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KNOWLEDGE-BASED SERVICES**

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Abstract

The rise of the service economy has been the predominant pattern of structural change in the twentieth century. The paper investigates the driving forces behind the recent stages of this development. Focusing on international input-output data from the early 1970s to the 1990s, a decomposition analysis separates the quantitative impact of demand, technology, and trade-driven determinants of output growth. Our findings confirm the rise of knowledge-based services as the most dynamic component, thus strengthening the case for “quaternarisation” as a process which is distinctly characterised by the substantial contribution of technological and organizational change to structural development.

Key Words: tertiarisation, quaternarisation, knowledge-based services, structural change, input-output analysis

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1. Introduction

Measured in terms of labour force reallocations, the scope of structural change which has occurred during the twentieth century is impressive to say the least. According to reported estimates for the total of 25 developed economies (Feinstein, 1999), at the turn of the century about 47 % of civil employment was working in the agricultural sector, but only 28 % in manufacturing and 25 % in services. Up to the 1970s, structural change was mainly characterised by the rapid decline of the agricultural sector. New jobs were created in both manufacturing and services, but the latter expanded its civil employment at a much faster pace.¹ The subsequent developments resulted in an employment share of the secondary sector in 1998 of 28 % as opposed to the 67 % of the service industries. The extent of sectoral reallocations appears equally impressive if we shift our focus to gross output. In the European Union between 1970 and 1995 the output shares of the primary sector shrank from about 6 % to 2 % and those of the secondary sector from 44 % to 31 %. Within the same time the share of the tertiary sector rose from one half to two thirds. Similar development can be observed in Japan and the USA, where in 1997 the share of services amounted to 62 % and 73 %, respectively.

As a consequence of this enduring process the tertiary sector already comprises more than two thirds of economic activities in the majority of developed economies. Due to the sheer magnitude of this phenomenon we should already suspect that the single all-encompassing term “tertiarisation” has by now become a much too general description. Furthermore, taking into account the highly heterogeneous nature of the service industries,² more focused differentiation becomes imperative. Driven by this motivation we formulate the purpose of this paper: to gain deeper insights into the process of tertiarisation by examining the underlying sources of structural change using input-output analysis.

Following the above introduction, in the next section we briefly account for the changing role of services in the history of economic thought. We thereby stress the presence of a substantial cognitive gap between the actual occurrence of major structural changes and their intellectual absorption into applicable concepts and their statistical measurement. Then we present a method to decompose the gross output growth of five broad sectors of the economy into demand, technology, and trade-driven components. Based on this decomposition we report and discuss tertiarisation and the specific role of knowledge-based services therein. It appears that many “traditional” services have not grown much above the average in terms of output and that the general dynamics of structural change is confined to the subgroup of knowledge and information based services. This strengthens the case for the recognition of “quaternarisation” as a process which is distinctly characterised by the substantial effect of technological and organizational change on sectoral development.

2. The cognitive gap

Despite the impressive scale of the phenomenon of tertiarisation, most of the contemporary economic thinking has remained entangled in the traditional paradigms of manufacturing production. There are two facets to this general failure to appreciate the role of services.

The first relates to an eminent debate in classical economics. Adam Smith criticized the view of French physiocrats on agriculture as the most productive activity and their failure to see the increasing importance of manufacturing. Smith considered the latter to be at the core of economic development. Yet he then made similar disparaging judgements with respect to domestic and other non-commercial services, which he dubbed “unproductive labour”. The reason for this distinction lies in the highly intangible nature of most services, which in Smith’s view barred any lasting contribution to the accumulation of wealth:³

[T]he labour of the manufacturers fixes and realizes itself in some particular subject or vendible commodity, which lasts for some time at least after that labour is past. ... The labour of the menial servant, on the contrary, does not fix or realize itself in any particular subject or vendible commodity. His services generally perish in the very instant of their performance, and seldom leave any trace or value behind them, for which an equal quantity of service could afterwards be procured. (Smith, 1776, II.iii, p. 330)

Smith’s views met criticism already in the early history of economic thought. Quarter of a century later, the French economist Jean Baptiste Say coined the term “immaterial product” – a product that is consumed at the instant of production. He thus emphasised that the notion of economic good applies to everything that commands a price.⁴ The debate was settled at the latest with the advent and acceptance of subjective value theory (Menger, 1871) as a cornerstone of neoclassical economics. In this theory, tangible and intangible outcomes of economic activities are valued on the basis of their ability to effect individual needs and wants. The perception of this ability being subjective to the individual. Contrary to popular beliefs, Smith’s judgment has thus never been the dominant attitude among economists. They generally tend to disregard services in a markedly different way, namely by thinking of them to operate just as any other kind of industry.⁵

That second reason for the general preoccupation with manufacturing as the standard model of production and exchange is based largely on neglect of the differences between the sectors. Among characteristic differences is the typically immaterial, non-durable and transient nature of the supply of services. It follows that the provision of services requires direct interaction with consumers, and consequently a high degree of coincidence of consumption and production, both in time and space.⁶ As the process of tertiarisation renders obvious, some of these characteristics must also be of importance to an industry’s long run potential for growth. Without a proper regard of them we cannot hope to explain the enormous scale of structural change.

In order to find the appropriate angle for launching our own research, we first need some conceptual clarifications. To begin with, we follow the general definition of services as

economic activities which create value and thus affect human conditions through the transformation of “material objects, goods, people, the natural environment or symbolic representations, data, text, etc.” (Metcalf and Miles, 2000, p. 2). Hence, we consciously acknowledge that services lie at the heart of any economic process. No material good could be manufactured without the combination of various services drawn from a company’s disposable resources (Penrose, 1959). Labour inputs being the prime example. In a certain sense, the distinction between manufacturing and services is therefore superficial, as it actually refers to two different levels of observation: services are defined in terms of economic activities, whereas manufacturing is associated with physical products. In the process of production, both are regularly entwined, making use of tangible physical inputs and intangible services.

In contrast to the above considerations, the common distinction between services and material goods nevertheless had an apparent impact on the general classification of economic branches commonly associated with the pioneering works of Alan Fisher (1935) and Colin Clark (1940). Activities that result in the market exchange of material goods were identified as manufacturing (secondary sector), or agriculture and mining (primary sector). Other activities with no characteristic outcome as material product were classified under the more or less residual category of services (tertiary sector). One direct consequence to this categorization is that activities which comprise the tertiary sector are extremely heterogeneous. They range from financial transactions, legal consulting, and communications – to name a few – to entirely different activities, such as medical care, transportation, security, or cleaning services.

As a first step towards sorting this vast and heterogeneous category, a proposal has been made in this journal to single out the fast growing branches of knowledge-based and informational services as a fourth class of activities, called the “quaternary sector” (De Bandt, 1999). This proposal is motivated by the hypothesis that structural change is not evenly distributed across the separate branches of the service industry, but shows considerable more dynamics within the subgroup of information and knowledge-based services. Our purpose is to investigate whether this hypothesis can be substantiated by empirical facts.

One of the problems with operationalisation of the above proposition is that despite its frequent use, the label “knowledge-based services” is rarely defined in precise terms. In its literal sense, any human activity must be knowledge-based. But what matters are the typical differences in the degree of required knowledge, i.e. *how difficult it is to accurately comprehend the meaning of relevant information.*⁷ Hence, before any information can be properly interpreted, processed and transposed into economic action, individuals have to *learn* specific capabilities. People, for example, need to learn the rules and (symbolic) codes for communication, of how to maintain and use complicated machinery, how to pursue specific tasks within complex social environments. We might therefore regard those services as knowledge-based, where (relative to other activities) the capabilities to process relevant information accurately are required to particularly large extents.

At an operational level, however, differences in the degree of required knowledge are difficult to capture. As a broad approximation, the OECD considers those industries as knowledge-

based which are “intensive users of high technology and/or have relatively highly skilled workforce that is required to benefit fully from technological activities” (OECD 1999, p. 18). This definition allows to distinguish industries according to the relative importance of average research expenditures and the shares of skilled labour in total employment. In the OECD classification knowledge-based services comprise of communications (ISIC 72), finance, insurance, real estate and business services (ISIC 8), as well as community, social and personal services (ISIC 9). In our empirical analysis we also adopt this definition, except that community, social and personal services form a separate group of industries.

3. The sources of structural change

In general, there are a bundle of possible explanations of why, in developed economies, changes in the sectoral composition of output systematically favour services rather than manufactured goods. Our chosen approach allows to focus on three different sources of shifts in the sectoral composition of output. The first are the shifts in international patterns of comparative advantage, the second are changes in technology, and the third stems from growth in demand.⁸

3.1 Shifts in the international patterns of comparative advantage

Occasionally, the process of tertiarisation in the developed economies is explained by a presumed steady decline in comparative advantages in the production of manufactured goods. It is then argued to follow from the increasing competition of economically less developed, low-wage countries, which benefit from the global integration of markets for manufactured products. In developed economies high wages and free trade might thus drive out price sensitive segments of manufacturing, causing employment to shift towards the less tradable service industries. This argument is apparently based on the observation that relative to manufacturing goods service industries tend to be more closely tied to their location and therefore less exposed to the competitive pressures of global trade.

The problem with this explanation is that many economically developed countries still enjoy a positive trade balance in manufactured goods. For many manufactured products, low-wages and other factor costs simply are of limited importance as sources of competitive advantage. The pursuit of entrepreneurial profits is much more dependent on factors such as the degree of product differentiation, customer relations and other aspects of quality-based competition (Peneder, 2001). In this respect, many external services have complementary and mutually reinforcing functions, enhancing the local capacity for creating competitive advantage in the manufacturing sector as well. Another problem is that the traditional explanation emphasises only the negative impact of decreases in comparative advantage in manufactured goods, whereas we must also consider the role of positive shifts in comparative advantage in favour of (for example ICT related) services, which become increasingly tradable.

3.2 Technological and organizational change

The second principal force causing shifts in the sectoral composition of output results from changes in technology and organization. Positive impulses for the rise of service industries would then correspond to the common perception of increasing differentiation and “complexification” of production, leading to a rising demand for complementary services. Driven by an interdependent process, both supply and demand tend to become more sophisticated during the course of economic development: new technologies incite consumers to be more demanding while sophisticated customers simultaneously raise the demand for knowledge intensive products and services. Efficient organization, innovation, brand creation and customised services then become the primary sources of competitive advantage, all of them exerting a certain tendency towards raising the level of inputs from specialised intermediary services.

Additionally, organisational change in terms of contracting-out of activities previously carried out in-house fuels the rise of service industries. Currently, many service industries benefit from a tendency of manufacturing firms to focus on core activities, leaving others to professional and specialised suppliers. Although this might be regarded as a mere statistical artefact at first glance, closer inspection reveals important dynamic implications of this kind of externalisation. Being an example of vertical disintegration, it can be understood as the outcome of market growth on the one hand, and benefits from the division of labour on the other (Stigler, 1951). Considering the firm as a bundle of distinct activities, the overall scale of operations typically reflects the increasing returns to specialisation in those activities that lie at the core of the firm’s competencies. Other functions, among them complementary services such as legal, technical or commercial consulting directed at the problems of particular markets, often operate at suboptimal scales. If at any particular location, the size of the market is too small to support the establishment of specialised suppliers, the company is forced to perform all these functions by itself. It is only with the expansion of the industry in question, that the demand for specialised complementary services may grow sufficiently large to justify being supplied by independent and specialised firms. Hence, the contracting-out of activities previously carried out in-house does not merely reflect a shift in the statistical classification of otherwise identical activities. It additionally hints at increasing returns from the division of labour.

3.3 Increasing demand for services

Finally turning to the demand side, the changing sectoral patterns can be explained in terms of a general shift in tastes and preferences towards intangible components of consumer satisfaction, which become evident as income levels and standards of living rise. There are two ways of explaining how differences in the income elasticity of demand can affect industrial structure. With respect to final consumption, the income elasticity of demand is believed to be high for immaterial sources of well-being, often associated with increasing

importance of leisure, entertainment and luxury. On the contrary, private expenditures on material goods are presumed to be more quickly affected by the saturation of markets, especially in the case of physiological limits to further consumption (e.g. foods and tobacco).⁹ This leads to the hypothesis that raw materials and basic manufactured products, which are associated with their respective physical quantities, have fewer opportunities to raise demand in correspondence with increases in disposable income per capita.

Secondly, intermediary demand for external services has a positive impact on tertiarisation, if those industries which make a relatively large amount of purchases from the tertiary sector grow faster than the rest of the economy. Such a tendency is indeed closely related to the above argument, as many external service inputs attempt to raise the capacity for product differentiation and quality improvements, thus allowing firms to move into segments with higher income-elasticities of demand.

Additionally to the effects resulting from individual consumer choices, the sectoral shifts in demand may also be driven by the increasing public procurement of services such as education, basic research or healthcare in order to increase social welfare, and also by investments in human capital and other intangible assets that affect economic performance in the long run.

4. The decomposition

The following analysis of input-output tables provides an empirical means of examining the relevance of various explanations for the process of tertiarisation as well as the more narrowly defined quaternarisation. The principle investigation consists of a simple decomposition of the overall growth in gross output into their constitutive components. There are (i) changes in the technology coefficients, which relate to intermediary inputs required per unit of output, (ii) the growth of domestic demand comprising public and private consumption and investment outlays (the latter are reported separately and include changes in stock), and finally (iii) the impact of changes in net exports, reflecting shifts in demand effected through foreign trade.¹⁰

Input-output tables strive to provide a complete record of all transactions of goods and services in the economy. They include separate matrices for intermediary demand (X) and the various components of final demand (Y). The sum of these components yields gross output (Q). Final demand (net of imports) consists of private and public consumption (C), investments (I ; here also includes changes in stocks), and net exports (F). Hence, $Y=C+I+F$. For the purpose of the following decomposition, the basic relationship ($X + Y = Q$) can be written as $(E-A)^{-1}Y = Q$, where A represents the direct input coefficients of the matrix for intermediary demand and E the conformable identity matrix. The term $(E-A)^{-1}$ is called the Leontief-inverse, denoted L , which requires the matrix $(E-A)$ to be non-singular. This yields the basic relationship $Q=LY=L(C+I+F)$. Now, the growth in Q between two points in time t and $t-z$ years can be decomposed into its

- technological component, i.e. growth due to changes of the Leontief-inverse matrix of technology coefficients (holding final demand Y_t constant),
- and changes resulting from shifts in any of the individual components of final demand, which comprises of domestic consumption, investment and net exports (holding the matrix of technology coefficients L_{t-z} constant)

$$\frac{Q_t - Q_{t-z}}{zQ_{t-z}} = \frac{(L_t - L_{t-z})Y_t}{zQ_{t-z}} + \frac{L_{t-z}(C_t - C_{t-z})}{zQ_{t-z}} + \frac{L_{t-z}(I_t - I_{t-z})}{zQ_{t-z}} + \frac{L_{t-z}(F_t - F_{t-z})}{zQ_{t-z}}$$

In contrast to the demand-sided effects which are based upon differential shifts in the level of intermediary and final demand for various industries, the technology effect results from a change in the intermediary demand per unit of output. It should also be noted that organizational and technological change form strongly intertwined aspects of corporate activities. As such, they cannot be separated in our decomposition analysis, because both result in changes of the coefficients in the matrix of intermediary inputs.

The numbers in the tables must be read as average annual growth expressed in terms of the average change in percentage points of output compared to the base year as attributed to the individual components. The contribution of the individual components add to the arithmetic mean of output growth measured in percentage points.

The data includes a set of harmonised input-output tables provided by the OECD, which was augmented by the data collected from national statistical offices. The OECD data cover the period from the early 1970s up to 1990 and are available in constant and current prices (in national currency). The government sector (including public investments) is generally treated as a part of final consumption. Data from 1990 onwards comes from national statistical offices and are not harmonised. In most cases they are available in current prices only.

Figures 1 and 2 focus on what we have labelled “quaternarisation” and hence present only the results of the decomposition for the group of knowledge based services. More detailed tables are available in the appendix, where industries have been aggregated into five broad sectors:

- manufacturing (ISIC 3),
- distributive services (wholesale and retail trade, transport; ISIC 61, 62, 71),
- knowledge-based services (communications, financial services, real estate and business services; ISIC 72, 81, 82, 83),
- personal and social services (restaurants and hotels, community services, etc.; ISIC 9 and 63), and
- other sectors (agriculture, mining, construction, utilities; ISIC 1, 2, 4, 5).

Conclusions must be drawn with care, as the methods of data generation and construction of input-output tables vary between countries and can introduce considerable distortions with respect to the sources of tertiarisation. Most importantly, the original data from the national statistical offices were compiled under different classificatory regimes. Consequently, an interpretation should put less emphasis on specific numbers and concentrate more on the general picture which is revealed by the decomposition.

5. Empirical findings

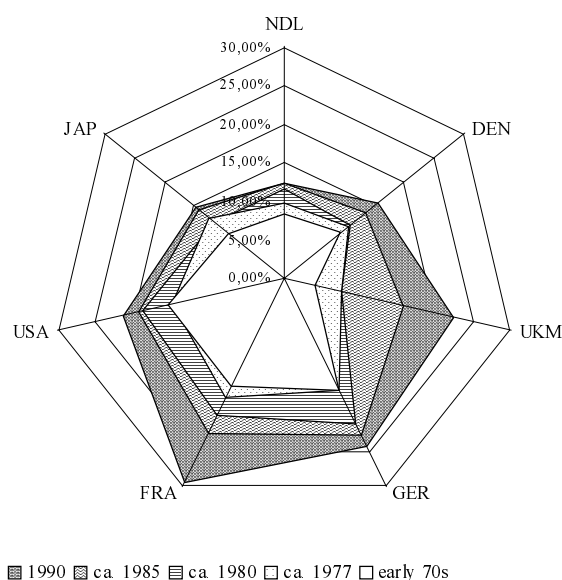
Before turning to the results of the decomposition analysis, let us briefly reflect on a simple illustration, which should leave no doubt that the rise of the knowledge-based economy has been well underway for many years. For instance, in France the share of knowledge-based services in the intermediary inputs of the total economy has risen from 17 % in 1970 to a level of 34 % in 1990, which is the highest among the countries compared. Even if we consciously refrain from placing too much weight on the specific numbers and abstain from comparisons of absolute levels between individual countries, the general picture is clear and surprisingly consistent for other countries as well (Table A.1a,b).¹¹ It shows a steady increase in the shares of knowledge-based services, measured in percent of total intermediary inputs (Figure 1).

Another robust observation tells us that most of the intermediary demand for knowledge-based services originates in knowledge-based services themselves. Conversely, the demand for knowledge-based services is lowest in manufacturing and in the aggregate of “other” industries, which comprise agriculture, mining, construction and utilities.

These simple calculations already imply that technological and organizational change plays a major role in the growth of knowledge-based services. Applying the decomposition presented in the previous section, we gain further insights into its actual importance relative to the effects from foreign trade and domestic demand. Figure 2 offers a visualisation of the separate effects for the group of knowledge-based services, whereas the detailed results for all the five broad sectors must be looked up in the appendix (Table A.2). The following stylized facts summarise what we consider to be the most important empirical findings:

(1) *Tertiarisation is an enduring process* which besides rising shares in employment is also manifest in higher growth of gross output in the services industries relative to manufacturing and other sectors. Measured at current prices, between 1970 and the late 1990s, nominal output of the service industries on average grew faster by 5.76 % p.a., whereas manufacturing (4.08 %) and other sectors (4.12 %) lagged behind. Measured at constant prices, relevant data had only been available until 1990. On average, output measured in real terms had grown by 1.79 % in manufacturing and 1.68 % in other sectors, as opposed to 2.73 % for all service industries taken together. But also if we take them separately, all the three service sectors grew faster on average.

Figure 1: Shares of knowledge-based services in total intermediary inputs (at current prices)

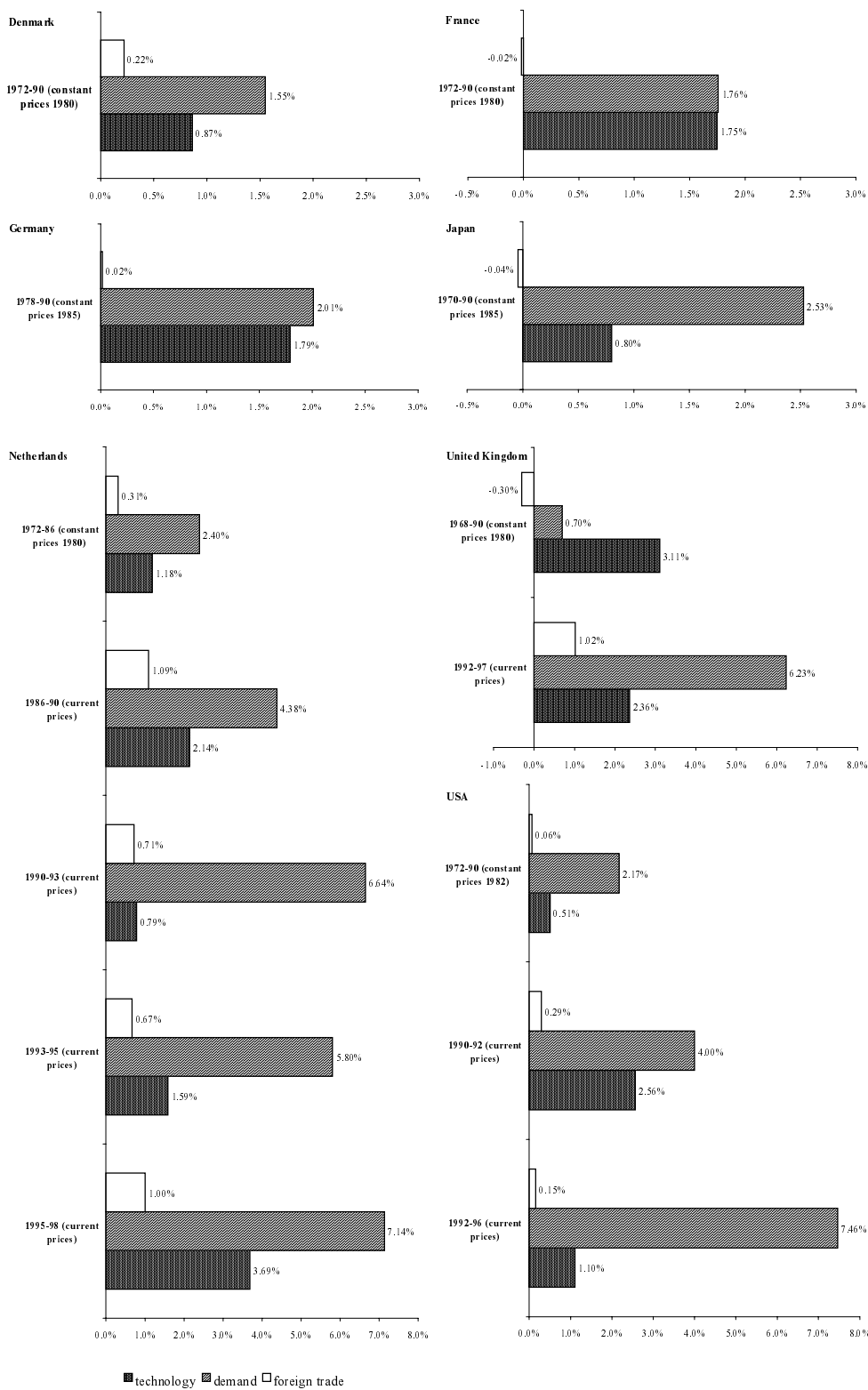


Sources: OECD, national statistical offices; own calculations.

(2) *Tertiarisation does not imply de-industrialisation.* During the observed period, in no country of our sample the gross output of manufacturing sector has declined in real terms. The lowest growth rate (1.03 % p. a. between 1968 and 1990) can be found in UK manufacturing and is clearly related to the loss of competitive advantage against foreign manufacturing firms. In other words, tertiarisation expands because the service sectors grow faster, and not because they drive out manufacturing industries.

(3) *The rise of the service economy has been primarily driven by the growth of knowledge-based services,* outperforming manufacturing growth in every single observation available. In many cases, the growth differential is quite substantial. But the same cannot be said of the other service categories, in which the average annual growth differential with the manufacturing sector is by far less dramatic. Apart from minor exceptions, knowledge-based services have consistently been the fastest growing sector of all five aggregates. Among all available observations their mean annual growth amounted to 3.34 % of real output (or 6.96 % if measured at current prices). In contrast, distributive services have only grown by 2.38 % (5.32 %), which is similar to the mean of 2.48 % p.a. (5.01 %) in personal and social services.

Figure 2: Decomposition of gross output growth in knowledge-based services



(4) *The rise of the knowledge-based services follows a distinct logic*, which cannot be aptly described with reference to the traditional notion of tertiarisation. What makes the most striking difference, is that in addition to the demand-sided effects, which dominate structural change in favour of the service industries more generally, organisational and technological change also appears to be a substantial source of growth in the knowledge-based services. On average, changes in the technological coefficient contributed 1.52 % growth in real output in the knowledge-based services, but only about a half percent in distribution as well as personal and social services. In manufacturing and other sectors on average the technology effect was even negative, though quite small. In contrast, the positive impulses to the growth of real output stemming from the general growth in demand were most explicit in personal and social services, although knowledge-based services follow closely.

To summarize, we have seen that among the sources of structural development, the growth effects stemming from shifts in comparative advantage are generally less pronounced.¹² Conversely, the increase of domestic demand has had the most pronounced impact on growth in all the five sectors, generally favouring the rise of the tertiary compared to the secondary and primary sectors.¹³ The technology effect (as revealed by the change of coefficients in the matrix of intermediary inputs) has been most pronounced in knowledge-based services. Although still smaller than the demand-sided effects, it has been the one additional factor which makes the difference relative to the other sectors. As the benefits from rising demand are stronger but also more evenly distributed, the decomposition suggests that technological and organizational change make the difference which accounts for the particularly high growth of knowledge-based services.

5. Conclusions

Our empirical findings support the claim that in view of the recent structural development the term tertiarisation has by now become too broad to be a useful analytic category. This reinforces the need to define a more focused sub-class of phenomena, which deals explicitly with the rise of knowledge-based services, already referred to as quaternarisation.

The essential difference to the traditional perspective, as expressed in the notion of tertiarisation, is the specific role of technology and knowledge as engines of growth. Our results confirm that knowledge-based services play an increasing role as suppliers of intermediary inputs to the remainder of the economy. Knowledge-based services have become increasingly important sources of innovation, product differentiation and productivity growth. These services not only contribute directly to economic development through their own growth in employment and income, they additionally have the potential to improve performance in the economic system via knowledge transfer and increasing specialisation.

As our final point, we conclude that in contrast to the gloomy forecasts on productivity and income envisaged with respect to the traditional process of tertiarisation, the label quaternarisation singles out a distinct process, in which the cumulative nature of information and knowledge as complementary factors of production raise the general prospects for entrepreneurial discovery and productivity growth.

Appendix

Table A.1a: Shares of knowledge-based services in intermediary demand (current prices)

Current Prices	Manufacturing	Distribution	Knowledge-based services	Personal and social services	Other sectors	Total
Denmark						
1972	5%	18%	31%	14%	12%	11%
1977	6%	18%	29%	16%	11%	11%
1980	6%	16%	30%	17%	12%	11%
1985	7%	16%	37%	19%	15%	13%
1990	9%	18%	42%	24%	24%	19%
1995	10%	32%	50%	51%	20%	29%
France						
1972	9%	31%	58%	17%	18%	17%
1977	10%	32%	58%	19%	19%	18%
1980	11%	32%	59%	22%	19%	20%
1985	14%	33%	62%	25%	21%	23%
1990	19%	38%	75%	29%	28%	34%
Germany						
1978	9%	39%	48%	18%	13%	16%
1986	13%	43%	56%	25%	18%	22%
1988	15%	44%	57%	27%	20%	24%
1990	16%	47%	59%	30%	21%	26%
1991	2%	24%	53%	8%	7%	11%
1995	3%	26%	48%	9%	7%	12%
Japan						
1970	5%	32%	24%	8%	7%	8%
1975	6%	33%	36%	11%	8%	11%
1980	5%	32%	34%	12%	9%	11%
1985	6%	39%	46%	15%	12%	14%
1990	7%	39%	54%	21%	15%	17%
The Netherlands						
1972	5%	22%	49%	14%	6%	9%
1977	5%	25%	50%	18%	7%	10%
1981	5%	25%	50%	20%	8%	11%
1986	8%	29%	54%	21%	8%	13%
1990	15%	31%	45%	25%	7%	20%
1993	17%	32%	47%	26%	8%	22%
1995	17%	38%	56%	56%	9%	31%
1998	20%	46%	63%	33%	12%	33%
United Kingdom						
1968	3%	12%	30%	18%	2%	5%
1979	3%	17%	36%	17%	2%	7%
1984	8%	25%	47%	26%	9%	15%
1990	15%	31%	64%	20%	12%	26%
1992	12%	33%	68%	25%	15%	29%
1995	12%	32%	68%	22%	16%	29%
1996	13%	32%	67%	22%	16%	29%
1997	14%	34%	67%	22%	17%	30%
USA						
1972	8%	41%	59%	26%	13%	19%
1977	6%	35%	56%	22%	11%	16%
1982	7%	32%	59%	24%	14%	19%
1985	8%	38%	59%	28%	14%	21%
1990	10%	40%	64%	32%	16%	26%
1992	10%	47%	67%	39%	19%	30%
1996	10%	47%	68%	40%	19%	31%

Sources: OECD, national statistical offices, own calculations.

Table A.1b: Shares of knowledge-based services in intermediary demand (constant prices)

Constant Prices 1980, 1995	Manufacturing	Distribution	Knowledge- based services	Personal and social services	Other sectors	Total
Denmark						
1972	5%	14%	28%	13%	11%	9%
1977	6%	16%	29%	16%	11%	11%
1980	6%	16%	30%	17%	12%	11%
1985	7%	17%	37%	18%	15%	13%
1990	7%	16%	41%	22%	19%	15%
1995	10%	32%	50%	51%	20%	29%
France						
1972	8%	28%	58%	18%	17%	16%
1977	9%	30%	58%	19%	18%	17%
1980	11%	32%	59%	22%	19%	20%
1985	13%	33%	62%	24%	21%	22%
1990	15%	34%	74%	27%	24%	29%
Germany						
1978	9%	37%	48%	18%	13%	16%
1986	12%	41%	55%	25%	17%	21%
1988	13%	42%	57%	27%	18%	23%
1990	14%	45%	59%	29%	19%	24%
Japan						
1970	5%	31%	24%	9%	8%	9%
1975	7%	36%	39%	14%	9%	12%
1980	6%	33%	35%	13%	10%	12%
1985	6%	39%	46%	15%	12%	14%
1990	6%	34%	51%	18%	13%	15%
The Netherlands						
1972	4%	20%	47%	13%	5%	8%
1977	5%	23%	49%	17%	7%	10%
1981	6%	26%	52%	21%	8%	11%
1986	6%	28%	53%	20%	8%	12%
United Kingdom						
1968	2%	11%	29%	17%	1%	4%
1979	4%	19%	33%	18%	2%	8%
1984	9%	27%	48%	27%	10%	16%
1990	12%	30%	59%	22%	10%	22%
USA						
1972	7%	34%	53%	23%	10%	15%
1977	6%	33%	55%	21%	10%	15%
1982	7%	32%	59%	24%	14%	19%
1985	7%	36%	58%	26%	12%	19%
1990	8%	35%	60%	28%	12%	21%

Source: OECD, own calculations.

Table A.2: Decomposition of average annual output growth in percentage points

	Gross Output	Technology	Consumption	Investment	Net exports
Denmark 1972-1990 (constant prices 1980)					
Manufacturing industries	1.38	-0.61	0.83	0.44	0.73
Distributive services	1.87	-0.23	0.63	0.16	1.32
Knowledge-based services	2.64	0.87	1.50	0.05	0.22
Personal and social services	1.40	-0.06	1.27	0.02	0.16
Other Sectors	1.48	-0.18	1.43	-0.34	0.57
France 1972-1990 (constant prices 1980)					
Manufacturing industries	1.44	-0.28	1.69	0.51	-0.47
Distributive services	2.25	0.27	1.71	0.09	0.18
Knowledge-based services	3.49	1.75	1.78	-0.02	-0.02
Personal and social services	2.65	0.21	2.40	0.02	0.03
Other sectors	1.69	-0.45	2.13	-0.16	0.17
Germany 1978-1990 (constant prices 1985)					
Manufacturing industries	1.84	0.00	1.01	0.79	0.04
Distributive services	2.31	0.11	1.57	0.28	0.35
Knowledge-based services	3.82	1.79	1.80	0.21	0.02
Personal and social services	1.88	0.26	1.43	0.11	0.08
Other sectors	1.21	-0.65	1.38	0.50	-0.03
The Netherlands 1972-1986 (constant prices 1980)					
Manufacturing industries	2.47	0.16	1.15	0.49	0.67
Distributive services	2.24	-0.07	0.83	0.23	1.25
Knowledge-based services	3.90	1.18	2.11	0.29	0.31
Personal and social services	2.47	-0.05	2.37	0.04	0.12
Other sectors	2.39	0.48	1.49	0.25	0.17
The Netherlands 1986-1990 (current prices)					
Manufacturing industries	4.77	-0.11	0.99	0.83	3.05
Distributive services	5.71	1.06	3.06	0.51	1.08
Knowledge-based services	7.61	2.14	3.74	0.64	1.09
Personal and social services	3.67	0.13	3.52	0.06	-0.03
Other sectors	1.49	-1.48	0.18	2.46	0.34
The Netherlands 1990-1993 (current prices)					
Manufacturing industries	0.54	-0.90	1.88	-1.55	1.11
Distributive services	6.58	-0.11	4.29	0.26	2.14
Knowledge-based services	8.15	0.79	6.20	0.45	0.71
Personal and social services	5.93	0.16	5.74	0.04	-0.02
Other sectors	1.50	-0.65	1.65	0.02	0.49

Table A.2: Decomposition of average annual output growth in percentage points (continued)

	Gross Output	Technology	Consumption	Investment	Net exports
The Netherlands 1993-1995 (current prices)					
Manufacturing industries	5.12	-0.50	1.20	1.50	2.92
Distributive services	4.63	0.31	3.11	0.32	0.90
Knowledge-based services	8.06	1.59	5.03	0.77	0.67
Personal and social services	3.65	0.01	2.48	0.34	0.82
Other sectors	3.33	-0.95	1.34	1.74	1.19
The Netherlands 1995-1998 (current prices)					
Manufacturing industries	4.16	-0.24	1.57	0.42	2.41
Distributive services	6.98	1.76	4.84	0.47	-0.08
Knowledge-based services	11.83	3.69	5.06	2.07	1.00
Personal and social services	3.87	-0.10	3.92	0.17	-0.13
Other sectors	3.86	-0.45	1.97	2.19	0.15
United Kingdom 1968-1990 (constant prices 1980)					
Manufacturing industries	1.03	1.46	1.24	0.60	-2.28
Distributive services	2.18	0.86	1.86	0.27	-0.81
Knowledge-based services	3.50	3.11	0.81	-0.11	-0.30
Personal and social services	3.56	0.57	3.26	0.04	-0.31
Other sectors	1.80	0.90	0.73	0.52	-0.35
United Kingdom 1992-1997 (current prices)					
Manufacturing industries	7.33	0.32	5.11	1.94	-0.04
Distributive services	9.19	2.48	5.86	0.62	0.22
Knowledge-based services	9.61	2.36	5.38	0.86	1.02
Personal and social services	8.47	3.07	5.24	0.16	0.00
Other sectors	4.38	-1.02	2.65	2.46	0.28
Japan 1970-1990 (constant prices 1985)					
Manufacturing industries	2.79	-0.37	1.86	1.22	0.08
Distributive services	2.99	0.13	2.17	0.73	-0.04
Knowledge-based services	3.29	0.80	2.06	0.47	-0.04
Personal and social services	2.72	-0.31	2.79	0.38	-0.13
Other sectors	2.30	-1.52	2.08	1.86	-0.12
USA 1972-1990 (constant prices 1982)					
Manufacturing industries	1.56	-0.38	1.58	0.64	-0.27
Distributive services	2.81	0.33	2.03	0.24	0.21
Knowledge-based services	2.74	0.51	2.00	0.17	0.06
Personal and social services	2.68	0.03	2.57	0.06	0.03
Other sectors	0.87	-0.59	1.54	0.38	-0.47
USA 1992-1996 (current prices)					
Manufacturing industries	6.08	0.88	3.41	3.08	-1.29
Distributive services	7.68	0.80	4.98	1.62	0.29
Knowledge-based services	8.72	1.09	5.15	2.31	0.16
Personal and social services	6.62	0.22	6.12	0.28	0.01
Other sectors	5.69	-0.56	3.39	3.60	-0.74

Sources: OECD (available at constant prices), national statistical offices (current prices only), own calculations.

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Notes

¹ In the developed nations, the shares of manufacturing in total employment typically peaked between the years 1964 and 1975. The individual peaks differed between countries, ranging for instance from a comparatively low level of 34 % in Canada or 36 % in the USA (both in 1966) to 49 % in Germany (1970). For detailed information see Feinstein (1999).

² See e.g. Bermejo-Rubalcaba (1999).

³ In contrast to “artificers, manufactures and merchants”, whom Smith considered as “productive” labour, he referred among others to menial and public servants, “protection, security, and defence”, “churchmen, lawyers, physicians, men of letters of all kinds”, “musicians”, etc., 1776, IV, ix, p. 331) as “unproductive” labour.

⁴ For a thorough assessment on the role of services in economic thought see Delaunay and Gadrey (1992).

⁵ Remarkable exceptions are the contributions of Fritz Machlup (1962, 1980).

⁶ Sapir (1993) offers an interesting typology of the different modes of interaction between the users and suppliers of services, which successfully brings together relevant aspects from the field of industrial organization as well as international economics.

⁷ This also corresponds to Mankiw’s definition of knowledge as “understanding about how the world works”. See Mankiw (1995, p. 298).

⁸ While our focus is on factors explaining observable shifts in the sectoral composition of gross output, our approach does not allow us to deal with the related question of the determinants of shifts in employment. In terms of employment and apart from the above factors, the rise of the service industries might to some extent be caused by differences in productivity growth related to the arguments known as Baumol’s “cost disease” (Baumol, 1967, 1985). The measurement of structural change due to cost-based effects on employment is not captured by the subsequent calculations.

⁹ An interesting explanation for the different saturation levels is reported in Delaunay and Gadrey (1992) who quote Heinrich Storch (1766-1835) for observing that “...there is no type of material good, which becomes more useful the more of it one has, whereas most internal benefits become more useful, the more one takes part in them” (Storch, 1823, p. 236, quotation from Delaunay and Gadrey, 1992, p. 27).

¹⁰ For related empirical work based on input-output analysis see e.g. Barker (1990), Driver (1994), Tomlinson (1997), Kratena (1998), or Brus et al (1999).

¹¹ We must be aware of the somewhat restricted comparability of input-output data both between countries and over the course of time, as the methods used in constructing them differ. We should also suspect that the rising shares of knowledge-based services are partly due to improved statistics, although this in itself has been motivated by the growing awareness of their importance.

¹² This effect was strongest in the UK prior to the 1990s. This tendency, however, cannot be characterised as a general trend for developed economies. Manufacturing growth in other nations, such as Germany, the Netherlands, Denmark, and Japan has consistently enjoyed positive impulses generated by foreign trade. We additionally observe that, for instance, both in France and the USA, an improving foreign trade position has positively contributed to output growth in the distribution related services. In the UK, at least from 1992 onwards, a similar shift in comparative advantage appears to have favoured the growth in knowledge-based services.

¹³ The decomposition also shows that the contribution of final demand (net of exports) to output growth is largely dominated by (public and private) consumption. Investment demand, which quantitatively plays a minor role, only has a substantial impact in manufacturing and other sectors such as construction and utilities, where in general more tangible and durable goods are produced. The recognition of intangible durable goods in the systems of national accounting is however still in its infancy. The high contribution of investment demand to the growth of knowledge-based services in the recent years in the USA and the Netherlands already seems to reflect an effort towards their better recording.

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