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Product Cycle Model and the Location Structure of Finnish Industries

Kimmo Niiranen
University of Joensuu, Finland
kimmo.niiranen@joensuu.fi

Abstract Different variations of the product cycle model (cf. e.g. Malecki 1991) have been used in the analysis of regional dynamics. The basic idea of the model is simple: products go through four phases from innovation to growth, maturity and decline. The locational factors vary in the different phases of the product cycle and this has impacts on regional development. During the innovation period certain functions are centred in metropolitan regions and during the mature phase of the cycle in peripheral regions. This conditions the regional division of labour in the case of an individual country as well as in the global economy.

This paper attempts to determine whether the changes in the location of manufacturing industries have been in accordance with the assumptions of the product cycle model in Finland from the 1970s to the 1990s. The empirical observations are made on the basis of a large data set covering employment figures on 80 manufacturing industries, the regional division being the Helsinki metropolitan region vs. the rest of Finland. Observations concerning Sweden are used as a point of comparison.

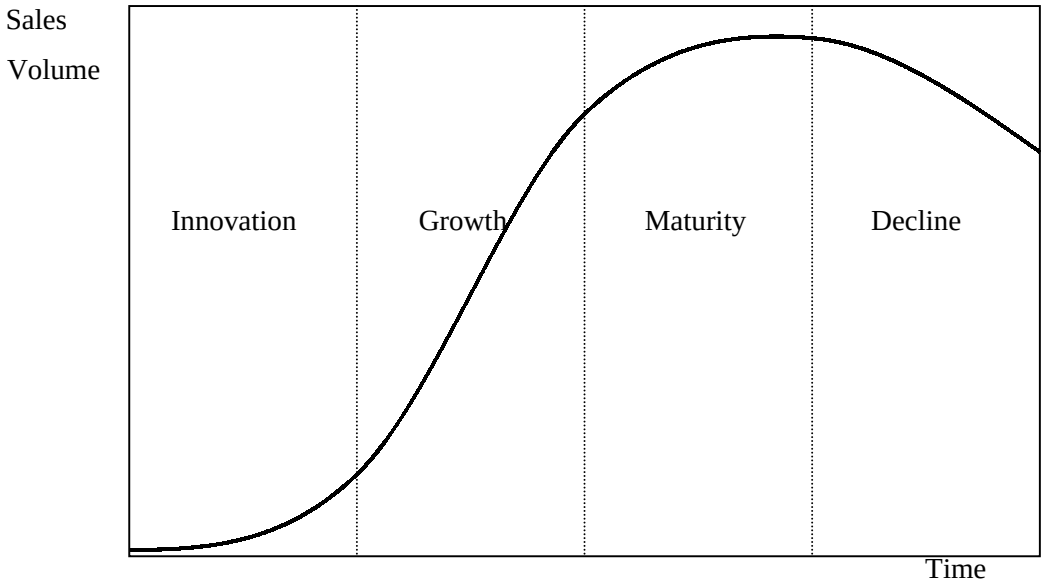
The empirical findings of this paper can be summarised as follows: the location structure of the Finnish manufacturing industries has evolved from the 1970s to the 1990s so that the Helsinki metropolitan region can be considered as a leading region. It can be argued that the role of Helsinki to Finland has been similar to the role of Stockholm to Sweden. At the end of the paper some remarks are made concerning whether the observations can be interpreted from the point of view of regional policy, and to what extent the spatial product cycle model can be considered relevant in present circumstances.

1. Introduction

During the latter half of the 20th century, the product cycle model was considered one of the most essential general frameworks in understanding the regional implications of technological change and economic development. Different variations and corollaries of the product cycle model (see e.g. Malecki 1991) have been put forward and have been widely used in the analysis of regional economic development. The basic idea of the model is simple: products go through four (or three, in some variations) phases from innovation to growth, maturity and decline (see Figure 1). The locational factors are different in the different phases of the cycle, and this has impacts on regional development. During the innovation period production is concentrated

in large urban centres and during the mature phase of the cycle in more peripheral regions. This is argued to condition the regional division of labour in the case of an individual country as well as in the global economy.

Figure 1. Phases of the product cycle (Malecki 1991).



In the Nordic countries, the product cycle model has been used in Sweden in the analysis of regional development and, in particular, urban hierarchy. The position of Stockholm as the seedbed of new and developing industries has been analysed in several empirical studies (cf. e.g. Johansson 1998, Karlsson 1997, Forslund & Johansson 1995). In contrast, although the regional and industrial structures of Sweden and neighbouring Finland can be considered relatively similar, the product cycle model has not been used in Finland apart from some occasional exceptions. Tervo (1985) referred to the product cycle model while interpreting the observations concerning the new development features of regional development and the effects of regional policy.

Despite its neglect in the Finnish case, the issue of spatial product cycles is of particular interest in the Nordic countries, especially Finland, Sweden and Norway. The spatial structure of these countries is more or less characterised by a core-periphery dualism in which metropolitan regions play important roles. On the other hand, non-metropolitan regions are characterised by scattered settlement structures, low population densities and small functional regions which lack critical mass. Thus, it can be argued that they cannot provide the best possible prerequisites for new and developing industries. As a consequence, the Nordic countries can be considered to be interesting testing arenas for the analysis of spatial product cycles.

In this paper we examine whether the empirical observations based on a large data set covering employment figures on 80 manufacturing industries support the spatial product cycle model in Finland from the 1970s to the 1990s. The regional division used in the study is the Helsinki metropolitan region vs. the rest of Finland. Because the Swedish case provides a well-studied and meaningful point of comparison, observations

concerning Sweden precede the analysis.

The paper is organised as follows: Section 2 deals briefly with the literature on the product cycle model and its variations. Data and empirical observations are presented in section 3, and Section 4 discusses their qualifications. Conclusions are presented in Section 5 in regard to whether the observations can be interpreted from the point of view of regional policy, and to what extent the relevant development features of industrial location are changing in the present global economy.

2. Theoretical background and variations of the model

The seminal article by Vernon (1966) is the most commonly cited paper on spatial product cycles. It presents a synthesis deriving from several authors and theories to analyse (multinational) firms' investment behaviour and international trade focusing on the spatial aspect of product development.

As such, the pattern characterised by localisation at an early stage of product development and followed by a later stage of dispersion had been recognised and studied decades earlier. For instance, while describing the technical maturation of industries Hoover (1948) referred to a study published in the late 1920s stressing this "typical historical pattern." In Hoover's own description the change in the locational pattern of an individual industry is driven by the changes in its labour requirements. Young industries concentrate at established industrial centres since they require specialised or highly trained labour. When the routinisation of production takes place through technical and managerial improvements ordinary labour with special training can be used. This results in a gradual dispersal from the original high wage centres either in the form of independent outside competition or the establishment of branch plants by the existing firms. Cycles in different phases evolve continuously as new industries are being born in industrial centres.

Although the resulting change in the pattern of industrial location in Vernon's product cycle model is more or less parallel to Hoover's description, the explanatory mechanism is somewhat different. Vernon emphasises, instead of comparative costs, the timing of innovation, the effects of scale economies and the roles of ignorance and uncertainty. Thus, the pure market mechanism is accompanied by several "imperfections." For instance, in Vernon's reasoning new product development is accelerated by effective communication between the potential market and the potential supplier (cf. modern theories of learning regions etc.). Therefore, during the innovation phase such factors as geographical proximity as a function of the ease of communication and other external economies, which, for instance, affect the degree of freedom concerning factor inputs of production, come to play important roles. Although the importance of production costs and internal economies of scale increases when the products mature and standardisation takes place, the outcome is based on the decisions based on cost analysis as well as the existence of such factors as uncertainty, the question of market information and reliance on external economies. The result is the typical pattern of the spatial product cycle model. Even though Vernon's analysis concerns international shifts in production, most features of the model

are valid in the case of the internal location dynamics of individual countries.

Since Vernon's concept of the product cycle several related concepts and models have been introduced. For instance, Malecki (1991) lists such concepts more or less analogous to the product cycle as the profit cycle, innovation cycle, manufacturing process cycle, process life cycle and skill-training cycle. Of these more complementary than alternative concepts the profit cycle of Markusen (1985) is presented in the context of an industry instead of a product. Industries move through a profit cycle, which contains stages of birth, growth, stagnation and decline. Each of these stages has a different profit level and identifiable market structure. The regional implications of the model are similar to those of the product cycle model. The location of an industry follows a path from the initial regional concentration to dispersal in the long run.

Depending on the definitions and specifications of these variations and corollaries to the product cycle model special emphasis is placed on such previously mentioned development characteristics as the nature of product development and innovation activity, the presence of technological spillovers and supply links and labour requirements varying over time. The pace and extent of the spatial dispersion depend on the characteristics of production systems, technological opportunities and production volumes. Despite the differences, the implications of these models are clear and similar: the location of economic activity varies with the type of activity undertaken. Production based on new technological possibilities takes place in areas providing the best prerequisites for growth, i.e. large urban centres. The reasons facilitating the early expansion in urban centres include large demand, diversity and density of economic activities, significant R&D resources, a rich endowment of infrastructure and a dense network of import channels, the presence of technological spillovers and highly educated labour. Irrespective of the reasons, production is likely to diffuse in other regions when the standardisation and routinisation of production takes place making these elements less decisive.
The multitude of diverse concepts and models was stimulated by the major change which the industrial structure underwent in most western countries: the powerful trend towards rural industrialisation. During the 1960s and 1970s, the dispersal of production from the industrialised centres to smaller cities and more peripheral regions was indisputable and in sharp contrast to the process of urbanisation. The changing spatial structure of production was observed in several countries including the US (Norton & Rees 1979) and the UK (Keeble 1976) as well as Finland (Tervo 1985, Lehmusto 1987).

The spatial dispersion of employment was the prevailing trend in Finland for at least two or three decades. However, the current trend seems to favour a relatively limited number of growing regions. Given these facts past regional dynamics are unquestionably worthy of empirical analysis. In the following, we seek to determine whether the empirical observations concerning Finland and the changes in the location of manufacturing industries have been in accordance with the assumptions of the product cycle model in recent decades.

3. Empirical observations

3.1 Data

The empirical analyses are based on two data sets, one concerning Finland and the other Sweden.[1] The first data set includes information on Finnish industrial statistics in the years 1974 – 1993. The detailed data include figures on employment and number of plants by region (labour market districts, N = 197) and industry (ISIC 79, 4-digit classification, 80 sectors). The statistics cover all plants with personnel of five or more. The Swedish data set covers the years 1970 and 1990, the industrial classification being the same as in the Finnish case. However, the regional division is based on municipalities (N = 270).

The analysis is mainly based on the use of location quotients.[2] In the following, the location quotient exceeding the value 1.5 is defined as high and a value below 0.7 low. Some interpretations are also made on the basis of shift-share analysis.[3]

3.2 Sweden 1970 – 1990

The analysis concerning Sweden and the years 1970 and 1990 provides comparatively clear-cut empirical support to the product cycle model. In 1970, the location quotients calculated for the manufacturing industries in the city of Stockholm exceeded the value 1.5 in 18 of the 71 industries with employment in the Swedish capital. That is to say, these industries' shares of the total manufacturing employment in the city of Stockholm were at least 50 percent larger than their shares in the national economy in the same year. Of these 18 manufacturing industries the employment shares of 15 grew in the rest of Sweden from 1970 to 1990. During the 20-year examination period the total employment share of these 18 manufacturing industries grew a total of 5.6 percentage points, from 15.2 percent in 1970 to 20.8 percent in 1990. On the other hand, the total employment share of those 33 manufacturing industries which received low (value below 0.7) location quotients in the city of Stockholm in 1970 decreased 6.9 percentage points in the rest of Sweden. In total, 21 of these 33 industries lost their relative employment shares during the 1970 – 1990 period.

For the purposes of the current analysis all the 71 manufacturing industries with employment in the city of Stockholm at the beginning of the examination period were classified according to both the value of the location quotient (high, average, low) and the development of the industry's employment share (increasing, decreasing) in six categories. According to the χ^2-test value ($10{,}68^{***}$) there was a statistically significant correlation between the classified location quotients calculated for the city of Stockholm and the employment share development in the rest of Sweden. Based on these observations, it can be argued that the position of Stockholm as the leading region and forerunner of the structural change in Sweden is apparent.

However, the Swedish case is used here merely as a point of comparison. Compared to its Finnish counterpart in this study, the labour market district of Helsinki, the city of Stockholm cannot be considered as important region for manufacturing in regard to its share of employment. The capital's share of all manufacturing employment in Sweden in 1970 was relatively low, only 7.1 percent. This being the case, the location quotients were also calculated for the province of Stockholm, which consists of the capital and its 24 surrounding municipalities. Although the relative importance of the province as the location for

manufacturing employment is still considerably smaller than its Finnish counterpart (12.9 percent and 22.0 percent of all manufacturing employment, respectively), these two metropolitan regions can be considered to be relatively similar in importance in many respects. For instance, in the aggregate the regional economy of the province of Stockholm constitutes ca. 20 percent of the national economy (Regioner, handel och tillväxt 1998).

In the grouped data, the relation between the location quotients calculated for the province of Stockholm in 1970 and the development of the employment shares of manufacturing industries in the rest of Sweden in 1970 – 1990 is depicted in Table 1. Although the relationship is not as pronounced as in the comparison between the city of Stockholm and rest of the country, it is apparent and statistically significant, the χ^2-test value being 7.87^{**}. According to these results and the regional divisions used it can be argued that the tighter the delineation of the metropolitan region of Stockholm, the more the pattern of regional change seems to be in accord with the logic and assumptions of the product cycle model.

Table 1. The location quotients of manufacturing industries in the province of Stockholm in 1970 and the employment development of these industries in the rest of Sweden in 1970 – 1990.

Location quotient in the province of Stockholm in 1970	**Change in the industry's employment share in the rest of Sweden in 1970 – 1990.**		
	-	+	N
High (>1,5)	7	10	17
Average (0,7–1,5)	7	14	21
Low (<0,7)	23	10	33
N	37	34	71

These observations are consistent with the results of several empirical studies concerning regional dynamics and urban hierarchies in Sweden. For instance, similar observations are made in a study published by Regionplane- och trafikkontoret (1998). This study concerned 750 industries including both the manufacturing and service sectors. More than 80 percent of all industries which received high (> 1.5) location quotients in the province of Stockholm in 1980 increased their employment shares in the rest of Sweden during the next ten years. Correspondingly, ca. 80 percent of those industries which received low (< 0.7) location quotients, decreased their employment share outside the metropolitan region.

Another useful method providing a framework for analysing the regional dispersal of industries is the shift-share analysis, which describes the rise in regional (employment) growth relative to the nation at large. Following the reasoning of Norton and Rees (1979), it can be expected that the sign of the industrial mix effect will be positive in the case of a region specialised in rapid-growth industries. Thus, metropolitan

regions are expected to have positive industrial mix effects. On the other hand, the sign of the regional shift signifies whether the flight of standardised production from the manufacturing core has accelerated during the examination period. In the Swedish case the results of the shift-share analysis are presented in Table 2.

Table 2. Results of shift-share –analysis: Sweden 1970 – 1990.

Region	Actual growth	Industry mix	Regional shift
Province of Stockholm	-22,1	18,3	-24,3
Rest of Sweden	-15,2	-2,7	3,6
Whole country	-16,1	-	-

The positive sign of the industry mix in the province of Stockholm signifies that the Swedish capital has strongly specialised in industries which have grown faster nationwide than the aggregate national growth rate in 1970 – 1990. Thus, it can be argued that the capital region has had a seedbed role in the spatial system. Notwithstanding, the actual employment development in the province of Stockholm has been even weaker than in the rest of the country because of the distinctly unfavourable regional (or competitive) factors of the capital region. In the rest of Sweden the manufacturing industries tended to suffer smaller losses than would have occurred if the employment development of industries had been the same as nationally. This is in line with the observations presented above.

3.3 Finland 1974 – 1993

The labour market district of Helsinki (Helsinki LMD) consists of the capital of Finland and its 25 neighbouring municipalities. In 1974, in region showed employment in 75 manufacturing industries. The location quotients which were calculated for these industries exceeded the value 1.5 in 26 industries in the Helsinki LMD. In one of these (wine industry) there was no manufacturing employment in the rest of Finland in establishments employing at least 5 persons. The other 25 industries in this group include, for instance, all those manufacturing industries which are classified as high technology sectors according to the current OECD-classification (manufacture of drugs and medicines, manufacture of office, computing and accounting machinery, manufacture of telecommunications products, and manufacture and repair of aircraft). The location quotients for all manufacturing industries in the Helsinki LMD both in the years 1974 and 1993 are presented in Appendix 1.

The relation between the location quotients calculated for the Helsinki LMD in 1974 and the changes in the relative employment shares of these industries in the rest of Finland during the period 1974 – 1993 is depicted in Table 3. Of the above-mentioned 25 high location quotient industries, 17 increased their relative employment shares. The growth of the total share of this group was 8.5 percent (from 13.2 percent in 1974 to 21.7 percent in 1993). Correspondingly, 17 of the 28 low location quotient value industries lost their employment shares in the rest of Finland during the 1974 – 1993 period. The total decline of the whole group

of 28 industries was 9.6 percentage points.

It is worth mentioning that in the Helsinki LMD itself there was no connection between the categorised location quotients and employment share development. In both high value and low value location quotient categories half of the manufacturing industries increased and the other half decreased their relative employment shares during the examination period.

Several of those manufacturing industries, for which the location quotients were high in the Helsinki LMD, were relatively small industries in the early 1970s. Characteristically, these industries were important to the metropolitan region but of low importance to the rest of the country. For instance, those ten manufacturing industries which received the highest location quotients employed 18.8 percent of the total manufacturing employment in the metropolitan region in 1974. In the rest of Finland their employment share was only 2.1 percent. However, in 1993 the corresponding figures were 19.6 percent and 5.8 percent.

Table 3. The location quotients of manufacturing industries in the labour market district of Helsinki in 1974 and the employment development in the rest of Finland in 1974 – 1993.

Location quotient in the Helsinki LMD in 1970	**Change in the industry's employment share in the rest of Finland in 1974 – 1993.**		
	-	+	N
High (>1,5)	8	17	25
Average (0,7–1,5)	12	9	21
Low (<0,7)	17	11	28
N	37	37	74

By and large, these observations concerning Finland are – although not as clear or statistically significant (χ^2 = 4,95*) – similar to those concerning Sweden. These observations indicate that those manufacturing industries which had a strong presence in the Helsinki metropolitan region in the early 1970s have had a certain growth potential, which has materialised in the form of a substantial increase in the employment shares of these industries in the rest of Finland during the 1974 – 1993 period. Correspondingly, many of those manufacturing industries which were less prominently represented in the metropolitan region have developed poorly in the rest of Finland. It can be argued that the comparison based on the city of Helsinki vs. rest of the country data would lead to stronger results in same vein as those of the city of Stockholm vs. rest of Sweden analysis.

The results of the shift-share analysis presented in Table 4 also bear a marked similarity to those concerning Sweden. Notwithstanding its distinct seedbed position as a location area for rapid-growth industries, the Helsinki LMD has suffered more severe employment losses than the other parts of the country because of

unfavourable regional factors. The actual employment development has been weaker than the industrial structure of the metropolitan region would suggest. It can be argued that the results of the shift-share analysis support the analysis based on the use of location quotients.

Table 4. Results of shift share –analysis: Finland 1974 – 1993.

Region	Actual growth	Industry mix	Regional shift
Helsinki LMD	-38,5	10,0	-13,6
Rest of Finland	-34,0	-2,8	3,8
Whole country	-35,0	-	-

4. Qualifications and discussion

Obviously, the present study offers only one very narrow perspective on the analysis of regional dynamics and cannot be considered as a test of the product cycle model or its corollaries. In addition, while assessing the observations one has to keep in mind that the present analysis is subject to several qualifications concerning both the methodology and the limitations of the available statistical data. Furthermore, the tentative results presented are open to various interpretations.

One evident qualification restricting the scope of issues under investigation concerns the process of industrial development in the non-metropolitan regions. Strictly speaking, if the employment growth of industries occurs later in other, more peripheral, parts of the country than in the metropolitan region, these observations may not necessarily reflect the evolution of product cycles but rather the inertia of regional development. That is, the development of industries may also include all phases of the product cycle in non-metropolitan regions. On the other hand, some variations of the product cycle model are not based on the assumption of firm/industry relocation alone. For instance, Johansson (1998) refers to a leader-follower dichotomy indicating that follower regions imitate a leading region, which benefits from an earlier start in the form of initially faster growth. This definition departs from the traditional product cycle model assuming the relocation of standardised fabricating operations or establishment of branch plants in the periphery. It may be more appropriate for describing the regional dynamics of national economies with low wage cost differentials and the dynamics of knowledge-based industries.

A deeper analysis of the evolution of product cycles would presuppose a comprehensive analysis of regional industrial development. Eventually, such an analysis would require more detailed statistical data. For instance, data on the R&D expenditures of newly established firms would be needed to reveal whether these firms take part to the early and demanding phases of the product cycle or whether they mainly produce standardised products.

Another qualification worth mentioning concerns the factors affecting plant relocations and the role of the

product cycle model as a major explanatory mechanism behind the process of regional dispersion. Explanations put forward in the product cycle literature may not have had a decisive role in the Finnish case. In Finland, especially during the 1970s, numerous manufacturing firms relocated themselves from the metropolitan region to other, often peripheral, parts of the country. According to a previous study touching on this subject (Lehmusto 1987), it is probable that the majority of these firms produced standardised products using routine methods. However, the reasons behind this regional movement also include, in addition to both the push factors of the metropolitan region and actual pull factors of the destination regions, and to a great extent, the regional policy pursued in that period. Thus, powerful market forces, such issues as wage cost differentials and changes in labour requirements in the subsequent phases of the product cycle, may not have been the major explanatory factors behind the regional dispersion in the Finnish case.

A third qualification is due to the limitations of the standard industrial classification used in the study. According to the traditional product cycle model new industries are constantly developed in metropolitan regions. During the later stages of their life cycle production spreads elsewhere. However, at the end of the examination period the high location quotients in the Helsinki LMD were calculated almost for the same industries as in the beginning of the period in question. It is reasonable to ask whether they are still in the first phases of their life cycle and whether these industries are expected to continue to grow in other parts of the country in the future. Although this will most probably be true for certain industries, the use of the standard industrial classification limits interpretations since each industry is an aggregate of heterogeneous products and the classification remains stable even though entirely new product groups are being developed. For the purposes of a more comprehensive analysis product-based data would be preferable to the data based on the industrial classification.

On the basis of a more recent industrial classification (ISIC 95, 5-digit classification, more than 200 sectors) it is possible to name some industries (e.g. recycling) which are currently in the innovation or growth phase of their product or industry cycle. In 1995 there was employment in 178 manufacturing industries in the Helsinki LMD. In the case of 60 industries the location quotient exceeded the value 1.5. The total employment share of these industries was 58.3 percent in the Helsinki LMD and 25.3 percent in the rest of Finland. Time will tell whether the location dynamics of these industries will follow the path predicted by the product cycle model.

One possible way of producing more information on the evolution of the cycles is to examine the product cycle model indirectly, analysing how the total manufacturing employment is divided among workers and other personnel. When the product cycle evolves from the innovation phase towards the more mature phases, it can be assumed that the share of other personnel decreases, and, correspondingly, the share of workers increases. In 1974, the share of workers in total manufacturing employment was 69.6 percent in the Helsinki LMD and 79.4 percent in the rest of Finland. 19 years later these figures had fallen to 53.3 percent and 71.0 percent, respectively. Not surprisingly, according to these numbers the metropolitan region clearly differs from the rest of Finland. Although the share of other personnel has increased in both the metropolitan region and the rest of the country, this increase implying technical development has been less pronounced in the non-metropolitan area.

In those manufacturing industries which received location quotients exceeding the value 1.5 in the Helsinki LMD in 1974 the workers' share among employees was 67.9 percent in 1974 and 50.2 percent in 1993. Thus, the workers' share in these industries has been slightly lower than the average, which could indicate that these industries were in the early phases of the product cycle. In the rest of Finland the respective figures were 74.8 percent and 65.5 percent. Although the employment share of workers has not increased outside the metropolitan region during the 19-year period in question, the difference between the metropolitan and non-metropolitan regions was even sharper in 1993 than at the beginning of the period. As in the case of the aggregate employment numbers of manufacturing, the regional division of labour in these industries implies that more labour-intensive operations take place in non-metropolitan areas. However, it seems that the growth of these industries has not been based – at least solely – on relocation of certain routine-based tasks from the metropolitan area to the peripheral regions.

5. Conclusions

The empirical observations of this paper can be summarised as follows: the location structure of the Finnish manufacturing industries has evolved from the 1970s to the 1990s so that the Helsinki metropolitan region can be considered to be a leading region and a leader in regional economic development. It can be argued that the role of Helsinki to Finland has been similar to the role of Stockholm to Sweden. These two metropolitan regions have functioned as seedbeds for emerging and rapidly growing industries, which have later on diffused throughout the country thus providing a major contribution to national economic development.

Despite the fact that in recent decades many industries have become more footloose and companies are freer to choose their location irrespective of local demand or factor inputs, it is necessary to emphasise that the empirical observations made in this paper reflect the dynamics of recent history and may not be relevant in current circumstances. Along with the current process of globalisation and the abolition of barriers to trade, product cycles evolve more and more in the global – or at least international – context reflecting more the international than the internal division of labour of national economies. For purposes of coping with the increasing competitive pressure, labour-intensive activities have been transferred to an ever-increasing degree from high cost countries to low cost locations abroad.

For the development of peripheral regions in high wage level countries, the changes which tend to intensify international competition between location sites seem to cause inevitable problems. On the other hand, according to numerous empirical studies, the process of globalisation seems to have been accompanied by an increasing spatial clustering of individual industries. In Finland as well, the clustering of similar and related industries and the industrial specialisation of local and regional economies have been the prevailing trends in the recent decades (Niiranen 1999). It is argued that clustering derives from sector-specific economies of localisation contributing to such potential sources of competitive advantage as the creation of new knowledge and other unique resources embedded in certain regions. Regional specialisation based on localisation

economies provides small and medium-sized regions new possibilities for maintaining and upgrading regional competitiveness. Such factors as the value of non-codifiable knowledge embedded in organisations and people working in them increase the significance of the local environment restraining international shifts.

This notion has also had implications on the objectives of regional policy. It can be argued that the product cycle model provided an appropriate theoretical basis for traditional regional policy. The Finnish regional policy of the past few decades was pursued to balance the prevailing regional differences and could be considered a means of accelerating the regional dispersal of production. However, the present-day policy objective seems to be in favour of the distinctive development features of the regions and the promotion of more or less specialised regional growth centres. The fundamental difference is that regions are currently given a more independent and less deterministic role than before. Thus, in the changing circumstances the goal of accelerating the evolution of product cycles has been displaced by the desire to support the accumulation of regional strengths in order to create endogenous growth based on localised capabilities.

However, in practice the success stories of this new doctrine of regional policy – such as the recent high technology-based rapid growth of the Oulu region – seem to have originated in the rooting of branch plants and the creation of local assets supporting this process. Furthermore, it has to be kept in mind that the product cycle model is still appropriate in certain industries at the national level (for instance, calling centres whose relocation abroad is somewhat restricted because of cultural reasons such as language skills). Thus, although not as fashionable as in recent decades, the product cycle model may still be a useful theoretical framework for understanding regional development in the context of an individual country as well.

According to the product cycle model the prerequisites for growth are, to a great extent, similar in all non-metropolitan regions. However, during the 1990s the process of industrialisation has been characterised by new development features and changes which question this assumption. Enhancing regional specialisation and differentiating regional development are visible consequences of these changes. It can be argued that the basic question of the analysis of product cycles concerns the issue of in which cases and to what extent the location dynamics follows a certain pattern. Eventually, the question will become what remains of the spatial product cycle model in the current circumstances.

Endnotes

[1] The data from the Finnish and Swedish industrial statistics were compiled for the purposes of the Nordic project “Regional Production Systems” (see Maskell *et al.* 1998). Anders Malmberg (Uppsala University) kindly provided the Swedish data.

[2] Location quotients are calculated in the following way:

$$LQ_{ir} = X_{ir} / Y_i,$$

where X_{ir} is the share of the sector i of the total industrial employment of the local economy r, and Y_i is the share of sector i of the total industrial employment in the national economy.

[3] On the basis of shift-share –analysis regional (employment) growth can be divided into three components: regional shift, industry mix and national growth. For the actual growth of region r, k_r, it holds that

$$k_r = (k_r-k_s)+(k_s-k_n)+k_n,$$

where the standardised growth in region r, k_s, comes from the formula

$$k_s = 100*\{\Sigma[B_i^{74}(KB_i^{93}/KB_i^{74})]-\Sigma B_i^{74}\}/\Sigma B_i^{74}$$

and where B_i = employment in region r in industry i, and

KB_i = national employment in industry i.

Industry mix (k_s-k_n) is the additional gain (or loss) in regional employment that would have occurred if the industries had grown faster (or slower) than the national growth rate of all industries. Regional shift is the difference between actual growth and standardised growth (k_r-k_s). Sometimes this component is referred as competitive effect.

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Appendix 1. Location quotients in the labour market district of Helsinki in 1974 and 1993.

Industry	LQ in Helsinki LMD		Industry	LQ in Helsinki LMD	
	1974	1993		1974	1993
Wine industries	4,5	4,8	Manufacture of carpets and rugs	1,0	0,2
Manufacture of other food products	3,9	1,9	Grain and mill products	1,0	0,6
Manufacture and repair of aircraft	3,5	3,1	Manufacture of engines and turbines	0,9	0,4
Manufacture of paints, varnishes and lacquers	3,5	4,3	Manufacture of metal and wood working machinery	0,9	0,9
Manufacture of other electrical apparatus and supplies	3,4	2,0	Manufacture of structural clay products	0,9	0,3
Manufacture of pottery, china and earthenware	3,2	2,0	Manufacture of motor vehicles, parts and accessories	0,9	0,3
Manufacture of telecommunications products	3,2	1,9	Manufacture of other wood and cork products	0,8	1,0
Manufacture and repair of railroad equipment	3,1	1,7	Slaughtering, preparing and preserving meat	0,8	0,6
Manufacture of office, computing and accounting	2,9	1,9	Malt liquors and malt	0,8	1,6
Soft drinks and carbonated waters industries	2,8	4,8	Petroleum refiners	0,7	1,2
Manufacture of soap and cleaning preparations etc.	2,7	2,1	Manufacture of dairy products	0,7	1,3
Manufacture of miscellaneous products of petroleum	2,6	2,3	Manufacture of basic industrial chemicals	0,7	0,3
Manufacture of vegetable and animal oils and fats	2,5	3,0	Knitting mills	0,7	0,1
Distilling, rectifying and blending spirits	2,5	2,4	Spinning weaving and finishing textiles	0,6	0,6
Tobacco manufactures	2,4	3,4	Manufacture of other transport equipment	0,6	0,2
Manufacture of other rubber products	2,3	1,4	Manufacture of cutlery, hand tools and hardware	0,6	0,3
Manufacture of musical instruments	2,3	3,0	Manufacture of special industrial machinery	0,6	0,7
Printing, publishing and allied industries	2,2	2,0	Manufacture of structural metal products	0,6	0,8
Manufacturing industries not elsewhere classified	2,2	1,8	Fur dressing and dyeing industries	0,6	0,0
Manufacture of other fabricated products	2,1	1,4	Manufacture of agricultural machinery and equipment	0,5	0,0
Manufacture of furniture and fixtures of metal	2,0	1,2	Manufacture of wearing apparel (except footwear)	0,5	0,3
Manufacture of other textiles	2,0	0,1	Manufacture of footwear (except rubber or plastic)	0,4	0,0
Manufacture of drugs and medicines	1,9	1,7	Manufacture of prepared animal feeds	0,4	0,3
Manufacture of other chemical products	1,9	1,1	Manufacture of other pulp, paper and paper board	0,4	0,1
Manufacture of cocoa, chocolate and sugar	1,8	1,5	Iron and steel basic industries	0,4	0,1
Manufacture of electrical machinery and apparatus	1,5	1,7	Manufacture of furniture and other fixtures	0,3	0,4
Manufacture of jewellery and related articles	1,5	1,5	Manufacture of containers and boxes of paper(board)	0,3	0,4
Manufacture cement, lime and plaster	1,4	1,5	Non-ferrous metal industries	0,3	0,4
Manufacture of professional and scientific instruments	1,4	2,3	Manufacture of electrical appliances and house wares	0,3	0,4
Other machinery and equipment, and repair	1,3	1,5	Manufacture of leather products and leather substitutes	0,3	0,1
Manufacture of other plastic products	1,3	0,9	Manufacture of wooden and cane containers	0,2	0,4
Canning and preserving of fruits and vegetables	1,3	0,3	Sawmills, planing and other wood mills	0,2	0,2
Manufacture of glass and glass products	1,2	0,1	Manufacture of made-up textile goods	0,2	0,7
Manufacture of bakery products	1,2	1,2	Manufacture of pulp, paper and paper board	0,2	0,3
Manufacture of other non-metallic mineral products	1,1	0,8	Canning, preserving and processing of fish	0,2	0,3
Manufacture of photographic and optical instruments	1,1	4,0	Manufacture of resins, plastic	0,1	0,2
Sugar factories and refineries	1,1	2,4	Manufacture of fertilisers and pesticides	0,1	2,0
Ship and boat building, and repair	1,1	0,8			