The deindustrialisation/tertiarisation hypothesis reconsidered: a subsystem application to the OECD7

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Abstract

The diffusion of outsourcing, both national and international, and vertical FDIs among manufacturing firms, along with the higher integration of business services in manufacturing, has recently led to question the empirical evidence supporting the Deindustrialisation/Tertiarisation (DT) hypothesis. Rather than a "real" phenomenon, it has been argued, DT would be an "apparent" one, mainly due to the reorganization of production across national and sectoral boundaries.

The empirical studies that have dealt with the topic so far have not been able to effectively rule out such possibility, because of two main limitations: the sectoral level of the analysis and/or the national focus. In order to overcome them, the paper carries out an appreciative investigation of the actual extent of the DT occurred in the OECD area over the '80s and the '90s by moving from a sector to a subsystem perspective, thus retaining both direct and indirect relations, and by referring to a "pseudo-World" of 7 OECD countries, thus taking into account the "global" dimension of the phenomenon.

The results strongly support the DT hypothesis: although the weight of business sector services in the manufacturing subsystem increased, acting as a counterbalancing tendency to the manufacturing decline, subsystem shares significantly decreased, thus confirming DT as a more fundamental trend of modern economies.

Keywords: Deindustrialisation; Input-output; Producer services; Tertiarisation; Subsystem; Vertical integration.

JEL Classification: L600; L800; O140; P000.

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1 Introduction

Although it dates back to the early '40s, the hypothesis that economic development passes through the binomial Deindustrialisation/Tertiarisation (DT) has been recently brought to the front of the debate. In spite of the several buzzy-words – such as "new-economy", "knowledge-economy", "learning-economy" – and conceptualization attempts (Foray, 2000), the current techno-economic paradigm appears incontrovertibly more service-based than the previous ones. Indeed, some consider this the only feature of modern economies which might be properly regarded as "new" (e.g. Daniels, 2004). Not only is a service sector such as that of *Information and Communication Technologies* (ICT) pivotal in driving economic activities and performances nowadays (Di Pilat, 2003); but services, both in general and in particular fields – such as the so called *Knowledge Intensive Business Services* (KIBS) (Tomlinson, 2000) – are re-shaping economic fundamentals, both from the demand and the supply-side.[1]

In the current techno-economic paradigm, therefore, quantifying and evaluating the actual impact of DT processes have become more important than ever. Notwithstanding, the results of those empirical applications which have been carried out with this scope are far from conclusive and rather seem to point out different dynamics for different kinds of service sectors. Apparently, rather than more deindustrialised and tertiarised, modern developed economies would simply appear more specialized in different kinds of services than before. The so-called Clark-Fisher hypothesis, which assumes that economic development is characterized by a shift from agriculture to manufacturing and from this to services, would thus not properly fit the new-economy paradigm.

The present paper aims at showing that the "invalidity" of the Clark-Fisher hypothesis should not be taken for granted either. The arguments which have been used to support it – briefly reviewed in Section 2 – are in fact affected by a crucial methodological flaw. In brief, as they are based on a sectoral view of economic systems, they disregard the actual shares of labour employed, and value created, in activities intended, directly and indirectly, for the production of manufactured goods or the provision of services delivered to final demand. Furthermore, the sector-based approach to the DT hypothesis is extremely sensitive to the hypotheses made about the organization of production and, accordingly, it is not reliable in spatial/temporal contexts in which the actual one is different from that assumed (as it is currently the

[1] As for the former, Sherwood (1994), for instance, claims that services in the "new economy" have made the role of the consumer prominent, given his active involvement in service provision. As for the supply-side, instead, Andersen and Corley (2002) have pointed out, among others, that standard measures of productivity and economic performance are no longer satisfactory, given their inadequacy to properly figure out productivity and output in services.

case).

On the basis of this argument, in Section 3, a subsystem approach originally developed by Momigliano and Siniscalco (1982a,b) is suggested as a superior alternative in investigating the structural change of modern developed economies.

As a major value added of the paper, this subsystem approach is then applied in an original manner, described in Section 4, to investigate the extent of DT processes occurred over the '80s and the '90s in an "artificial" World made up of a consistent aggregation, dictated by data availability, of seven OECD countries – Canada, Denmark, Germany, France, Japan, UK and USA – together accounting for almost half of the World GDP at PPP.

The special features of this empirical application allow us to disentangle the multiple and different mechanisms which underpinned the structural change of this developed part of the World in the last two decades.

Indeed, as we fully argue in Section 5, although the weight of business sector services in the manufacturing subsystem increased, acting as a counterbalancing tendency to the manufacturing decline, the labour and value added shares of the latter subsystem in fact decreased considerably. Such a decrease was even more marked than the sectoral one, and apparently not explained by the increasing resort of the OECD7 to international trade. Moreover, the same decline does not seem to have been fully accounted by the increase of the integration of manufacturing in the service subsystems which, possibly in the light of the ICT diffusion, has paralleled the increased integration of services into manufacturing.

Section 6 recapitulates the main points of the paper and envisages future research lines for it.

2 The DT hypothesis: old and recent evidences

Since Clark's (1940) major contribution, *deindustrialisation* (D) – defined as the decline of manufacturing shares of both employment and value added in economic systems — has been usually regarded as a general tendency of economic development, strictly connected with *tertiarisation* (T), that is, the increase of the shares accounted by the so called "tertiary".[2]

This tendency has been related by economists to both demand and supply-side factors, pointing to, respectively, the higher income elasticities and the lower pace of the productivity increase of services with respect to manufacturing. Which of these factors should be given the major role has not been ascertained yet.[3]

[2]This tendency is commonly referred to as the Clark-Fisher hypothesis. As is well known, Clark terms the tendency "Petty's Law" and, relying on a passage of *Political Arithmetick* (1676), credits Petty for having first suggested it.

[3]Some have claimed that demand-side factors are the most prominent (e.g. Clark, 1940;

To be sure, not only are the determinants of DT still debated, but also its actual extension has been and is still subject to empirical investigation. Clark himself, for first, seventeen years after having suggested the relative hypothesis, actually questioned it in the third edition of *The Conditions of Economic Progress* (1957). Indeed, he there observed that most of the results achieved for the tertiary as a whole did not hold if services were in fact subdivided into *producer* and *consumer* ones: on the one hand, there were no evidences of high income elasticity for consumer services; on the other hand, there had been great improvements of efficiency in some producer service, such as transport and trade.

The importance of the latter in explaining the sectoral patterns of change in modern economies, and DT in particular, was thus highlighted.[4] On its basis, for example, Gershuny (1978) criticized the well-known Bell's (1973) idea of the "post-industrial society" as a *service economy*, by opposing to it that of a *self-service economy*. As he argued, this is characterized, on the one hand, by an increased number of domestic and individually purchased durable goods in households that eliminate the dependence on outside provided services; on the other hand, by an increased industrial production requiring an increased service support sector (like advertising, marketing, financial and insurance services).

A similar argument was put forward later on by Stanback (1979, 1981) who, by disaggregating services into consumer, producer and public ones, did not find "significant trend away from goods and toward services in the pattern of consumer expenditure, but rather that the purchases of many goods and services are *closely linked*." (1979, p.16). By using data on interindustry transactions, he identified a remarkable growth of producer services, which he related to: the consolidation of smaller firms into larger units, the increased government regulation of the economy, the increase of market size and their expansion into international markets.[5]

An important point made by Stanback concerns the hypothesis that, the greater the range of services firms are able to provide is, the higher will be the probability of contracting-out them, thus accelerating the pace of producer services growth, in a sort of self-reinforcing process. Indeed, this is what has occurred recently with the widespread diffusion of service

Rostow, 1959, 1990; Pasinetti, 1993), whereas others have played down the role of demand and rather retained supply-side factors as critical (e.g. Stigler, 1956; Kuznets, 1957; Fuchs, 1964, 1965; Baumol, 1967). In a recent empirical analysis, Rowthorn and Ramaswamy (1997, 1999) find some evidence supporting the latter. The question is still very debated, but not directly relevant to this paper's aim.

[4]Apart from Clark's (1957) insights, it was Greenfield (1966) who first suggested distinctly the dichotomy producer/consumer services.

[5]Original explanations are also provided by Stanback (1979) for the destiny of consumer services, in particular in terms of: complementarity between services and consumer goods; rigidity of the constraints to time for consumption; questionability of the increase of leisure-time.

outsourcing practices. A phenomenon which has shifted the attention on the actual integration of services in manufacturing, with the related possible overestimation of the actual decline (increase) of manufacturing (tertiary).

The point – already dealt with in the '80s by Momigliano and Siniscalco (1982a,b) – has been recently addressed by Domberger (1998), who showed that the only services exhibiting long-term proportional growth for six OECD countries have been those usually intended for intermediate consumption (Domberger, 1998, p.186). The same issue has been investigated by McCarthy and Anagnostou (2004) who, by using a decomposition method put forward by Dietrich (1999), identified an overestimation of DT for the UK over the '80s and explained it in terms of an increased integration of services into manufacturing.[6]

The DT hypothesis becomes even more blurred when the increasing resort to international trade and the upsurging international fragmentation of production (Jones and Kierzkowski, 1990) are considered. In particular, although the latter apparently fuels DT, the delocalization of manufacturing processes abroad and the localization at home of service based activities in fact does not strictly amount to it, because it involves simply a reorganization of production across national boundaries, but no change in terms of overall economic structure.

Following these lines of argument, a sort of consensus is emerging about a counter-DT hypothesis, which sees it as "superficial" rather than "real". As Postner (1990) puts it, much of the observed surge of producer services could merely be a "superficially different way for business to operate and can be reasonably explained within the economic literature on industrial organization. An extreme version of the argument claims that no new producer services employment, particularly business services employment, have really been created in recent years" (1990, p.178).

3 The DT hypothesis reconsidered: from a sector to a subsystem perspective

Although it gives extremely useful insights, the bulk of evidence on an apparent "superficial" DT hypothesis suffers from a crucial methodological drawback. As noted by Momigliano and Siniscalco (1982a,b) more than two decades ago, in all these works "*producer services* are defined as those services *mainly* intended for intermediate demand, and *consumer services* as those *mainly* intended for final consumption" (1982a, p.276). In so doing, the economy is disaggregated into sectors – usually following standard SIC definitions – by assuming demand, output and technology within each sector homogeneous enough to retain each and every one of them in "relative isolation from the rest" (Georgescu Roegen, 1971).

[6]For a critical analysis of this decomposition technique see Vittucci Marzetti (2006).

This hypothesis has two relevant implications for the analysis of DT. Firstly, it amounts to assuming intra-sectoral relationships stronger than intersectoral ones. In other words, sectors are dealt with as if they were vertically integrated models of production: the intermediate inputs of a certain sector are not regarded as produced means of production, but rather as products external to the sector itself, with respect to which the latter has no role to play, either directly or indirectly, while this is not the case at all.[7] Secondly, the sectoral view of the economy is extremely sensitive to changes in the way firms within sectors actually organize the production process, which could be erroneously taken for structural kinds of changes. Thus, for instance, if some business activities previously performed "in house" by manufacturing companies are simply re-organized, and thus "hived off" to specialist subcontractors, all things equal, this makes service sector shares increase, while the manufacturing ones decline, suggesting an apparent tertiarization.

While possibly not so crucial in the past techno-economic paradigms, these two implications seriously hamper the analysis of DT in the present scenario. On the one hand, in the so-called "knowledge-economy", the wide spread of ICTs has made horizontal linkages among sectors no less important than vertical ones. On the other hand, the increasing resort to outsourcing practices has dramatically changed the actual organization of production, at least in the OECD area (e.g. Domberger, 1998).

In the attempt of overcoming the limitations of such analysis of DT, and thus measuring the real weight of manufactured goods and service provision in the economic system, we here suggest shifting to a different perspective and referring explicitly to the idea of economic *vertical integration*.[8] This is what, in an article which is much more quoted than used, Momigliano and Siniscalco (1982a,b) for first have done in investigating the structural change of the Italian economy from the middle '60s to the middle '70s. More precisely, in order to detect its actual degree of tertiarisation in the light of the service integration in manufacturing, they referred to the concept of *subsystem* by building up a matrix such as:

$$\mathbf{B} = \hat{\mathbf{q}}^{-1}(\mathbf{I} - \mathbf{A})^{-1}\hat{\mathbf{y}} \tag{1}$$

[7] On this point see, for instance, Baranzini and Scazzieri (1990).

[8] The genesis of vertical integration can be traced back to William Petty (1662) and Adam Smith (1776), who extensively, though still somewhat implicitly, used such "logical device" (Scazzieri, 1990, p.20). However, starting from the seminal notion of *subsystem* put forward by Sraffa (1960), it was only in the late '60s that the concept of vertical integration was analytically studied by, among the others, Pasinetti (1973), who developed the concept of *vertically integrated sector*, a compact representation of the productive system suitable for dynamic analyses. Since then on, such tools have been mainly utilized in empirical studies on productivity, as those by Gossling (1972) and Gupta and Steedman (1971) and, more recently, by Wolff (1985), Milberg (1991), Panethimitakis (1993) and De Juan and Febrero (2000).

where $\hat{\mathbf{q}}$ is the diagonalized vector of gross production, $\mathbf{A}$ is the matrix of domestic flows-based input-output coefficients and $\hat{\mathbf{y}}$ is the diagonalized vector of final demand.

Each row of $\mathbf{B}$ adds up to 1 and shows "the proportion of the activity of each branch which comes under the various subsystems" (Momigliano and Siniscalco, 1982a, p.281).[9] $\mathbf{B}$ can therefore be used as an operator to reclassify any magnitude from sectors into subsystems. Indeed, on the basis of $\mathbf{B}$, Momigliano and Siniscalco (1982a,b) worked out the matrix $\mathbf{N}$, which is crucial in the actual investigation of DT processes from a subsystem perspective, defined as:

$$\mathbf{N} = \hat{\mathbf{l}}\mathbf{B} \tag{2}$$

where $\hat{\mathbf{l}}$ is the diagonalized vector of labour inputs. The generic element n_{ij} of $\mathbf{N}$ actually gives the amount of labour required, both directly and indirectly, from sector i in order to satisfy the final demand addressed to sector j.

Extremely relevant, for the same scope, is also the matrix $\mathbf{C}$, which is obtained from $\mathbf{N}$ by dividing each of its cells by the total of the correspondent column. Denoting with $\mathbf{i}'$ a row unit vector, $\mathbf{C}$ can be written as:

$$\mathbf{C} = \mathbf{N}(\widehat{\mathbf{i}'\mathbf{N}})^{-1} \tag{3}$$

The generic element of $\mathbf{C}$, c_{ij}, measures the share accounted by sector i in the total labour required by subsystem j in order to produce the output needed to satisfy its final demand.

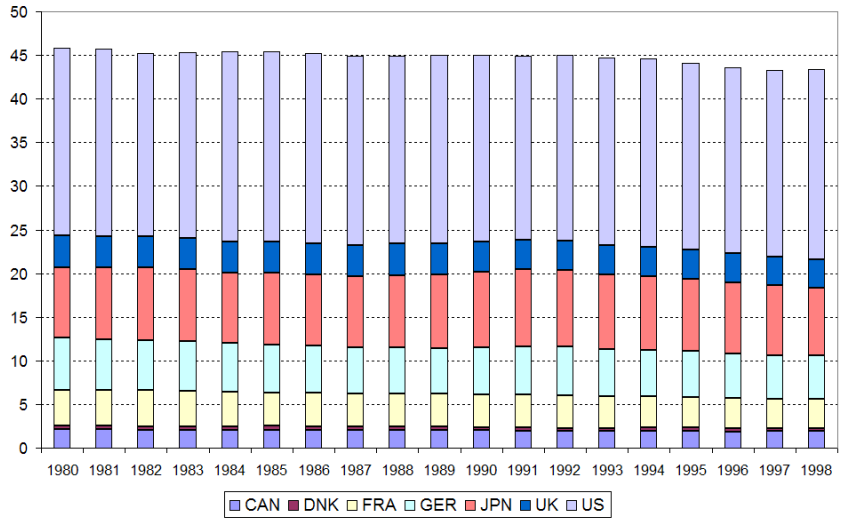
It is worth emphasizing that, as demonstrated by Rampa (1982), all the previous matrices are invariant to relative prices.[10]

Moreover, it is important to note that a comparative analysis of the changes occurred in the above defined matrices can prove useful for disentangling structural change determinants. Indeed, while $\mathbf{N}$ works out levels, $\mathbf{B}$ and $\mathbf{C}$ report shares and do not depend on, respectively, sectoral labour productivities and final demand structures. $\mathbf{B}$ calculates the shares of each

[9] As noted by Rampa (1982), given that $\mathbf{B}$ depends not only on strict technological factors, but also on the structure of final demand, it cannot be taken as an indicator of technological change as such.

[10] Denoting with $\bar{\mathbf{x}}$ each magnitude $\mathbf{x}$ expressed in physical quantities and with $\hat{\mathbf{p}}$ the diagonalized vector of prices, we can write:

$$\begin{aligned}
\mathbf{B} &= \hat{\mathbf{q}}^{-1}(\mathbf{I}-\mathbf{A})^{-1}\hat{\mathbf{y}} = \\
&= \left(\hat{\bar{\mathbf{q}}}^{-1}\hat{\mathbf{p}}^{-1}\right)\left(\mathbf{I}-\hat{\mathbf{p}}\bar{\mathbf{A}}\hat{\mathbf{p}}^{-1}\right)^{-1}\left(\hat{\mathbf{p}}\hat{\bar{\mathbf{y}}}\right) = \\
&= \left(\hat{\bar{\mathbf{q}}}^{-1}\hat{\mathbf{p}}^{-1}\right)\left(\hat{\mathbf{p}}\left(\mathbf{I}-\bar{\mathbf{A}}\right)^{-1}\hat{\mathbf{p}}^{-1}\right)\left(\hat{\mathbf{p}}\hat{\bar{\mathbf{y}}}\right) = \\
&= \hat{\bar{\mathbf{q}}}^{-1}\left(\mathbf{I}-\bar{\mathbf{A}}\right)^{-1}\hat{\bar{\mathbf{y}}}
\end{aligned}$$



Source: World Economic Outlook Database, 2005.

Figure 1: OECD7 share of World GDP at PPP

subsystem on the total hours worked in the relevant sector and changes of the total employment in the sector, keeping constant its gross production, do not affect these shares. On the contrary, assuming constant returns of scale, **C** is not affected by changes in the composition of final demand (on this point see Montresor and Vittucci Marzetti, 2007). Thus, **B** changes are mainly related to non proportional dynamics of final demand, whereas **C** variations to that of sectoral labour productivity.

Drawing on the present subsystem view, in the following we will apply these and others indicators in an original empirical investigation of the DT hypothesis in the OECD area from the early '80s to the middle '90s. Before illustrating its main results, the methodology of this application is worthwhile discussing at first.

4 The DT hypothesis in the OECD7: an "aggregated" sector/subsystem analysis

The empirical application we have carried out has several elements of originality. First of all, rather than focusing on one country at a time, or on some countries comparatively – as the majority of the studies does – we attempt to estimate the extent of the DT hypothesis at an aggregated level: that is, by considering the economic sectors and subsystems of a "pseudo-World", made up of seven OECD countries – that is, Canada, Denmark, Germany, France, Japan, UK and the US – together accounting for almost half of the

Table 1: International trade integration of the OECD7

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Manufacturing[a]	46.1	45.4	44.6	45.3	45.1	43.9	43.3	43.8	44.5
Total[b]	44.2	43.5	43.0	43.6	43.6	42.5	42.0	42.6	43.6

Source: OECD STAN Bilateral Trade Database, 2006.

[a] $\sum_{i=1}^{7} \frac{\sum_{j=1}^{7}(X_{ij}^{m}+M_{ij}^{m})}{\sum_{i=1}^{7}\sum_{j}(X_{ij}^{m}+M_{ij}^{m})} \times 100$, where X_{ij}^{m} is the export of manufactured goods from country i to j, M_{ij}^{m} is the import of manufactured goods from country j to i, and the countries are ordered in such a way that the first seven belong to the OECD7.

[b] $\sum_{i=1}^{7} \frac{\sum_{j=1}^{7}(X_{ij}+M_{ij})}{\sum_{i=1}^{7}\sum_{j}(X_{ij}+M_{ij})} \times 100$, where X_{ij} is the export from country i to j, M_{ij}^{m} is the import from country j to i, and the countries are ordered in such a way that the first seven belong to the OECD7.

World GDP at PPP (see Figure 1). Although the choice of the countries has been mainly determined by reasons of data availability, these 7 economies are actually quite integrated at the international level. Indeed, the average international flows intra OECD7 amounted to about 45% of the total ones (Table 1). Accordingly, while it (deliberately) neglects country specificities, on the other hand, the present analysis allows us to appreciate the extent at which DT processes have occurred on a (pseudo) global scale: in the globalisation era, this actually seems to us a proper level of investigation of the phenomenon.

A second element of originality, at least as far as an input-output data based application is concerned, is its time coverage, which spans, although across discrete sub-periods, from the early '80s to the middle '90s. By crossing the "old" with the "new" *OECD Input-Output Database* (1995, 2005), and by combining them consistently with data on sectoral hours worked – obtained from the *60-Industry Groningen Growth and Development Centre Database* (2005)– we have thus been able to examine the structural changes brought about in the OECD7 by the upsurge of the knowledge-base economy.

Third, the analysis is carried out by using domestic intersectoral flows as a baseline, but controlling for the role of changes in international trade along with that of the degree of vertical integration at the subsystem level. In particular, data on imports and exports of manufactured goods – from the *OECD STAN Database* (2004) – and on country GDP at current prices – from the *World Economic Outlook Database* (2005) – have been used to calculate the trade balance of manufactured goods as a percentage of country GDP from 1980 to 1998.

This multiple and consistent integration of datasets, combined to check for alternative explanations of DT, represents the last, but not least, added value of the present application.

In detail, for each of the 7 countries, the matrix $\mathbf{N}$ (Equation (2)), based on labour inputs, has been first worked out for four periods: early '80s,

middle '80s, early '90s and middle '90s.[11] For the sake of a DT analysis, the data have been then aggregated in order to obtain six different macro-sectors with the relative subsystems: primary (1-14 ISIC Rev.3), manufacturing (15-37), public utilities (40-41), construction (45), business sector services (50-74) and non-market services (75-99). Finally, the absolute values of **N** have been simply summed up across countries to obtain the correspondent values for the whole set, that is for the OECD7.[12]

After having worked with employment data, in order to analyze the process of value creation at the subsystem level, a similar procedure has been followed for sectoral value-added data (**v**). The **B** operators at the country level have been thus pre-multiplied by the correspondent diagonalized vectors ($\hat{\mathbf{v}}$):

$$\mathbf{U} = \hat{\mathbf{v}}\mathbf{B} \tag{4}$$

The generic element u_{ij} of **U** gives the contribution of sector i to subsystem j in terms of value added.

Given that we are dealing with values, in order to obtain the correspondent aggregate matrix for the OECD7, in this case it is not possible to simply sum up the different country results as before. Therefore, by using the data from the *World Economic Outlook Database* (2005), country's shares have been weighted by using PPP. Thus, for instance, denoting with s_i^j the share of sector (or subsystem) j with respect to the total value added of country i and with $\$Y_i$ the GDP based on Purchasing-Power-Parity (PPP) of the same country, the correspondent share for the whole set of OECD countries (s_{OECD7}^j) is equal to:

$$s_{OECD7}^j = \sum_i s_i^j \frac{\$Y_i}{\sum_i \$Y_i} \tag{5}$$

5 The OECD7 over the '80s and the '90s: "DT or not DT"?

5.1 Has the OECD7 actually become more deindustrialised?

At first sight, from the early '80s to the middle '90s, our OECD7 has actually undergone a sustained DT process. When both direct and indirect effects are retained at a subsystem level, the manufacturing decline appears more

[11] In order to avoid, as much as possible, distortions coming from sectoral aggregation, calculations have been carried out at the maximum level of disaggregation compatible with the data at country level and the results have been then re-aggregated. For details about the definition of the four periods see Appendix A.

[12] Let us observe that this is possible given that data on labour inputs refer to such a homogeneous variable as hours worked.

Table 2: Hours worked by sector/subsystem in the OECD7

		early '80s	mid-'80s	early '90s	mid-'90s
Primary	Sector	37,700,172	33,723,454	29,307,863	24,629,501
			(-3,976,719)	(-4,415,591)	(-4,678,362)
	Subsystem	13,895,862	12,611,489	11,793,032	10,035,300
			(-1,284,373)	(-818,457)	(-1,757,732)
Manufacturing	Sector	106,179,748	104,728,629	104,452,384	97,238,631
			(-1,451,119)	(-276,244)	(-7,213,754)
	Subsystem	136,112,879	136,122,350	132,649,492	119,782,561
			(9,470)	(-3,472,858)	(-12,866,931)
Public Utilities	Sector	4,242,153	4,332,810	4,472,372	4,207,845
			(90,656)	(139,562)	(-264,527)
	Subsystem	4,681,344	4,328,551	4,631,808	4,573,702
			(-352,793)	(303,257)	(-58,107)
Construction	Sector	36,238,076	36,363,778	40,420,758	42,798,288
			(125,702)	(4,056,980)	(2,377,530)
	Subsystem	59,049,399	57,049,589	61,710,582	61,041,902
			(-1,999,811)	(4,660,994)	(-668,680)
Business services	Sector	179,101,746	195,239,286	214,688,898	237,355,549
			(16,137,539)	(19,449,612)	(22,666,651)
	Subsystem	147,735,188	164,696,060	176,995,039	194,607,392
			(16,960,871)	(12,298,980)	(17,612,353)
Non market services	Sector	105,924,143	111,075,352	125,590,539	133,760,729
			(5,151,209)	(14,515,187)	(8,170,190)
	Subsystem	107,911,366	110,655,270	131,152,861	149,949,687
			(2,743,904)	(20,497,591)	(18,796,826)
Total		469,386,039	485,463,307	518,932,814	539,990,543
			(16,077,268)	(33,469,506)	(21,057,730)

Source: OECD I-O Database and 60-Industries GGDC Database.

intensive than at the sectoral level. In terms of total hours worked, the share of the OECD7 manufacturing subsystem has decreased by 6.82 percentage points, while, during the same period, the sectoral share of manufacturing decreased of only 4.61% (Table 3). A similar result can be identified in terms of value added, with respect to which the manufacturing subsystem shifted from a share of 29.57% of the total value created in the early '80s, to a share of 22.86% in the middle '90s: a decrease of 6.71 percentage points vs. a sectoral one of only 4.58 points (Table 4).

To be sure, as far as hours worked are concerned, not only was the decline in relative terms, but also in absolute ones. Indeed, while the total hours worked in the OECD7 from the early '80s to the middle '90s increased continuously, the hours worked in manufacturing decreased (Table 2).

This is a first important result of our application. When horizontal linkages are allowed for along with vertical ones, the (pseudo-)World seems to have been affected by an actual *deindustrialisation* process, both in terms

Table 3: Sectoral and subsystem shares of the OECD7 total economy (hours worked)

		early '80s	mid-'80s	early '90s	mid-'90s
Primary	Sector	8.03	6.95	5.65	4.56
			(-1.09)	(-1.30)	(-1.09)
	Subsystem	2.96	2.60	2.27	1.86
			(-0.36)	(-0.33)	(-0.41)
Manufacturing	Sector	22.62	21.57	20.13	18.01
			(-1.05)	(-1.44)	(-2.12)
	Subsystem	29.00	28.04	25.56	22.18
			(-0.96)	(-2.48)	(-3.38)
Public Utilities	Sector	0.90	0.89	0.86	0.78
			(-0.01)	(-0.03)	(-0.08)
	Subsystem	1.00	0.89	0.89	0.85
			(-0.11)	(0.00)	(-0.05)
Construction	Sector	7.72	7.49	7.79	7.93
			(-0.23)	(0.30)	(0.14)
	Subsystem	12.58	11.75	11.89	11.30
			(-0.83)	(0.14)	(-0.59)
Business services	Sector	38.16	40.22	41.37	43.96
			(2.06)	(1.15)	(2.58)
	Subsystem	31.47	33.93	34.11	36.04
			(2.45)	(0.18)	(1.93)
Non market services	Sector	22.57	22.88	24.20	24.77
			(0.31)	(1.32)	(0.57)
	Subsystem	22.99	22.79	25.27	27.77
			(-0.20)	(2.48)	(2.50)

Source: OECD I-O Database and 60-Industries GGDC Database.

of employment and of value added. What is more, a purely sectoral approach seems to hide a good part of the same process, which a subsystem perspective instead recovers.

While it might have been to a certain extent expected, which are the causes of this deindustrialisation and, in particular, which is the scope of a truly *tertiarisation* process for it, deserves special attention. Accordingly, three possible explanations, in addition to that of tertiarisation, are addressed in the following.

5.2 Deindustrialisation and producer services: how far do they matter?

As we have seen in Section 2, increasingly more numerous are those contributions which contrast the deindustrialisation process with the increase of the role of producer services and, on this basis, question an actual decrease of the weight of manufacturing in modern developed economies. Our analysis

Table 4: Sectoral and subsystem shares of the OECD7 total economy (value added, PPP weights)

		early '80s	mid-'80s	early '90s	mid-'90s
Primary	Sector	5.58	4.76	3.38	2.66
			(-0.82)	(-1.38)	(-0.72)
	Subsystem	2.09	1.96	1.61	1.30
			(-0.13)	(-0.35)	(-0.31)
Manufacturing	Sector	24.14	23.14	22.16	19.56
			(-0.99)	(-0.98)	(-2.61)
	Subsystem	29.57	28.82	26.98	22.86
			(-0.75)	(-1.84)	(-4.12)
Public Utilities	Sector	2.51	3.03	2.42	2.27
			(0.52)	(-0.61)	(-0.15)
	Subsystem	2.04	2.08	1.79	1.63
			(0.05)	(-0.29)	(-0.17)
Construction	Sector	7.06	6.00	6.61	5.86
			(-1.06)	(0.61)	(-0.75)
	Subsystem	12.01	10.68	11.01	9.47
			(-1.32)	(0.33)	(-1.54)
Business services	Sector	40.90	42.62	45.36	49.21
			(1.72)	(2.74)	(3.85)
	Subsystem	33.06	35.11	36.26	39.77
			(2.05)	(1.14)	(3.51)
Non market services	Sector	19.80	20.44	20.07	20.44
			(0.64)	(-0.38)	(0.37)
	Subsystem	21.24	21.34	22.35	24.97
			(0.10)	(1.01)	(2.62)

Source: World Economic Outlook Database and OECD I-O Database.

does not entirely support this point of view. Although an increase of the share accounted by business sector services in the manufacturing subsystem is confirmed by our data – both in terms of employment (Table 5) and value added (Table 6) – the decline of the manufacturing sector seems to be only partially explained by it.

Consider, for example, what has happened in the OECD7 from the early to the middle '80s in terms of hours worked. While the manufacturing sector decreased of as much as -1,451,119 hours worked, the correspondent subsystem gained +9,470 hours worked (Table 2). This mismatch is partially explained by the consistent increase (+1,315,548 hours worked) of the integration of business services into manufacturing (Table 5(a)). Still, something else should have occurred, given that the manufacturing subsystem share in the total economy decreased anyway (-0.96 percentage points) (Table 3).

Similar mismatches can be found with respect to other periods, and also

Table 5: Business sector services integration in the production system in the OECD7 (hours worked)

(a) Business service employment in subsystems (absolute values)

Subsystem	early '80s	mid-'80s	early '90s	mid-'90s
Primary	1,351,668	1,336,592	1,367,255	1,421,716
		(-15,077)	(30,663)	(54,461)
Manufacturing	27,036,126	28,351,675	29,977,849	31,049,241
		(1,315,548)	(1,626,174)	(1,071,391)
Public Utilities	1,056,993	973,230	1,196,389	1,316,193
		(-83,763)	(223,159)	(119,804)
Construction	11,872,229	10,824,500	13,084,453	12,962,725
		(-1,047,729)	(2,259,954)	(-121,728)
Business services	128,922,953	144,538,685	158,133,652	173,288,046
		(15,615,732)	(13,594,967)	(15,154,394)
Non market services	8,861,777	9,214,605	10,929,299	17,317,628
		(352,827)	(1,714,695)	(6,388,329)

(b) Business service integration into subsystems (percentage values)

Subsystem	early '80s	mid-'80s	early '90s	mid-'90s
Primary	0.8	0.7	0.6	0.6
Manufacturing	15.1	14.5	14.0	13.1
Public Utilities	0.6	0.5	0.6	0.6
Construction	6.6	5.5	6.1	5.5
Business services	72.0	74.0	73.7	73.0
Non market services	4.9	4.7	5.1	7.3
Total	100.0	100.0	100.0	100.0

(c) Share of business service employment in subsystems (percentage values)

Subsystem	early '80s	mid-'80s	early '90s	mid-'90s
Primary	9.7	10.6	11.6	14.2
Manufacturing	19.9	20.8	22.6	25.9
Public Utilities	22.6	22.5	25.8	28.8
Construction	20.1	19.0	21.2	21.2
Business services	87.3	87.8	89.3	89.0
Non market services	8.2	8.3	8.3	11.5

Source: OECD I-O Database and 60-Industries GGDC Database.

Table 6: Business sector services integration in the production system in the OECD7 (value added, PPP weights)

(a) Business sector services integration into subsystems (percentage values)

Subsystem	early '80s	mid-'80s	early '90s	mid-'90s
Primary	0.86	0.77	0.70	0.60
Manufacturing	15.58	15.05	14.68	12.49
Public Utilities	0.72	0.59	0.65	0.58
Construction	6.53	5.83	6.25	5.23
Business services	71.09	72.47	71.89	73.23
Non market services	5.22	5.29	5.82	7.86
Total	100.0	100.0	100.0	100.0

(b) Share of business sector services in subsystems (percentage values)

Subsystem	early '80s	mid-'80s	early '90s	mid-'90s
Primary	17.52	18.36	19.95	23.43
Manufacturing	21.54	22.01	24.21	26.60
Public Utilities	15.10	12.49	16.70	17.80
Construction	22.17	23.33	25.53	27.03
Business services	87.84	87.96	90.14	90.83
Non market services	10.28	10.84	11.86	15.47

Source: World Economic Outlook Database and OECD I-O Database.

within the individual countries of our OECD7.[13]

In conclusion, producer services might have produced some differences in the patterns of change between the manufacturing sector and the correspondent subsystem, but the tendency toward the decline of manufactured goods production seems to be more fundamental. In other words, its observed decrease would have been surely greater without the increased integration of business sector services, but the latter was not sufficient to counteract its decline.

5.3 Is it manufacturing simply more integrated at the subsystem level?

A different "impure" account of the observed deindustrialisation has to do, as we have seen in Section 2, with the structural change implications of the diffusion of ICTs. Also in this case, an actual deindustrialisation hypothesis is questioned, but this time contrasted with the changing nature of manufacturing, increasingly more representing the hardware for the software

[13]For the US, for example, this is traceable also with respect to the middle '90s. The relative tables have been omitted because of scope constraints, but are available from the authors at request.

Table 7: Manufacturing integration in the production system in the OECD7 (hours worked)

(a) Manufacturing employment in subsystems (absolute values)

Subsystem	early '80s	mid-'80s	early '90s	mid-'90s
Primary	795,797	779,164	667,844	541,867
		(-16,633)	(-111,320)	(-125,977)
Manufacturing	81,971,395	81,945,607	80,672,788	71,757,410
		(-25,788)	(-1,272,818)	(-8,915,378)
Public Utilities	498,204	401,015	409,070	359,813
		(-97,189)	(8,055)	(-49,257)
Construction	10,507,969	9,596,263	10,138,078	9,846,569
		(-911,706)	(541,815)	(-291,509)
Business services	7,446,497	7,327,251	7,699,889	8,862,190
		(-119,245)	(372,638)	(1,162,301)
Non market services	4,959,887	4,679,328	4,864,715	5,870,781
		(-280,559)	(185,386)	(1,006,067)

(b) Manufacturing sectors integration into subsystems (percentage values)

Subsystem	early '80s	mid-'80s	early '90s	mid-'90s
Primary	0.7	0.7	0.6	0.6
Manufacturing	77.2	78.2	77.2	73.8
Public Utilities	0.5	0.4	0.4	0.4
Construction	9.9	9.2	9.7	10.1
Business services	7.0	7.0	7.4	9.1
Non market services	4.7	4.5	4.7	6.0
Total	100.0	100.0	100.0	100.0

(c) Share of manufacturing employment in subsystems (percentage values)

Subsystem	early '80s	mid-'80s	early '90s	mid-'90s
Primary	5.7	6.2	5.7	5.4
Manufacturing	60.2	60.2	60.8	59.9
Public Utilities	10.6	9.3	8.8	7.9
Construction	17.8	16.8	16.4	16.1
Business services	5.0	4.4	4.4	4.6
Non market services	4.6	4.2	3.7	3.9

Source: OECD I-O Database and 60-Industries GGDC Database.

Table 8: Manufacturing integration in the production system in the OECD7 (value added, PPP weights)

(a) Manufacturing sectors integration into subsystems (percentage values)

Subsystem	early '80s	mid-'80s	early '90s	mid-'90s
Primary	0.89	0.86	0.76	0.64
Manufacturing	77.16	78.32	77.69	74.70
Public Utilities	0.54	0.50	0.47	0.40
Construction	9.12	8.61	8.71	8.50
Business services	7.35	7.17	7.59	9.54
Non market services	4.94	4.54	4.78	6.23
Total	100.0	100.0	100.0	100.0

(b) Share of manufacturing in subsystems (percentage values)

Subsystem	early '80s	mid-'80s	early '90s	mid-'90s
Primary	11.03	10.81	10.81	9.92
Manufacturing	62.82	62.83	63.97	64.00
Public Utilities	6.42	5.52	5.76	4.78
Construction	17.98	18.33	17.34	17.51
Business services	5.31	4.72	4.62	4.58
Non market services	5.53	4.99	4.61	5.03

Source: World Economic Outlook Database and OECD I-O Database.

of immaterial services ICTs largely stand for. Given that this last wave of technological progress has produced an intensive use of manufactured goods for the provision of services (both market and non market ones), one might be entitled to expect, *ceteris paribus*, an increase of the share manufacturing sectors account for in the other subsystems, and in the service subsystem in particular, both in terms of labour and value added.[14]

Such an expectation is however not confirmed by our OECD7. On the contrary, the percentage share manufacturing accounts for of the market and non-market services subsystems has in general decreased along the '80s and the middle '90s, both in terms of hours worked (Table 7(c)) and value-

[14]It should be noted that, given that manufactured goods related to ICT are mainly durable goods, and that input-output data do not include depreciation of fixed capital goods among intersectoral flows, the reference to the subsystem level could underestimate the actual integration of manufacturing in services, as well as the overall share of the manufacturing subsystem. However, it is also true that, following SNA93, in most of the countries included in our sample, also software related expenditures are included as investments. Thus, as long as the depreciation of capital goods is not taken into account, the integration of establishments providing such services in manufacturing is underestimated too. Which is the more undervalued subsystem between the two is not so obvious. However, as the percentage of the total cost due to software has progressively increased with respect to the hardware in the last fifty years, that business service subsystem has been underestimated even more than the manufacturing one could be at least suggested.

added (Table 8(b)). The decrease over the retained period has been not negligible, amounting for the overall service subsystem to 1.17 percentage points in terms of hours worked and 1.22 points in terms of value added. Quite interestingly, this decrease has occurred in the presence of an actual increase in the integration of manufacturing in the service subsystems, as the ICT hypothesis would suggest. This increase was quite consistent in the first half of the 1990s: indeed, from the early to the middle '90s, the percentage of produced manufactured goods entering, directly and indirectly, into the provision of services, both market and non-market, increased by 3 percentage points in terms of hours worked, and 3.4 points in terms of value added (Tables 7(b) and 8(a)).[15] As a consequence of this increased integration, in the middle '90s these shares were, respectively, 15.1% (Table 7(b)) and 15.77% (Table 8(a)), amounting to, respectively, 2.73% of the total hours worked and 1.97% of the total value added in the OECD7. Still, as we have said, an actual deindustrialisation should have occurred too, given that, although in the presence of such an increased intregration, the service based subsystems saw a decrease in the weight manufacturing has in them.

In conclusion, although the diffusion of ICTs, along with other causes, determined an expected increased integration of manufacturing in services, and this integration might have had important consequences for the productivity growth of the latter, notwithstanding, its impact in terms of labour and value added was not so high to contrast an actual deindustrialisation process.

5.4 What about international trade?

A last "impure" account of the observed deindustrialisation of the OECD7 could be found in the change occurred in the sectoral composition of the trade-flows with respect to the correspondent economies. One might claim that, going further the internal production flows retained by input-output tables, the decline in the weight of internal manufacturing could have been counteracted by an increase in the imports of foreign manufactured goods in the OECD7, especially in the light of their increasing resort to offshoring practices (Spencer, 2005).

The analysis of the trade balance of manufactured goods as a percentage of country GDP for the OECD7 countries, still obtained by using PPP weights, does not support this interpretation either. Indeed, in the OECD7

[15] It should be observed that the increase of manufacturing integration in business sector services over the period was particularly marked in the USA: the country of the ICT revolution. Indeed, from the early '80s to the middle '90s, the share accounted by the market service subsystem in the manufacturing sector in terms of hours worked changed from 7.59%, a value already above the OECD7 average (7.02%), up to 11.35%, while the correspondent value for the OECD7 is 9.11% (Table 7(b)), and this is also reflected in terms of value added. The tables for the US are not reported but available from the authors at request.

the trade balance of manufactured goods over the retained period was almost always positive and, although a certain worsening can be detected, its impact could be retained to have been limited (Figure 2): in the relevant period, the average trade balance was not higher than 0.38% of GDP, spanning from a maximum of 0.36%, in 1981, to a minimum of -0.02%, in 1988.[16] More precisely, if a negative trade balance of manufactured goods can be observed with respect to the US, the positive one of Germany and Japan seem to counterbalance it nearly completely, thus supporting our suggestion of a quite integrated OECD area.

At first sight, therefore, also the recent changes occurred in the trade flows and patterns of the investigated OECD countries are not able to contrast what is emerging as an important result of the paper. Summing up, as far as the production of manufactured goods is concerned, it seems reasonable to conclude that, although these production processes remain undoubtedly crucial in economic systems, their decline in terms of contribution to labour employment and value creation is quite evident. Thus, deindustrialisation might be regarded as a general tendency characterizing modern economies.

5.5 The other side of the coin: tertiarisation

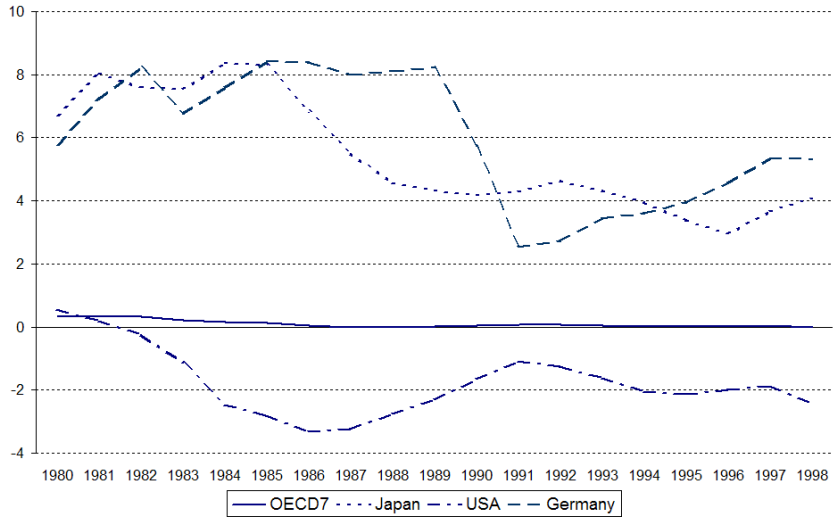
As far as the other side of the deindustrialisation coin is concerned, that is *tertiarisation*, in the OECD7 the share of services, as a whole, increased at a higher rate at the subsystem than at the sectoral level, both in terms of hours worked (9.34 vs. 8) and value added (10.44 vs. 8.94) (Tables 3 and 4). As revealed by the relative share in the correspondent subsystems, this was mainly due to the increased integration of business services in both market and non market services (Tables 5 and 6).

Remarkable is the significant increase of the share of business sector services in the non market service subsystem from the early to the middle '90s, both in terms of hours worked (3.22 percentage points) and value added (3.61 percentage points) (Tables 5(c) and 6(b)). As we have already noticed, this is probably due to the increasing diffusion of contracting-out in the public sector occurred in this period.[17]

More in general, the interplay between market and non market services entailed by outsourcing practices has increased the "sensitivity" of input-

[16] This conclusion is consistent with Rowthorn and Ramaswamy (1997). Unlike their study, we do not control for the impact of North-South trade on deindustrialisation, that is, for the possibility that imports from less developed countries could be more labour intensive than exports of more developed ones (Wood, 1994). However, it is worthwhile noting that, although Rowthorn and Ramaswamy (1997) do not find evidence of such an impact, their analysis is carried out at the sectoral level, and the outcome could be different at the subsystem level.

[17] In the case of the US, the pace of the integration increase is more stable and distributed all along the period. This seems to support the idea that contracting-out practices of public sector in the US have a longer history, going back at least to the early '80s.



Source: OECD STAN Database (2004) and World Economic Outlook Database (2005).

Figure 2: Trade balance of manufactured goods in OECD7 as a percentage of GDP (PPP weights)

output tables to intermediate inputs of services for the provision of public sector services. What was before a non-market service intended for intermediate uses, and thus recorded by input-output tables as final demand, is transformed by outsourcing into a business service, and thus registered as intermediate input. This seems also the cause of the observed high growth of the non-market service subsystem share with respect to the relative sectoral share, mainly in terms of value added. In the overall period, the subsystem share of non market services in the OECD7 increased by 4.78 percentage points in terms of hours worked and by 3.73 points in terms of value added, whereas the correspondent changes in the sectoral shares were, respectively, 2.2 and 0.64 points (Tables 3 and 4).

6 Conclusions

The main result this paper reaches is somehow at odds with what seems to have become the new "consensus" about the "impure" deindustrialisation of the learning economy.

The weight of manufacturing in the OECD(7) area actually decreased from the early '80s to the middle '90s, in the sense that less hours are worked and less value created in the production of manufactured goods than it used to be in the early '80s. Even after having controlled for a number of "impure" accounts of deindustrialisation, which tend to relegate it to

nothing but a different, possibly "lighter" industrialization era – namely, either intensive of producer services or complementary to ICT services in a software-hardware kind of relationship – "much" seems to remain unexplained of the weight reduction of the OECD7 manufacturing sector and, even more, of the manufacturing subsystem.

Although the appreciative nature of our application does not allow us to establish "how much" this "much" actually is, we feel to have enough elements to conclude that the DT hypothesis has not dead yet. Rather than a simple re-organization of the manufacturing subsystem – as Italy appeared to Momigliano and Siniscalco (1982a, 1986b,a) over the '70s and the '80s – the OECD7 appears to us a truly less material and more intangible global economy.

In parallel, this actual deindustrialisation appears accompanied by an as much actual tertiarisation, though of a special kind. Indeed, the role of services has increased mainly because, in the meantime, it has changed too. The increasing integration of business services in the non-market service subsystem is actually, also and above all, the result of the transformation recently occurred in the organization of production, both in the private and in the public sphere.

This is another extremely important result that the shift from a sectoral to a subsystem level and the overcoming of the limiting national perspective within which the analysis has been usually carried out at this level have allowed us to capture. Once more, the notable **B** operator turns out useful in detecting the actual extent of an economic phenomenon by retaining the complexity of the direct and indirect relationships of the economic systems in which it takes place: somehow paradoxically, although the conclusions they reached for Italy more than twenty years ago are here reversed, Momigliano and Siniscalco are still worthwhile reading!

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A Input-Output data coverage

Country	Input-Output Tables			
	early '80s	mid-'80s	early '90s	mid-'90s
Canada	1981	1986	1990	1997
Denmark	1980	1985	1990	1997
France	1980	1985	1990	1995
Germany	1986	1988	1990	1995
Japan	1980	1985	1990	1995
United Kingdom	1979	1984	1990	1998
United States	1982	1985	1990	1997