Regional Productivity and Technological Change in the 1980's. The Manufacturing Sector in Denmark

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Abstract

This paper deals with regional productivity and strategies of technological change in the manufacturing sector, especially concerning the Copenhagen Metropolitan Area. The development is explained within the framework of the French Regulationist School using the metal product industry as a case. The anatomy of spatial industrial development in Denmark is examined by examining the movements in labour, gross domestic product at factor cost, capital stock, labour and capital productivity and the capital-labour ratio is used as an indicator of technological change. The major argument is that technological change does not advance to productivity gains because of difficulties in adopting and implementing technological change into firms and society.

Keywords

Economic geography, industrial development, productivity, technological change, technological paradigm.

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This paper is based on ongoing research in the spatial development of productivity and technological change in the manufacturing sector (Winther 1994). Productivity is a central concept in economic geography as well as in the process of regional economic development; geographical inequalities in productivity create geographical inequalities in economic welfare (Anderson 1990). Because of competition between firms, the firm has a continuous requirement to increase productivity either by intensification or by technological development. With an increase in productivity the firm will become more competitive due to the opportunity to produce cheaper products. This process takes place in a geographical space: Different locations - regions and urban areas - have different conditions for production. Every region and urban area is a product of its own socio-economic history and is a complex combination of natural and human characteristics: the location's geographical structure (Massey 1984a, Maskell 1986). This may include geographical variation in accessibility to factors of production and marketing possibilities, which are not distributed evenly throughout space. This spatial variation in conditions of accessibility and production creates spatial variation in the possibilities for increases in productivity, technological development and capital accumulation.

The paper studies the anatomy of the regional development in the manufacturing sector (ISCI code no. 31 - 39), using the metal product industry (ISCI code no. 37 and 38) as a case. Changes in labour, gross domestic product at factor cost, capital stock, the capital-labour ratio and labour and capital productivity are examined in 12 Danish regions in the period 1980 - 1990.

The paper is mainly concerned with regional differences in strategies of technological change and regional transitions in the technological paradigm in the Danish manufacturing sector and the metal product industry in the 1980's, especially the development in the Metropolitan Area as opposed to the more rural and peripheral regions in Jutland.

The growth of the metal product industry by region, and the manufacturing sector in general, is outlined in the second part of the paper and an explanation of this development is discussed within the framework of the French Regulationist School, which is outlined in the first part, as technology and technological change must be understood in a broader socio-economic context. Furthermore, this first part of the paper also outlines four categories of strategies of technological change and links the strategies to changes in the capital-labour ratio, which then is used as an indicator of technological change.

A Framework for Analysis: The French Regulationist School

The School has developed a theoretical framework which explains interaction between socio-economic processes, spatial and historical variations, and economic development (Aglietta 1979, Boyer 1990, Esser & Hirsch 1989, Jessop 1990, Leborgne & Lipietz 1988,1992, Lipietz 1987, Dunford 1990). The starting point of the school is economic crisis and the symptoms of these crises, such as inflation, deficit in the balance of trade, deficit in the balance of payments, unemployment and a restrictive fiscal policy. Within the framework developed by the School, three elements have been developed, which are involved in a mode of growth; a regime of accumulation, a mode of regulation and an technological paradigm. These elements explain the development in the socio-economic processes, which show significant spatial and historical variations.

In a capitalist society valorisation and capital accumulation are fundamental goals of economic activities, and the rate of profit and its determinants and the rate of investments are central variables. The inherent conflicts in capitalism, especially the conflict between capital and labour and competition between individual firms and sectors of capital, assume specific forms in different historical epochs. A regime of accumulation is a systematic organisation of production, income distribution, exchange of the social product, and consumption. A mode of regulation is a concept that is used to denote a specific local and historical collection of structural or institutional arrangements which provides a framework for individual and collective behaviour (for instance labour market negotiations and state control). A technological paradigm is defined by the type of technology and labour organisation used in production in a given historical epoch. If one of the elements in a mode of growth changes, it influences the other elements in a given mode of growth. Regulation theory has become significant as speculation into the nature of Fordist mode of growth's replacement has strengthened (see for instance Boyer 1991 and Leborgne & Lipietz 1992). Some argue that it may already be conceivable to identify a new mode of growth labelled post-Fordism or flexible accumulation (Harvey 1990 and Oberhauser 1990) whereas others believe that we are in a period of extended crisis (Peck & Tickell 1995, Hansen & Jensen-Butler 1995).

The concepts of the Regulationist School are developed for analysis at the national level, and most studies at the regional level examine the way changes in the national mode of growth affect the local state (Goodwin et al. 1993). The national and international environment is important for regional economic development. National and supra-national policy has a considerable impact on the possibilities for regional economic development, for example; fiscal policy, monetary policy, industrial policy and different subsidies to industries in recession and subsidies to peripheral regions. Furthermore, globalisation of production and increasing interregional trade has made the single region more dependent on inputs and markets located outside the region. Thus, at the national and international level the mode of regulation has an impact on the possibilities for regional economic development, as have the national and international regimes of accumulation.

Recent studies, Tickell & Peck (1992), Peck & Tickell (1995) and Norcliffe (1993), use and discuss regulation theory in a regional/local context. Norcliffe analyses the transition from mass-production to flexible production in Lyon, France, within the framework of the French Regulationist School. Peck & Tickell (1995) analyse the social regulation of uneven development of England's South East and propose a '....'spatial division of labour plus social regulation' approach....p. 27'.

This paper aims at using the concepts of the Regulationist School as a framework in a regional context, especially in connection with regional transitions in the technological paradigm. As argued above every region and urban area is a product of its socio-economic history and is a complex combination of natural and human characteristics: the location's geographical structure. From this it can be argued that a region or an urban area has its own mode of growth due to the geographical structure (e.g. variation in accessibility and in production conditions, which produces an uneven development of both economy and society). It must be remembered that general processes do not function in a pure form. They develop in particular historical context, and in a particular place or location (Massey 1984a, 1984b). Regulation theory can therefore be used for regional analysis because the mechanisms and components of regulation operate regionally as well as nationally.

First, at the regional level, local governments (counties and municipalities) do have some macro-economic policy options available (e.g. increase in public demand and to create local industrial areas and business and technology support) to participate directly in the process of income

and employment creation (Hansen & Jensen-Butler 1993). Local governments play an active role in income distribution (e.g. social security benefits). Additionally, regional differences exist in other institutional and social arrangements, for example regional differences in the level of unionization and consumption patterns. This opens up the option of defining regional modes of regulation, regimes of accumulation and modes of growth.

Second, and central to this paper, the concept of the technological paradigm may be used in an analysis at the regional level, which means that different regions may have different technological paradigms, and transitions in these paradigms do not occur at the same time nor include the same type of change.

Technology and Strategies of Technological Change

Following Müller (1982) and Müller et al. (1984) the nature of technology is defined as consisting of four elements; a) technique; the joining of means of production, labour power and inputs in the labour process, b) knowledge; the joining of the expertise of handicraft, scientific knowledge and know-how, c) organisation; the vertical and horizontal internal division of labour and d) product; the result of the production process (the production process is the fuse of technique, knowledge and organisation). A broad definition which includes the more traditionally definitions obtained from Marx (see for instance Hansen & Serin 1980). Changes in one element involve changes in the other elements leading to a technological change, which affects the socio-economic structures as well as changes in the socio-economic structures affect the nature of technology. Thus, technological change must be understood in a broader socio-economic context, because technological change transforms the structure of firms and affects the socio-economic structures. Technological changes create new demands and involve transformation of the qualifications of the labour force, the employment pattern, the social structures, the institutional arrangements, the income distribution, the social values, the ideology, etc.; technological changes involve transformation of the dominant regime of accumulation and mode of regulation. On the other hand the existent socio-economic structures, (the dominant regime of accumulation and mode of regulation), always influence and either facilitate or retard the process of technological change. The social relations and socio-economic structures are at the same time the cause and consequence of technological change (Boyer 1988, Ferrão & Jensen-Butler 1987, Freeman 1988).

It is possible to define different strategies of capital accumulation and technological change at the regional level. Massey & Meegan (1982) define three strategies of capital accumulation: 1) Intensification, a strategy which increases labour productivity without major new investment or reorganisation of the production process. 2) Investment and technical change, which increase labour productivity by investment in different (new) technology. 3) Rationalisation is defined as a reduction in total capacity. Ferrão & Jensen-Butler (1987 pp. 26 - 28) have developed these strategies of technological change as four categories and have looked further into the consequences for location and the capital-labour ratio. The first strategy is survival, which involves limited investment, keeping the capital-labour ratio constant, rendering labour characteristics more important as a factor of production, especially wage levels. The second strategy is rationalisation, which is investment in reorganisation and education of the labour force keeping capital at a constant level. This strategy has greatest potential in labour intensive industry. The third strategy is changes in capital stock, which involves investment in capital equipment. Ferrão & Jensen-Butler divide this group into three types of investment: a) investment in (new) machines and buildings, raising the capital-labour ratio b) investment in lower cost capital stock, lowering the capital-labour ratio and making wages more important c) investment in communications and information technology, increasing the capital-labour ratio and reducing the advantages of agglomerations. The fourth and final strategy is product differentiation, which involves investment in R&D facilities and new machines, increasing the capital-labour ratio. The firms in different regions may use different strategies of technological change to survive or increase productivity and profitability and different strategies may be combined within any firm or region.

This paper uses the capital-labour ratio as an indicator of technological change; as an indicator of which strategies of technological change the firms in a particular region have chosen in the 1980's, in general. An increase in the regional capital-labour ratio suggests that the firms in general have chosen strategy three and/or four as a path of development in a particular region. A constant or declining

regional capital-labour ratio suggests that the firms, in general, have chosen strategy one and/or two. Using the capital-labour ratio as an indicator means that one does not capture all technological change because a constant capital-labour ratio can cover no change at all, strategy one and two and/or extensive growth. In the latter case production and labour processes remains basically unchanged with the additionally capacity being provided by a copy of existing production techniques.

Industrial Development in the 1980's and the Metal Product Industry

This analysis is based upon 12 Danish regions, 11 Danish counties and the Copenhagen Metropolitan Area which consists of three counties and two municipalities with county status, see figure 1.

The analysis uses 3 types of data in the examination. Data on employment (L) and gross domestic product at factor cost (GDP) have been obtained from the regional economic data bank of the Local Governments' Research Institute's (AKF). The data on capital stock (K) is calculated by a linear depreciation of gross fixed capital formation (the perpetual inventory method). Three categories of assets are distinguished, means of transport (depreciation over 6 years), machinery and equipment (10 years) and residential and non-residential buildings (30 years). The three categories of capital stock were calculated for 12 Danish regions and 21 industries for the years 1979 - 1991 (Junge & Winther 1993, Winther 1994,1995). Anderson & Rigby (1989) used a revised putty-clay method to estimate capital stock in Canada's regions. The ability of this method, contrary to the perpetual inventory method, is that it allows estimation of the most plausible pattern of depreciation independently for any region but due to the reliability of the data, the perpetual inventory method is used in this study.

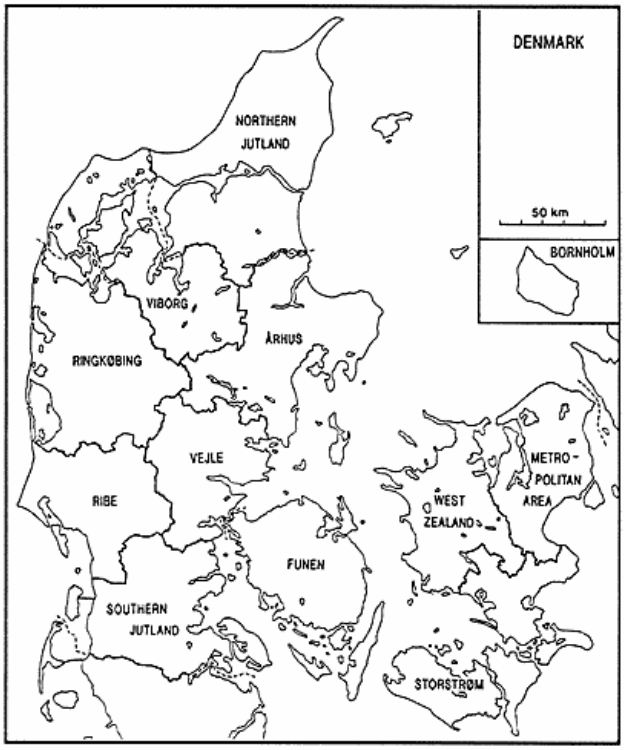

Figure 1: The Danish Regions.

The data used are aggregates. The technological question could accordingly be clarified due to intraregional and intrasectoral variation as both regional and sectoral technology vary. However, examine changes in the capital-labour ratio provides an indication of which strategies of technological change that dominate the firms regionally.

The metal product industry is the largest sector in the manufacturing sector in Denmark (37% of industrial GDP at factor cost in 1990). The sector has been chosen as a case because of its importance in Danish manufacturing and because it reveals some important spatial features in the 1980's.

The Danish manufacturing sector experienced large-scale relocation in 1970's and 1980's. This relocation has been examined by a number of authors (see for instance Hartoft-Nielsen 1980, Maskell 1986, Jensen-Butler 1992, Winther 1994). Relocation consisted mainly of firm closures in the Metropolitan Area and in the opening of new firms in the rural and peripheral regions in Jutland, especially in small town locations. The metal product industry is no exception. The industry experienced large-scale relocation in the 1970's and 1980's with respect to production and employment. This development is summarised in figures 2 and 3 which show changes in gross domestic product at factor cost (GDP) and employment (L) in the manufacturing sector and metal product industry between 1980 - 1990. Despite this relocation, the Metropolitan Area still has the largest share of the metal product industry (30% of industrial GDP in 1990) and of the manufacturing sector in general (31% of sectoral GDP in 1990).

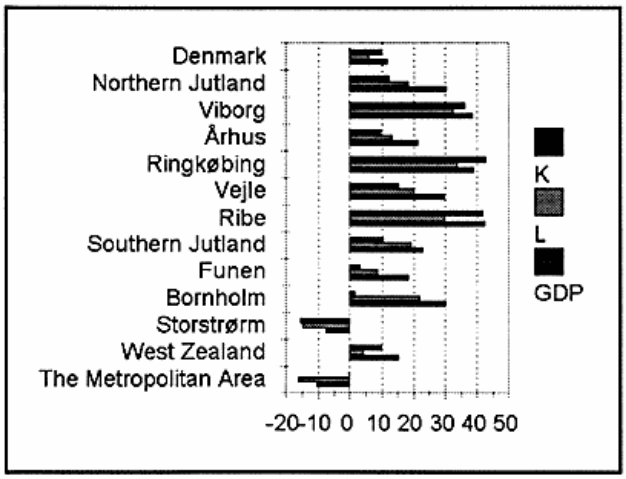

Figure 2: Changes in GDP at Factor Cost (GDP), Employment (L) and Capital Stock in the Manufacturing Sector by Region between 1980 - 1990 %.

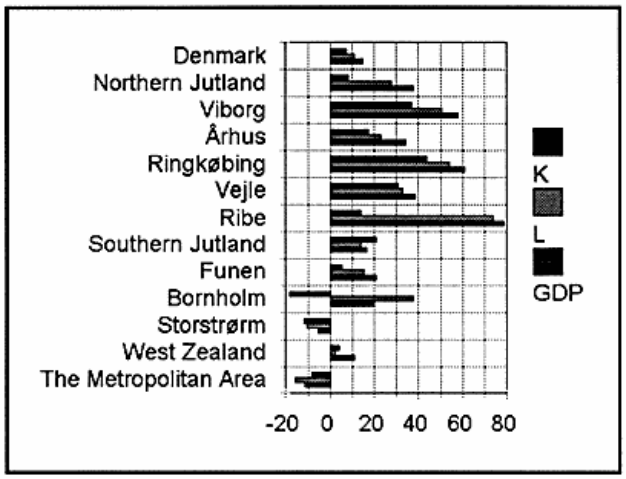

Figure 3: Changes in GDP at Factor Cost (GDP), Employment (L) and Capital Stock (K) in the Metal Product Industry by Region between 1980 - 1990 %.

Figures 2 and 3 also show changes in capital stock in the period 1980 -1990 in Danish regions. In the manufacturing sector and the metal product industry this development is identical to that of production and employment. There has been a relocation of capital stock in relative terms from the Metropolitan Area to regions in Jutland, especially to Vejle, Ringkøbing and Viborg. However, examining the capital-labour ratio, this pattern alters.

Changes in the Capital-Labour Ratio

The manufacturing sector experienced a growth of 26% in the capital-labour ratio at the national level. In regional terms, (see figure 4), all regions experienced an increase, but the Metropolitan Area and West Zealand had growth well above the national average and Ribe just above the average. The remaining regions had below average increases. Thus, industrial development and restructuring in the Metropolitan Area and West Zealand have been far more capital intensive than industrial growth in the rest of the country in the 1980's.

The metal product industry experienced a decrease in the capital-labour ratio for Denmark as a whole. In regional terms, the Metropolitan Area, West Zealand and Southern Jutland experienced an increase in the capital-labour ratio, see figure 4, whilst the remaining regions experienced status quo or decline. Thus, restructuring of the metal product industry is capital intensive in the Metropolitan Area,

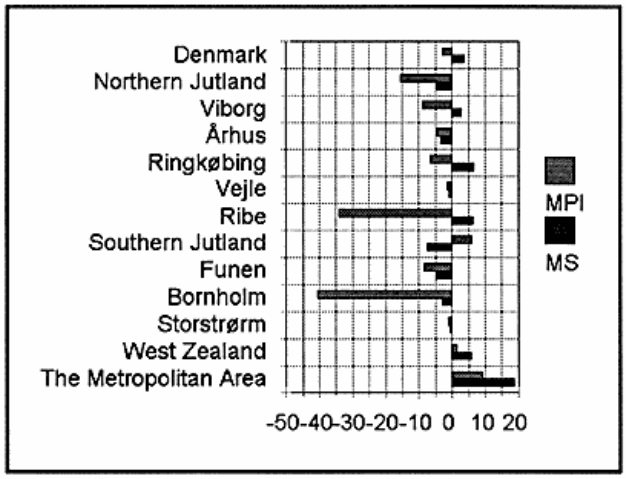

Figure 4: Changes in the Capital - Labour ratio in the Manufacturing Sector (MS) and the Metal Product Industry (MPI) by Region between 1980 - 1990 %.

capital substituting labour, whilst growth in the more peripheral and rural regions in Jutland is more labour intensive, labour substituting capital.

Strategies of Technological Change

The manufacturing sector as a whole and the metal product industry have relocated in the 1980's from the Metropolitan Area to (mainly) Jutland in relation to production, employment and capital stock. It has been seen that the

restructuring of the manufacturing sector in the Metropolitan Area is capital intensive. The decline in employment has been greater than the decline in production and capital stock, which has caused a rise in labour productivity (see below) and an increase in the capital-labour ratio, as capital substitutes labour which is generating by a marked decline in capital productivity (see below). This suggests that the firms, in general, in the Metropolitan Area have used the investment and technical change strategy in Massey & Meegan's terms. In Ferrão & Jensen-Butler's terms the firms in the Metropolitan Area may have used several different strategies all involving a considerable increase in the capital-labour ratio. First, the firms may have used the strategy of changes in capital stock, more specific investment in new machines and buildings, and in communication and information technology. Second, the firms may also have used the strategy of product differentiation.

The more peripheral and rural regions in Jutland had an increase in employment, in production and in capital stock. The increase in production has been larger than the increase in employment and capital stock and therefore both labour and capital productivity have risen in the 1980's in the metal product industry (see below). Furthermore, the increase in employment has been larger than the increase in capital stock and therefore the regions experienced a declining capital-labour ratio in the metal product industry. The process of industrial growth in these regions has been far less capital intensive for the manufacturing sector as a whole than in the Metropolitan Area. This suggests that the firms in these regions have mainly used a strategy of survival, rationalisation and/or investments involving lower cost capital in the 1980's, in the metal product industry and, to some extent, in the manufacturing sector in general, making labour characteristics more important.

The Turbulent Changes in Productivity in the 1980's

At the national level Denmark experienced a turbulent period in the 1980's in relation to labour productivity in the manufacturing sector. In the mid-80's there was an increase in investment, production and employment, but a decrease in labour productivity in the manufacturing sector (Gjerding et al. 1992). This was explained by difficulties in adopting and implementing new technology such as CIM, CAD, CAM and CCN-machines (Gjerding 1991) - (see below).

Despite declining labour productivity in the mid-80's, the manufacturing sector had a growth of approximately 5% in labour productivity in the 1980's for Denmark as a whole. In regional terms, figure 5 reveals, that in relation to average national growth, the peripheral regions did rather badly; Bornholm, Southern Jutland, Ringkøbing and Viborg are under the national average and Ribe (which has a significant contribution from the North Sea oil-related activities) is just a little above. The Metropolitan Area and the intermediate areas of Aarhus and Funen, as well as Vejle and Northern Jutland experienced larger gains whilst West Zealand experienced marked gains.

Between 1980 and 1990 the metal product industry had a moderate growth in labour productivity, 3.5% for Denmark as a whole. In regional terms West Zealand, Århus and Northern Jutland experienced growth well above the national average, while the remaining regions experienced moderate growth around the national average, from approximately 2% in Southern Jutland to 5.5% in the Metropolitan Area.

The productivity of capital (measured as GDP/Capital Stock) in the manufacturing sector experienced an increase of 2% at the national level in the period but exhibited considerable regional variation. The Metropolitan Area had a decrease of 10% and Ringkøbing a decrease of 3%, while the remaining regions all experienced increases in capital productivity especially Bornholm, Funen, Århus and Northern Jutland (see figure 6).

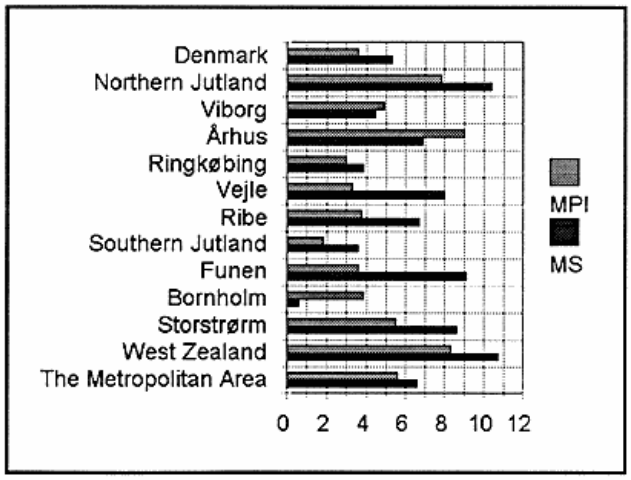

Figure 5: Changes in Labour Productivity (GDP/L) in the Manufacturing Sector (MS) and the Metal Product Industry (MPI) by Region between 1980 -1990 %.

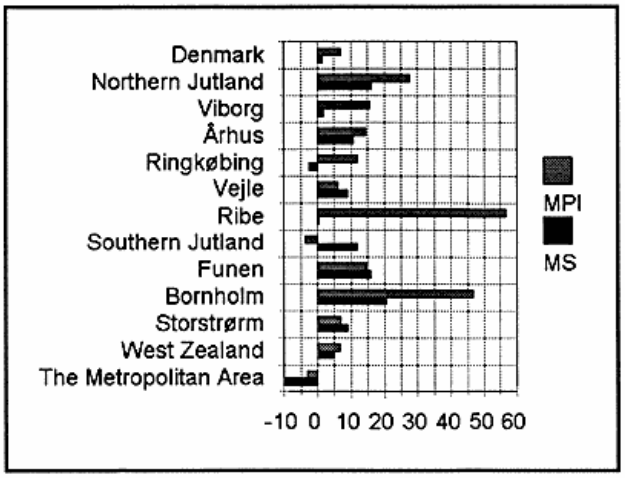

Figure 6: Changes in Capital Productivity in the Manufacturing Sector (MS) and the Metal Product Industry (MPI) by Region between 1980 - 1990 %.

In the metal product industry the regional development of capital productivity is similar to development in the manufacturing sector though not at the same scale. The Metropolitan Area and Southern Jutland experienced a decrease in capital productivity whilst all other regions experienced an increase, West Zealand, Storstrøm and Vejle had below national average increase while the remaining regions had above national average increases, especially Ribe and Bornholm (see figure 6).

Thus, the rising capital-labour ratio in the Metropolitan Area in 1980's, which indicates that strategy three and/or four is dominating, has not been manifested in substantial gains in productivity as assumed in the introduction. The following section discusses some of the underlying explanations within the theoretical framework outlined above.

Crisis, Denmark and the Metropolitan Area

As in the rest of the capitalist world Denmark experienced strong economic growth in the post-war years, but the Danish post-war mode of growth is different from the ideal type. The post-war technological paradigm in Denmark cannot be defined as Fordism as there is a predominance of small scale and even handicraft organisation of production. The regime of accumulation has therefore not been dominated by massproduction for massconsumption. Massconsumption was and still is a component of Danish Fordism but most massconsumption goods were imported. The Danish mode of regulation can, however, be termed as Fordism - among other things because of the Danish welfare state and its Keynesian macro-economic policy, and with collective bargaining related to productivity. From this, Nielsen (1991 p. 285) argues that Denmark had Fordism on the demand-side but not on the supply-side. As in the rest of the capitalist world, the mode of growth based on Fordism went into recession, but the crisis of Fordism came later in Denmark than in the rest of the capitalist world due to the fact that Denmark did not have either sunrise or sunset industries. Additionally, Denmark had advantages of an already flexible production (niche-production based on small scale or handicraft organisation of production due to the domination of small and medium sized firms) for an international market (Nielsen 1991). The crisis became, however, apparent in the 1980's. There was a low technology content in export products from Danish manufacturing and the sector was caught in a vice between Japan and USA on one side (high technology production) and the NIC-countries on the other (labour intensive production). Furthermore, Danish manufacturing exports went to declining international markets (Larsen & Rasmussen 1986, Nielsen 1991).

It could be argued that Denmark responded to the crisis in the mid-80's by investing in new technology (such as CCN-machines, CAD, CAM, CIM and communication and information technology), which makes production more flexible and alters the production processes, employment relations and relations between firms. A response which caused a decline in labour productivity due to difficulties in adopting and implementing new technology (Gjerding et al. 1992). The difficulties were especially due to the lack of qualified labour, technical problems and support (Gjerding 1991). Moreover, the Metropolitan Area experienced a decline in capital productivity in the manufacturing sector and in the metal product industry, which could also have been caused by difficulties in adopting and implementing new technology. This analysis shows that the decline in capital productivity is more profound than the decline in labour productivity: The capital stock was not used to its full potential. A similar pattern has been observed in mature industrial regions in countries like the United States, Canada and the United Kingdom where major difficulties in adopting and implementing new flexible machines, production processes, employment relations, etc. are also found (Gertler 1993).

In a spatial context it could be argued that the increase in the capital-labour ratio in the metal product industry, and in the manufacturing sector in the Metropolitan Area is a result of the investment and technical change strategy, investment in new machines and buildings, in communication and information technology and in product differentiation, as a reaction to the crisis and as part of restructuring the manufacturing sector in the region, especially investment in new machinery. This is supported by the fact that the capital machinery/labour ratio in the region inceased 44,3 % from 1980 -1990 (Winther 1995). Difficulties in adopting and implementing new technology may have caused moderate gains in labour productivity and falling capital productivity.

This argument is partly supported by Breum (1991,1993) and Jacobsen (1993). Jacobsen shows that the Metropolitan Area has the highest establishment rate of new high-technology firms in the micro electronics sector whilst the more rural and peripheral regions have high establishment rates of low- and medium-technology firms. These regions have also experienced a decline in their capital-labour ratio as labour substitutes capital. Breum emphasises the Metropolitan Area as an innovative region based on the fact that approximately 50% of the Danish high-techfirms were located in the region in 1989, whilst the more rural and peripheral regions (Ringkøbing, Ribe, Viborg and Southern Jutland) did not have more high-technology firms than Northern Jutland. Two thirds of the R&D activities in the private sector are located in the Metropolitan Area and 73% of Danish engineers live in the region (Breum 1993 pp.49 - 51).

Thus, it appears that the Metropolitan Area in the 1980's experienced a beginning transition from one technological paradigm to another, which means a transition in the type of technology and labour organisation used in production, a transition which has caused a decline in the growth of labour productivity and a fall in capital productivity. As noted, if one element in a mode of growth alters, it influences the other elements in a given mode of growth which either facilitates or retards the process of technological change.

The Metropolitan Area seems to have problems in restructuring the metal product industry and the manufacturing sector as a whole, as well as adjusting to the transition in the technological paradigm based on new flexible machinery, production processes, employment relations, etc. Perhaps some of the problems are to be found in the small and medium sized firms which lack qualified labour, information and resources for further investment rather than in new technology alone. From the data and conclusions it seems that economic success is not ensured simply by investing in new technology as investments in new technology create a demand for accessibility to knowledge, information, qualified labour and more support in the phase of implementation of new technology.

Another important obstacle, related to and maybe causing above mentioned problems, is to be found in the mode of regulation, in the public and private institutional arrangements, which may have retarded the process of technological change. For example, the Metropolitan Area has no common management (Matthiessen 1994,1995). The Area consists of five counties and 50 municipalities which are inward looking in most cases. There is a lack of common regional industrial policy - public as well as private - urban management etc. Recent debate, however, focuses on a revision of the present administrative division of the Metropolitan Area (Matthiessen 1995, Møller 1995). A revision centred on a communal management with responsibility for urban management and strategic planning and maybe industrial policy. A revision which may provide some of the necessary changes in some of the central institutional arragements.

Defining the Metropolitan Area as a region in recession seems in quantitative terms correct - the region had a decline in employment, production and capital stock in the 1980's - but looking at the capital-labour ratio and establishment of new high-technology firms, the region seems to have experienced some dynamic development in the 1980's, though with a falling capital productivity as a result. Despite difficulties in restructuring the manufacturing sector and adjustment to the transition in the technological paradigm, the location of high-technology firms and the marked growth in the capital-labour ratio, which was interpreted as investment in new and more flexible technology, shows that the Metropolitan Area does have some locational advantages compared with the growth regions in Jutland.

The Metropolitan Area seems to have some potential for a present and a future industrial development. So, if restructuring of the metal product industry as well as the manufacturing sector in general in the region is to be a success and the firms in the sector are able to adjust to the transition in the technologiaal paradigm (and use its capital stock to its full potential), the general recession may come to an end because the metal product industry and the

manufacturing sector may become more competitive in the future. This, however, depends highly on how the mode of regulation, the public and private institutional arrangements, develop and adjust to the transition.

Conclusion

Spatial industrial development in Denmark experienced a turbulent period in the 1980's. The relocation patterns of the 1970's continued with respect to employment, GDP and capital stock, but examining the capital-labour ratio this pattern alters. The Metropolitan Area and West Zealand experienced a marked growth, whilst the peripheral regions in Jutland experienced moderate growth in the manufacturing sector and a decrease in the metal product industry. Growth in labour productivity was moderate for Denmark as a whole in the 1980's. In regional terms, the Metropolitan Area and the intermediate areas of Funen, Aarhus and Vejle preformed quite well, whilst the growth regions in Jutland generally did rather badly. Examining capital productivity, West Zealand and the Metropolitan Area experienced a large decline in the manufacturing sector, whilst the remaining regions had moderate declines. In the metal product industry all regions except Southern Jutland and the Metropolitan Area experienced a growth in capital productivity.

This development can be interpreted as a process of restructuring in the Metropolitan Area, the investment and technical change strategy has been used in Massey and Meegan's terms. This led to a transition in the technological paradigm (a transition towards more flexible technology using CNC-machines, information technology, etc.), which caused the decline in capital productivity because of difficulties in adopting and implementing new technology. The process of industrial growth in the peripheral and rural regions in Jutland has been less capital intensive for the manufacturing sector as a whole and the metal product industry in particular than restructuring in the Metropolitan Area. This suggests that these regions have used a strategy of survival, rationalisation and/or investments in lower capital cost in the metal product industry and to some extent in the manufacturing sector in general.

If the Metropolitan Area succeeds in the process of restructuring and adjustment to the transition in the technological paradigm, the recession in the manufacturing sector may come to an end but this, however, depends highly on whether or not the institutional arrangements in the region develop and adjust.

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manufacturing sector may become more competitive in the future. This, however, depends highly on how the mode of regulation, the public and private institutional arrangements, develop and adjust to the transition.

Conclusion

Spatial industrial development in Denmark experienced a turbulent period in the 1980's. The relocation patterns of the 1970's continued with respect to employment, GDP and capital stock, but examining the capital-labour ratio this pattern alters. The Metropolitan Area and West Zealand experienced a marked growth, whilst the peripheral regions in Jutland experienced moderate growth in the manufacturing sector and a decrease in the metal product industry. Growth in labour productivity was moderate for Denmark as a whole in the 1980's. In regional terms, the Metropolitan Area and the intermediate areas of Funen, Aarhus and Vejle preformed quite well, whilst the growth regions in Jutland generally did rather badly. Examining capital productivity, West Zealand and the Metropolitan Area experienced a large decline in the manufacturing sector, whilst the remaining regions had moderate declines. In the metal product industry all regions except Southern Jutland and the Metropolitan Area experienced a growth in capital productivity.

This development can be interpreted as a process of restructuring in the Metropolitan Area, the investment and technical change strategy has been used in Massey and Meegan's terms. This led to a transition in the technological paradigm (a transition towards more flexible technology using CNC-machines, information technology, etc.), which caused the decline in capital productivity because of difficulties in adopting and implementing new technology. The process of industrial growth in the peripheral and rural regions in Jutland has been less capital intensive for the manufacturing sector as a whole and the metal product industry in particular than restructuring in the Metropolitan Area. This suggests that these regions have used a strategy of survival, rationalisation and/or investments in lower capital cost in the metal product industry and to some extent in the manufacturing sector in general.

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