in technology transfer.

While the Bologna and Modena packaging machinery companies mainly relied on market processes for information on how to enter new markets, there was an important role for local specialized firms, which undertook to market the products of the local industry. This is an important combination of market and community, of exogenous procedure and endogenous substance. The firms operate on normal commercial principles; they are not acting as charities. However, the fact that they are locally based suggests the importance of local information flows, contacts, possibly even trust relationships - in other words, LCCGs. This is one of those points at which it is possible to ask whether ERVET's attempts to turn the attention of leader firms away from their local bases may disrupt useful processes. *Local* government agencies, on the other hand, seems to play a significant role, and seem to have seen a niche in providing information to firms on meeting European standards.

In the British and French cases formal associations and organizations were important. Even our British questionnaire respondents considered associations (usually MTTA) to be about equal in importance to their usually preferred 'own resources'. Wider evidence showed this to be a field where consultants - exogenous to the firm, and offering substantive but marketed and non-collective goods, were also significant.

It is often argued that German manufacturing tends to rely on reputation acquired by its technical excellence rather than on direct marketing strategies, and this seems to be reflected in our findings in Stuttgart. The emphasis of both public and neo-corporatist institutions for industry support is on technology transfer and workforce training. But firms themselves are increasingly aware of the importance of marketing, and for this seem to rely much more on their own resources. This has been one element favouring the strengthening of the networked firm model: it is the larger firms who are most able to execute marketing strategies without external support.

Training and skills

In this classic area of collective goods, Stuttgart firms followed the classic German model of initial vocational training provided through an apprenticeship system regulated by the public schools and by the public-corporate structures of the *Kammer* system. The German system is today considered to be in some kind of crisis of the training system, as more importance is placed on further rather than initial training (where the apprenticeship pattern cannot operate), and as some firms are reported to resent the costs imposed on them. There is no evidence from Glassmann's interviews of the latter, but it is clear that further training and retraining are being carried out within the firm and not as a collective good.

Emilia-Romagnan firms made use of a number of institutions external to the enterprise for training purposes. Important among of these were the usual informal links, but there was also the important role of the Istituto Aldini-Valeriani, a classic example of a formally organized source of local competition goods. Links with universities and trade associations also seemed significant. As Farrell and Lauridsen report, both the aging of the labour force and the emergence of apparently more attractive forms of employment are producing labour problems for the packaging industry here which it did not face in past decades. The response seems to have been increased reliance on various collective sources.

Despite the collective goods character of training questions, this topic found the British firms at their most introverted. Both our general research and our enterprise interviews showed overwhelming reliance on within-company solutions and consultants. This cannot be explained by a lack of potential external agencies. The West Midlands Enterprise Board had tried to play a role here; so did local TECs, programmes of the Department of Trade and Industry, and various bench-marking exercises.

The growing complexity of governance

The evidence on these three specific issues demonstrates the general theme of a growing relative importance of the corporate hierarchy or networked firm model. But that finding itself may be only an aspect of a more general conclusion, again embedded in both these particular issues and the general national accounts: the growing complexity of economic governance.

In our previous study (Crouch and Trigilia 2001) it was pointed out that empirical cases were more mixed than theoretical models implied. Even if at the theoretical level we try to define market, state, associational, community and hierarchical governance modes mutually exclusively, actors on the ground are likely to combine these in complex and creative ways. This does not refute the utility of the theoretical types; provided the typology is useful in identifying elements within the empirical cases, it has done its work. The existence of mixed and hybrid forms is a problem only for any observers who may want to argue that conceptual difference necessarily implies empirical incompatibility.

As Glassmann cites Offe as arguing, mixed modes of action can be extremely useful to practical actors. Virtually all pure modes have their defects; these can be remedied if actors have access to a second different, even directly contradictory, mode. This may both explain such developments as British governments of the 1980s constructing new collective institutions even as they intensify their fundamentally neo-liberal policies, or the regional authorities of Emilia-Romagna stressing the role of leader firms while the region's economic strength seems to rest in its diversity and large number of small firms. This is the redundancy principle. Its limitation is that it is subject to important congestion and waste constraints. It is not possible to leave a whole array of institutions around unused; and at certain points contradictory principles do become mutually incompatible.

At the present time a large increase is taking place in institutional complexity and potential redundancy, partly because firms and public authorities are aware that past parameters of competition are changing rapidly and that there is a need to investigate new ways of acting, and because globalization extends the potential array of governance modes of which actors have knowledge. At its best this process produces constructive new hybrid forms, enabling existing but increasingly inadequate strengths to be bolstered by new mechanisms. There are several examples of this in Glassmann's account of how Stuttgart firms are acquiring more flexible modes of independent action without destroying the public and corporatist mix of external support, and more generally in the obvious willingness of actors in each country to try to learn something from the experience of others. At its worst it may produce an eventual convergence on a particular path which may corrode valuable elements in other governance modes and in the end actually reduce the diversity of possibilities available, ignoring Offe's principle. Among SMEs in the machinery industry this threat is mainly posed by the growing dominance of the networked firm model. If this develops beyond a certain point it both destroys the capacity for autonomy of small enterprises and devitalizes LCCGs by internalizing them.

The growing complexity of governance modes also increases the complexity of a question which this study must address. Our four cases include two which were seen as successful examples of machinery districts: Emilia-Romagna and Baden-Württemberg; and two where long-term national policy is seen as having been hostile to the development of districts. If the theory of local production systems is valid, the Italian and German cases should have emerged better from the 1990s recession. If in contrast theories of the rigidifying consequences of embeddedness are more suited to the conditions of the late 1990s and beyond, we should expect either no difference among the countries or even superior performance in France and the UK.

Both the statistical data presented in Chapter 1 and the individual case studies suggest the former: the industries around Bologna and Stuttgart remain stronger and more vibrant than those around Birmingham and scattered across France. Of course, it can be argued that true success lay in getting out of machinery production altogether; that therefore the smaller the industry by the end of the 1990s the better; and that their lack of embeddedness enabled both British and French capital to escape from industries in which Italians and Germans remain trapped. It is also the

case that in each country the industries are smaller in terms of numbers of both employees and independent enterprises than in the early 1990s. Those who remain are survivors; certainly no approach to machinery production was able to sustain an industry in its entirety.

However, not only have the Stuttgart and Bologna firms shown that machinery production of various kinds can remain viable in western European countries, but they have also refuted those theorists who predicted that strong embeddedness implied incapacity to change. Our case studies describe several institutional as well as product innovations, innovations which produce the increased complexity which we now see. In fact, however, all four cases experienced institutional changes, which falsifies the idea of a simple 'before and after' comparison between industries embedded in local production systems and those without such structures. The rise of the networked firm model means that neither the German nor the Italian cases present today the same institutional structures as they did in 1990. Meanwhile however the British and French have been trying to erect some institutions resembling some of those found in Germany or Italy, and also to develop some original hybrids.

It is not possible on the basis of this research alone to determine whether the complex patterns of borrowing and sharing we have observed relate specifically to processes of Europeanization. For that we would need to see if these cases, all in EU member-states, differed significantly from similar industries in other parts of the world. Unlike the steel industry and other sectors in clear crisis, or like some high-tech sectors which have been made objects of future-oriented policy, the machinery sector has not been at the forefront of European public policy-making. That is a characteristic that makes the sector interesting to those concerned with specifically local and autonomous forms of dynamism. Although our authors have drawn attention to some EU initiatives, they have not been of fundamental importance in reshaping the industries. They have been fundamentally shaped by more global competitive processes, as the various narratives show. It is therefore more likely that borrowing and hybridization have been taking place on a wider scale than the EU alone.

On the other hand, our findings are relevant to the debate over Europeanization in the wider sense of immanent convergence. Much is made in the institutional and policy-making literature of major differences and incompatibilities of the structures and frameworks of different EU states: for example, German neo-

corporatism and French statism. Our account shows considerable variation within countries around such stereotypical positions, and we think an intensification of that phenomenon. If that is the case, cross-national incompatibilities are either becoming less important, or at least are not as set in stone as we are often led to believe. National patterns remain distinctive, but increasingly because of their specific mix of shared elements, rather than because of strongly distinct monopolies of particular institutional forms.

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