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Industrialisation as an engine of growth in developing countries, 1950–2005

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ABSTRACT

This paper examines the emergence of manufacturing in developing countries in the period 1950–2005. It presents new data on structural change in a sample of 67 developing countries and 21 advanced economies. The paper examines the theoretical and empirical evidence for the proposition that industrialisation acts as an engine of growth in developing countries and attempts to quantify different aspects of this debate. The statistical evidence is not completely straightforward. Manufacturing has been important for growth in developing countries, but not all expectations of the 'engine of growth hypothesis' are borne out by the data. The more general historical evidence provides more support for the industrialisation thesis.

1. Introduction

Major technological breakthroughs in textile production and the application of steam power to production in Great Britain in the second half of the eighteenth century made a deep impression on contemporary and later observers. In the nineteenth century the term industrial revolution was coined to describe these developments in retrospect.

In many respects the term industrial revolution is misleading. It disregards the incremental nature of increases in productive capacity, the continuity with earlier developments in Northwest Europe in particular in the Low Countries and the importance of developments in other sectors of the economy. Also, the acceleration of British productivity growth only started in the early nineteenth century, rather than in the eighteenth century as widely perceived (Crafts, 1983; Maddison, 1982, 2007). In other respects, industrial revolution remains an apt term. It captures the introduction of radically new production technologies which have fundamentally affected the nature of global production. The emergence of modern manufacturing has led to dramatic changes in the structure of the world economy and to sustained increases in the growth of labour productivity and economic welfare (Maddison, 2001, 2007).

Great Britain was the first industrialiser and it became the technological leader in the world economy. It was the exemplar for other countries. Manufacturing became the main engine of accelerating economic growth in the nine-

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teenth century. Manufacturing production technologies spread to other countries. A global race for industrialisation had begun.[1]

Industrialisation should be seen as a single global process of structural change, in which individual countries follow different paths depending on their initial conditions and moment of their entry into the race (Pollard, 1990). The first industrial followers were European countries such as Belgium, Switzerland and France (Bergier, 1983; Crafts, 1977; Pollard, 1990; von Tunzelman, 1995). In the nineteenth century, the United States followed a different path towards industrialisation based on primary exports, abundance of land and natural resources, and scarcity of labour. Famous latecomers to the process of industrialisation were Germany, Russia and Japan. As argued convincingly by Gerschenkron (1962), latecomers profit from the availability of modern technologies developed in the leading industrial economies, without bearing all the risks and costs involved in research and development. Gerschenkron reasoned that technological developments had increased the scale of industrial production. This required a larger scale of resource mobilisation than before. Therefore, late industrialisation either would not take place or would be very dynamic. If the conditions were right and economic growth took off in a late developing country, it would take the form of a growth spurt.

According to Gerschenkron, the role of government policy and large financial conglomerates was more important in late industrialisation than in early industrialisation. The self-financing of firms, characteristic of early industrialisation in Great Britain, was incapable of raising sufficient resources to match the required scale of investment. Governments and financial institutions took over this role. They invested directly in industries and transport infrastructure. They played a crucial role in the mobilisation of resources for investment and they were very active in education and technology acquisition.[2] Development-oriented governments set themselves the task of eliminating historical obstacles to industrialisation and challenging the economic, political and military dominance of the early industrialisers.

What about the developing countries? From the middle of the nineteenth century onwards, the world economy had divided into industrial economies and agricultural economies (Lewis, 1978a,b; Maddison, 2001, 2007). Colonies and non-colonised countries in the tropics remained predominantly agrarian, while the Western world and the Asian latecomer Japan industrialised. Industrial growth in the West created an increasing demand for primary products from developing countries. Technological advances in transport, infrastructure and communication expanded the opportunities for trade. Thus, the colonial division of labour came into being. Developing countries exported primary agricultural and mining products to the advanced economies. Industrial economies exported their finished manufactured goods to the developing countries. Industrialisation became synonymous with wealth, economic development, technological leadership, political power and international dominance. The very concept of development came to be associated with industrialisation. Industrialisation was rightly seen as the main engine of growth and development.

In developing countries, moves towards industrialisation were scarce and hesitant. Towards the end of the nineteenth century, one finds such beginnings in Latin American countries such as Brazil, Argentina, Chile and Mexico and large Asian countries such as India and China.[3] But developing countries still remained predominantly dependent on agriculture and mining. Lewis has argued that the shear profitability of primary exports was one of the main reasons for the specialisation of developing countries in primary production. But colonial policies also played a negative role (Batou, 1990). For instance, in India, textile manufacturing suffered severely from restrictive colonial policies which favoured production in Great Britain.

Whatever the reasons, the groundswell of global industrialisation, which started in Great Britain in the eighteenth century, swept through Europe and the USA and reached Japan and Russia by the end of the nineteenth century, subsided after 1900 (Pollard, 1990). With a few exceptions, developing countries were bypassed by industrialisation. The exceptions were countries such as Argentina, Brazil and South Africa which profited from the collapse of world trade in the crisis years of the 1930s to build up their own manufacturing industries, providing early examples of successful import substitution. In Asia, China and India experienced some degree of industrialisation in the late nineteenth century, but industrialisation only took off after these countries freed themselves from colonialism and external domination. On the whole, the developing world remained overwhelmingly oriented towards primary production.

This started to change in 1945. After a pause of 50 years developing countries rejoined the industrial race in the post-war period (e.g. Balance et al., 1982). Since World War II, manufacturing has emerged as a major activity in many developing countries and the shape and structure of global manufacturing production and trade have changed fundamentally. The colonial division of labour of the late nineteenth century has been stood on its head. Large parts of manufacturing have relocated to developing countries which supply industrial exports to the rich countries. Some developing countries have experienced a process of rapid catch-up which was invariably tied up with successful late industrialisation (Szirmai, 2008). It should be noted that

[1] The term industrialisation is somewhat ambiguous. In the ISIC classifications, the industrial sector includes not only manufacturing but also mining, construction and utilities. However, the term 'industrialisation' usually refers to the expansion of the manufacturing sector. It is in this latter sense that it is used in this paper.

[2] With the wave of mergers of the eighties and nineties, the role of government in mobilisation of resources has become less important again. The resources of the mega-multinational companies dwarf those of many of the smaller national states and they are able to mobilise financial resources for very large investment projects, without any public support.

[3] Around 1750, the Indian textile industry was producing around one quarter of global textile output (e.g. Roy, 2004). However, the basis of production was more artisanal than industrial.

Table 1
Catch-up since 1820.

Country	Period[a]	Growth of GDP	Growth of GDP per capita	Rate of catch-up[b]
1820–1913				
USA	1820–1905	4.1	1.5	1.3
Germany	1880–1913	3.1	1.9	1.8
Russia	1900–1913	3.2	1.4	2.0
Japan	1870–1913	2.5	1.5	1.5
United Kingdom	1820–1913	2.0	1.1	
World average	1820–1913	1.5	0.9	
1950–2003				
China	1978–2006	8.1	6.9	3.6
West Germany	1950–1973	6.0	5.0	2.7
India	1994–2006	6.7	5.1	2.4
Indonesia	1967–1997	6.8	4.8	2.4
Ireland	1995–2006	6.2	6.2	2.8
Japan	1946–1973	9.3	8.0	3.6
Korea	1952–1997	8.2	6.3	3.0
Malaysia	1968–1997	7.5	5.1	2.6
Russia	1998–2005	7.2	7.2	3.9
Singapore	1960–1973	10.0	7.6	2.5
Taiwan	1962–1973	11.4	8.7	2.8
Thailand	1973–1996	7.6	5.8	3.2
Vietnam	1992–2005	7.6	6.1	2.9
World average	1950–1973	4.9	2.9	
World average	1973–1997	3.1	1.4	
World average	1997–2003	3.5	2.3	

Sources: Country data 1990 and before, plus figures for world total from Maddison, *Historical Statistics, World Population, GDP and Per Capita GDP, 1-2006* AD (update: July 2009) http://www.ggdc.net/maddison/. Country data 1991–2006 and West Germany from: *The Conference Board and Groningen Growth and Development Centre, Total Economy Database*, November 2007, http://www.conference-board.org/economics.West Germany from Conference Board/GGDC.

[a] The periods have been chosen so as to maximise sustained high growth rates over an extended period.

[b] Ratio of Growth of GDP per capita compared to growth in lead economy in corresponding period. Prior to 1913, the comparison is with the UK, after 1950 with the USA.

an important role for manufacturing in the process of economic development does not mean that the role of other sectors is unimportant. In development economics, *balanced growth path theory* has emphasised that a dynamic agricultural sector is crucial to successful industrialisation. Financial and transport services also provide key inputs to industrial development (Szirmai, 2005).

Table 1 summarises catch-up experiences since the nineteenth century. Very rapid growth is the norm in catch-up economies since 1950.

Per capita growth rates of GDP in the catch-up economies vary from 5 to 9 per cent per year. GDP growth varies from 6 to 11.5 per cent. All examples of catch-up are associated with the widespread and rapid emergence of manufacturing. Industrialisation appears to be a key driver of catch-up.

One of the most interesting results in Table 1 is the way catch-up has accelerated since the nineteenth century, due to increased globalisation, greater possibilities for international technology transfer and increasing advantages of backwardness. In the nineteenth century, GDP per capita in the catch-up countries was growing at between 1.4 and 1.9 per cent per year, compared to the 5–9 per cent after 1950. The ratio of per capita GDP growth to that of the United Kingdom in the corresponding years prior to 1913 was between 1.3 and 2. After 1950, the catch-up countries were growing on average three times as fast as the world leader the USA.

2. Structural change and the emergence of manufacturing

The following tables document the process of structural change in developing countries in the period 1950–2005. Table 2 presents shares of agriculture, industry, manufacturing and services for a sample of 29 larger developing countries. In 1950, 41 per cent of developing country GDP originated in the agricultural sector. It declined dramatically to 16 per cent in 2005. It is worth noting that the average share of services in developing countries was already 40 per cent in 1950, far higher than the average share of industry. Thus, the pattern of structural change in developing countries differs radically from the traditional patterns of structural change, in which the rise of industry precedes that of the service sector.

In 1950, the share of manufacturing was only 11 per cent of GDP compared to 31 per cent in the advanced economies. This is low in comparative perspective, but higher than one would expect for countries that are just embarking on a process of industrialisation.[4] The only countries which really had negligible shares of manufacturing were Tanzania, Zambia and Nigeria and Sri Lanka. Latin America is by far the most industrialised region in 1950.

The average share of manufacturing increased in all countries between 1950 and 1980, peaking at around 20 per cent in the early eighties. Between 1980 and 2005, the share of manufacturing continued to increase in many Asian economies, but there were processes of deindustrialisation in Latin America and Africa. This was most marked in Latin American countries where the share of manufacturing declined from 24 to 18 per cent on average. In the advanced economies, the share of manufacturing declined substantially from 31 per cent in 1945 to 17 per cent in 2005. The most important sector in 2005 is the service sector, accounting for around 70 per cent of GDP, up from 43 per cent in 1950.

In comparative perspective we observe a narrowing of the gap between developing countries and advanced economies. There was a long-run contraction in the shares of manufacturing in the advanced economies, while there was a modest long-term increase in the shares of manufacturing in developing countries, especially till around 1980. By 2005, the average share of manufacturing in the developing world is somewhat higher than in the advanced economies.

[4] It is possible that the early national accounts for developing countries focus on the formal sector and thus will exaggerate the share of manufacturing. They tend to underestimate informal activities and the agricultural sectors, even though several of the national accounts present estimates of the non-monetary sectors.

Table 2
Structure of production, 1950–2005 (gross value added in agriculture, industry and services as percentage of GDP at current prices, 29 developing countries).

	1950[a]				1960[b]				1980				2005[c]			
	AG	IND	MAN	SERV	AG	IND	MAN	SERV	AG	IND	MAN	SERV	AG	IND	MAN	SERV
Bangladesh[d]	61	7	7	32	57	7	5	36	32	21	14	48	20	27	17	53
China	51	21	14	29	39	32	27	29	30	49	40	21	13	48	34	40
India	55	14	10	31	43	20	14	38	36	25	17	40	18	28	16	54
Indonesia	58	9	7	33	51	15	9	33	24	42	13	34	13	47	28	40
Malaysia	40	19	11	41	35	20	8	46	23	41	22	36	8	50	30	42
Pakistan	61	7	7	32	46	16	12	38	30	25	16	46	21	27	19	51
Philippines	42	17	8	41	26	28	20	47	25	39	26	36	14	32	23	54
South Korea	47	13	9	41	35	16	10	48	16	37	24	47	3	40	28	56
Sri Lanka	46	12	4	42	32	20	15	48	28	30	18	43	17	27	15	56
Taiwan	34	22	15	45	29	27	19	44	8	46	36	46	2	26	22	72
Thailand	48	15	12	37	36	19	13	45	23	29	22	48	10	44	35	46
Turkey	49	16	11	35	42	22	13	36	27	20	17	54	11	27	22	63
Argentina	16	33	23	52	17	39	32	44	6	41	29	52	9	36	23	55
Brazil	24	24	19	52	21	37	30	42	11	44	33	45	6	30	18	64
Chile	15	26	17	59	12	41	25	47	7	37	22	55	4	42	16	53
Colombia	35	17	13	48	32	23	16	46	20	32	24	48	12	34	16	53
Mexico	20	21	17	59	16	21	15	64	9	34	22	57	4	26	18	70
Peru	37	28	15	35	21	32	20	47	12	43	20	45	7	35	16	58
Venezuela	8	48	11	45	7	43	11	50	6	46	16	49	4	55	18	40
Congo, Dem. Rep.	31	34	9	35					27	35	15	38	46	27	7	28
Cote d'Ivoire	48	13		39	48	13		39	26	20	13	54	23	26	19	51
Egypt	44	12	8	44	30	24	14	46	18	37	12	45	15	36	17	49
Ghana	41	10		49	41	10		49	58	12	8	30	37	25	9	37
Kenya	44	17	11	39	38	18	9	44	33	21	13	47	27	19	12	54
Morocco	37	30	15	33	32	26	13	42	18	31	17	50	13	29	17	58
Nigeria	68	10	2	22	64	8	4	28	21	46	8	34	23	57	4	20
South Africa	19	35	16	47	11	38	20	51	6	48	22	45	3	31	19	67
Tanzania	62	9	3	20	61	9	4	30			12		46	17	7	37
Zambia	9	71	3	19	12	67	4	21	15	42	19	43	23	30	11	47
Averages																
Asia	49	14	10	36	39	20	14	41	25	33	22	42	13	35	24	52
Latin America	22	28	16	50	18	34	21	48	10	40	24	50	7	37	18	56
Africa	44	19	9	36	37	24	10	39	25	32	14	43	26	30	12	45
Developing countries	41	19	11	40	33	25	15	42	21	35	20	44	16	34	18	51
16 advanced economies[e]	15	42	31	43	10	42	30	48	4	36	24	59	2	28	17	70

Sources: See detailed discussion of sources in Szirmai (2009). The primary sources used are: UN, *Yearbook of National Accounts Statistics, 1957, 1962 and 1967*; Groningen Growth and Development Centre, *10 Sector Database*, 2009, http://www.ggdc.net/index-dseries.html; World Bank, WDI online, accessed February 2009; World Bank, World Tables, 1980; Advanced economies, 1950, unless otherwise specified from OECD, *National Accounts*, microfiche edition, 1971, Japan 1953 from GGDC ten sector data base.

[a] Earliest year for which data are available: 1950, except for Morocco, Taiwan and Thailand, 1951; China and Tanzania, 1952; South Korea, 1953; Malaysia and Zambia, 1955; Ghana, Ivory Coast, 1960. Belgium, 1953, West Germany, Italy and Norway, 1951, Japan, 1952.

[b] China, 1962, proportions for 1960 not representative due to collapse of agriculture in great leap forward 58–60; Morocco, 1965, manufacturing share Tanzania, 1961.

[c] Canada 2003 instead of 2005; Venezuela 2004.

[d] Bangladesh 1950–1959, same data as Pakistan.

[e] Australia, Austria, Belgium, Canada, Denmark, Finland, France, (West) Germany, Italy, Japan, The Netherlands, Norway, Sweden, Switzerland, UK, USA.

Table 3 presents average shares of manufacturing for a much larger sample of 67 developing countries, including many smaller economies and a large sample of advanced economies. The country data are reproduced in Table A.1. Table 3 confirms the patterns of Table 2, though the average peak value for the share of manufacturing in 1980 is somewhat lower than that shown in Table 2.

3. Why is manufacturing considered to be an engine of growth?

There are powerful empirical and theoretical arguments in favour of industrialisation as the main engine of growth in economic development. The arguments in the literature can be summarised as follows:

Table 3
Shares of manufacturing in GDP in 63 developing countries, 1950–2005 (at current prices).

	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Average 20 Asian countries	8.9	11.2	12.5	13.8	16.8	18.2	20.5	20.1	19.9	19.0	18.7	20.1
Average 25 Latin America countries	14.7	15.2	16.6	18.4	19.2	20.1	19.9	19.6	18.7	17.0	16.4	15.4
Average 22 African countries	11.0	8.4	9.0	9.7	10.4	11.5	11.5	12.0	13.3	12.1	11.8	11.1
Average 67 Developing countries	11.9	12.2	13.0	14.2	15.4	16.6	17.1	17.1	17.1	16.0	15.6	15.4
Average 21 advanced economies	29.6	28.6	30.4	30.5	23.3	19.6	18.3	17.5	17.7	16.8	16.2	13.3

Source: see Table 2.

1. There is an *empirical correlation* between the degree of industrialisation and per capita income in developing countries.
2. Productivity is higher in the manufacturing sector than in the agricultural sector. The transfer of resources from agriculture to manufacturing provides a *structural change bonus*. A dynamic version of the structural change bonus argument is that manufacturing has higher rates of productivity growth than other sectors.
3. The transfer of resources from manufacturing to services provides a *structural change burden* in the form of Baumol's disease. As the share of the service sector increases, aggregate per capita growth will tend to slow down.
4. Compared to agriculture, the manufacturing sector offers special *opportunities for capital accumulation*. Capital accumulation can be more easily realised in spatially concentrated manufacturing than in spatially dispersed agriculture. This is one of the reasons why the emergence of manufacturing has been so important in growth and development. Capital intensity is high in mining, manufacturing, utilities and transport. It is much lower in agriculture and services. Capital accumulation is one of the aggregate sources of growth. Thus, an increasing share of manufacturing will contribute to aggregate growth.
5. The manufacturing sector offers special opportunities for *economies of scale*, which are less available in agriculture or services.
6. The manufacturing sector offers special opportunities for both *embodied and disembodied technological progress* (Cornwall, 1977). Technological advance originates in the manufacturing sector and diffuses from there to other economic sectors such as the service sector.
7. *Linkage and spillover effects* are stronger in manufacturing than in agriculture or mining. Linkage effects refer to the direct backward and forward linkages between different sectors. Linkage effects create positive externalities to investments in given sectors. Spillover effects refer to the disembodied knowledge flows between sectors. Spillover effects are a special case of externalities which refer to externalities of investment in knowledge and technology. Linkage and spillover effects are presumed to be stronger within manufacturing than within other sectors. Linkage and spillover effects between manufacturing and other sectors such as services or agriculture are also very powerful.
8. As per capita incomes rise, the share of agricultural expenditures in total expenditures declines and the share of expenditures on manufactured goods increases (*Engel's law)*. Countries specialising in agricultural and primary production will not profit from expanding world markets for manufacturing goods.

There is a hierarchy between these arguments. The arguments mentioned under points 4, 5 and 6 point to the specific characteristics, which supposedly make manufacturing a more productive and dynamic sector. If manufacturing is more productive than other sectors, an increase in the share of manufacturing in GDP will result in more rapid aggregate growth of the economy (points 2 and 3). The effects of manufacturing on aggregate growth go beyond reallocation effects. There are a variety of positive externalities of manufacturing which result in positive contributions of the growth of manufacturing on the growth of the total economy (point 7). Point 8 shifts the discussion from supply to demand effects and hypothesizes that growth of manufacturing and demand elasticities reinforce each other. The arguments under points 2–8 result in the empirical proposition 1 that there is an empirical relationship between industrialisation and the level of development.

These arguments are frequently mentioned in the literature and are often considered self-evident, though the recent literature increasingly questions whether manufacturing will continue to be the engine of growth and points to the increasing importance of service led growth. In this paper we examine the empirical support for some of these arguments for the post-war period.

4. Examination of the arguments

In this section, we provide a further elaboration of the theoretical debate on the role of manufacturing in economic development introduced in section three. We examine some of the empirical evidence for the different hypotheses, using a mix of secondary literature and secondary data.

4.1. Empirical correlations between industrialisation and economic development

The historical evidence points to the overall correlation between industrialisation and the level of economic development. The advanced economies are the countries that first embarked on industrialisation, when the developing countries were still oriented towards primary production. Also, the more successful developing countries are invariably those that have been able to industrialise. The historical record provides strong support for this correlation.

Statistically the correlation is less easy to demonstrate, because the advanced economies have now become service economies, where service sectors account for over two thirds of GDP. Also, the sequence of structural change in developing economies is different from the earlier patterns of structural change in the presently advanced economies. In the earlier pattern of structural change, the shares of manufacturing in GDP and employment increased first, the shares of services increased later. In developing countries the share of services in GDP was usually already larger than that of the industrial sector in the 1950s and 1960s (see Table 2 above, and Szirmai, 2005).

Contributions of manufacturing to growth can be measured in different ways: using growth accounting techniques and econometric analysis (Bosworth et al., 1995; Fagerberg and Verspagen, 1999, 2002, 2007; Timmer and de Vries, 2009). Growth accounting techniques analyse what proportion of a given growth rate of national income derives from growth of manufacturing. These techniques are straightforward and transparent. But they do tend to underestimate the contributions of dynamic sectors, because they do not take various external effects and

spillovers into account. The role of manufacturing in nurturing technological advance and enhancing spillovers may make the net contribution of manufacturing to aggregate growth greater than found measuring direct sectoral contributions to growth. Such spillover effects are better captured with econometric techniques.

The evidence in the secondary literature is mixed. The older literature tends to emphasise the importance of manufacturing, the more recent literature finds that the contribution of service sector has increased. Also, in the more recent literature one finds that manufacturing tends to be more important as an engine of growth in developing countries than in advanced economies and also more important in the period 1950–1973 than in the period after 1973.

Fagerberg and Verspagen (1999) regress real growth rates on growth rates of manufacturing. If the coefficient of manufacturing growth is higher than the share of manufacturing in GDP, this is interpreted as supporting the engine of growth hypothesis. Fagerberg and Verspagen find that manufacturing was typically an engine of growth in developing countries in East Asia and Latin America, but that there was no significant effect of manufacturing in the advanced economies. In the second article by the same authors (Fagerberg and Verspagen, 2002), they examine the impact of shares of manufacturing and services on growth in three periods: 1966–1972, 1973–1983 and 1984–1995 and for a sample of 76 countries. They find that manufacturing has much more positive contributions to growth before 1973 than after. The interpretation in both papers is that the period 1950–1973 offered special opportunities for catch-up through the absorption of mass production manufacturing techniques from the USA. After 1973, ICT technologies started to become more important as a source of productivity growth, especially in the nineties. These technologies are no longer within the exclusive domain of manufacturing, but also operate in the service sector.

A recent article by Timmer and de Vries (2009) also confirms the increasing importance of the service sector. Using growth accounting techniques, they examine the contributions of different sectors in periods of growth accelerations, in periods of normal growth and in periods of deceleration. In periods of normal growth they find that manufacturing contributes most to growth. In periods of acceleration, this leading role is taken over by the service sector, though manufacturing continues to have an important positive contribution.

For India, Chakravarty and Mitra (2009) conclude on the basis of VAR analysis that manufacturing is still one of the important drivers of growth, though more and more activities are becoming independent of the manufacturing sector. Katuria and Raj (2009) focus on regional differences in growth in India. They analyse the relationship between manufacturing growth and output growth in Indian states (including the informal sector) and find support for the engine of growth hypothesis and conclude that manufacturing is still functioning as an engine of growth, even in India with its important and dynamic ICT service sectors.

Rodrik (2009) finds that rapid growth in developing countries since 1960 is strongly associated with structural change, the transfer of resources from traditional sectors to more modern industrial sectors. He explicitly concludes that transition to modern industrial activities acts as an engine of growth. But he is rather vague about what he means by 'modern' activities. They also include non-traditional primary activities such as horticulture in Ethiopia.

Recent research by Szirmai and Verspagen (2010) finds highly significant relationships between the shares of manufacturing in GDP at the beginning of 5-year periods and average growth rates in 5-year periods, for a panel dataset of 90 countries for the period 1950–2005.

In Table 4 of this paper, we have tried to capture the empirical relationship between industrialisation and development by focusing on the share of manufacturing in total commodity production (i.e. agriculture, mining, manufacturing, construction and utilities) rather than in total GDP (see for a similar approach Balance et al., 1982, pp. 110 ff.). The share of manufacturing in commodity value added is set out against a country's per capita gross national income in 2000. We find a highly significant positive correlation of 0.74 between a country's rank in terms of the logarithm of income per capita and its rank in terms of share of manufacturing in commodity production.

Services are excluded from this table. Thus it cannot tell us whether manufacturing-led growth is more important than service-led growth. What we do learn is that the structure of commodity production is related to levels of per capita income and that manufacturing matters in this context.

In line with the argument in the previous section about different patterns of structural change and different initial conditions, the correlation is not a perfect one. Major exceptions among the advanced economies are primary exporters such as Norway, Canada and Australia. Among the developing countries, Taiwan, Thailand and Brazil rank higher in terms of industrialisation than in terms of income. Nevertheless, the table illustrates the general point about industrialisation. The poorest countries in the table are invariably those with the lowest shares of manufacturing and the highest shares of agriculture in commodity production. The more prosperous countries are the more industrialised ones.

4.2. Structural change bonus

A second argument in favour of industrialisation states that labour productivity in agriculture is much lower than labour productivity in industry. A transfer of labour from low productivity agriculture to high productivity industry results in an immediate increase in overall productivity and income per capita. This transfer has been a major source of growth in developing countries. It is referred to as the structural change bonus (Ark et al., 2003; Chenery et al., 1986; Fagerberg and Verspagen, 1999; Fei and Ranis, 1964; Lewis, 1954; Rodrik, 2009; Temple and Woessmann, 2006; Timmer and Szirmai, 2000; Timmer and de Vries, 2009).

Table 5 presents data on value added per worker for a selected number of developing countries in Asia and Latin America for which data are available for the whole post-war period. It is immediately clear from this table that value added per worker is much higher in manufacturing

Table 4
Industrialisation and Per Capita Gross National Product in 2000 (45 countries).

	Share of manufacturing in total commodity production[a]		GNP per capita (2000 US$)	
	(%)[b]	Ranking		Ranking
Switzerland	72	2	38,140	1
Japan	64	11	35,620	2
Norway	26	40	34,530	3
U.S.A.	63	14	34,100	4
Denmark	60	17	32,280	5
Sweden	66	9	27,140	6
Austria	60	16	25,220	7
Finland	66	8	25,130	8
Germany	72	3	25,120	9
Netherlands	58	18	24,970	10
Belgium	69	4	24,540	11
U.K.	60	15	24,430	12
France	65	10	24,090	13
Canada	56	20	21,130	14
Australia	45	25	20,240	15
Italy	66	7	20,160	16
Taiwan	77	1	14,188	17
South Korea	66	6	8910	18
Argentina	55	22	7460	19
Mexico	63	12	5070	20
Chile	36	32	4590	21
Venezuela	35	34	4310	22
Brazil	67	5	3580	23
Malaysia	58	19	3380	24
Turkey	36	30	3100	25
South Africa	55	21	3020	26
Peru	41	26	2080	27
Colombia	31	36	2020	28
Thailand	63	13	2000	29
Egypt	38	29	1490	30
Nigeria	38	28	1180	31
Philippines	48	24	1040	32
Sri Lanka	36	33	850	33
China	52	23	840	34
Côte d'Ivoire	36	31	600	35
Indonesia	41	27	570	36
India	31	38	450	37
Pakistan	31	37	440	38
Bangladesh	30	39	370	39
Kenya	34	35	350	40
Ghana	15	42	340	41
Zambia	25	41	300	42
Tanzania	12	43	270	43
Morocco	5	45	260	44
Congo, Dem. Rep.	6	44	100	45

Sources: GNP per capita and shares from World Bank, *World Development Indicators*, 2002, except: Zaire from World Bank (http://www.worldbank.org/data/countrydata/countrydata.html) Canada, Norway, Sweden, Switzerland, Canada and the USA: calculated with OECD, *Main Economic Indicators*, 2010 (http://www.oecd.org/EN/document/0,EN-document-7-nodirectorate-no-1-5194-7,00.html), UNIDO (2010), *Industrial Statistics*, Database, INDSTAT 2000 (http://www.unido.org/Regions.cfm?area=GLO) and UNIDO (2011), *Yearbook of Industrial Statistics 2000*.

[a] Value added in manufacturing as percentage of total value in commodity production (agriculture, forestry, fisheries, mining, manufacturing, construction and utilities).

[b] Manufacturing share advanced economies, latest year in period 1998–2000.

than in agriculture. This is in line with the structural bonus argument. There will be a positive static shift effect, when workers relocate to manufacturing.

It is also not surprising that labour productivity in the capital intensive mining sector is far higher than that in manufacturing. The results with regard to services are more puzzling. Between 1950 and 1970, labour productivity in the service sector in Latin American countries is much higher than in manufacturing. If this is not due to measurement error, this would suggest that transfer of resources to services would provide a higher static shift effect than to manufacturing, which is counterintuitive. From 1980 onwards, however, productivity in manufacturing is substantially higher than in services, which is more in line with our expectations.[5]

[5] The use of constant prices with a base year in the 1990s of course overestimates the share of services in value added relative value added in the early years, as manufacturing prices increase less than service prices. But a similar table with current values – not reproduced here – shows very similar patterns.

Table 5
Value added per worker in agriculture and manufacturing (at constant prices).

	1950						1960						1970					
	Ag	Min	Ind	Man	Services	Tot	Ag	Min	Ind	Man	Services	Tot	Ag	Min	Ind	Man	Services	Tot
India							77	344	162	120	155	100	67	350	192	140	179	100
Indonesia																		
Malaysia																		
Pakistan																		
Philippines																		
South Korea													49	153	125	88	167	100
Sri Lanka																		
Taiwan													40	294	119	111	147	100
Thailand							46	238	326	283	287	100	38	134	300	294	274	100
Turkey																		
Argentina	29	94	113	98	134	100	39	142	91	86	135	100	43	242	115	114	110	100
Bolivia	31	783	334	205	235	100	32	799	298	229	231	100	25	621	268	194	183	100
Brazil	26	111	180	165	220	100	22	173	204	196	179	100	19	269	169	180	170	100
Chile	28	183	125	78	139	100	21	162	147	127	125	100	19	229	151	127	114	100
Colombia	54	262	160	134	160	100	50	277	171	147	140	100	53	385	159	129	118	100
Costa Rica	46	31	144	149	187	100	36	30	127	141	189	100	41	40	131	157	149	100
Mexico	30	166	139	130	237	100	27	121	131	127	208	100	26	96	115	112	180	100
Peru							26	452	173	137	198	100	23	481	159	142	169	100
Venezuela	11	1649	332	78	80	100	12	1950	313	90	61	100	18	2691	270	105	63	100
Average Asia													48	233	184	158	192	100
Average Latin Am.	32	410	191	130	174	100	30	456	184	142	163	100	30	562	171	140	139	100

	1980						1990						2000					
	Ag	Min	Ind	Man	Services	Tot	Ag	Min	Ind	Man	Services	Tot	Ag	Min	Ind	Man	Services	Tot
India	57	555	222	158	206	100	50	458	221	175	190	100	41	446	169	142	219	100
Indonesia	42	2909	320	165	110	100	39	1253	243	193	119	100	40	1099	217	196	96	100
Malaysia	61	1013	169	120	97	100	64	1737	149	126	91	100	54	1981	123	115	98	100
Pakistan																		
Philippines	49	304	274	261	95	100	54	287	248	278	95	100	56	333	243	271	89	100
South Korea	41	172	131	113	130	100	48	160	132	115	95	100	57	427	181	192	69	100
Sri Lanka																		
Taiwan	36	258	98	96	135	100	31	398	92	95	126	100	27	392	88	96	118	100
Thailand	33	167	249	259	206	100	24	479	246	263	187	100	28	1110	220	243	122	100
Turkey																		
Argentina	46	327	112	115	105	100	67	480	123	127	96	100	76	700	166	161	85	100
Bolivia	32	312	198	181	133	100	40	438	236	229	112	100	49	462	155	170	108	100
Brazil	17	205	173	190	140	100	28	372	154	143	116	100	37	646	182	166	95	100
Chile	25	316	149	130	104	100	39	268	151	125	93	100	63	625	175	145	79	100
Colombia	55	137	169	162	107	100	61	329	165	138	98	100	67	401	165	143	93	100
Costa Rica	42	52	127	151	123	100	47	111	115	126	126	100	62	72	140	163	95	100
Mexico	26	153	106	104	145	100	32	179	105	107	131	100	37	322	110	120	113	100
Peru	18	362	180	169	144	100	31	384	167	145	118	100	32	689	224	173	111	100
Venezuela	36	1545	190	131	71	100	43	1393	201	155	71	100	38	1759	213	137	66	100
Average Asia	46	768	209	167	140	100	44	682	190	178	129	100	43	827	177	179	116	100
Average Latin Am.	33	379	156	148	119	100	43	439	157	144	107	100	51	631	170	153	94	100

Source: GGDC: ten sector database, downloaded February 2009.
Note: At constant prices. The base year varies per country, but all base years are in the mid-nineties.

A second aspect of the structural change bonus argument focuses on the dynamics of sectors. If productivity growth in manufacturing is more rapid than in other sectors, a transfer of resources to this sector will result in more rapid aggregate growth (This is referred to as the dynamic shift effect). Here the evidence is more mixed. In the richest countries of the world growth of labour productivity in agriculture in the post-war period has been higher than in industry – particularly due to biotechnological innovation (see Maddison, 1991, pp. 150–151). However, in developing countries since 1950, productivity growth in manufacturing has been more rapid than in the primary sector.

In Table 6, we present a comparison of growth rates in manufacturing and agriculture in a sample of developing countries (derived from the GGDC 10-sector database). These are compared with sectoral growth rates in advanced economies in the post-war period. This table provides some interesting findings which provide a more nuanced picture of the role of manufacturing in growth. Between 1950 and 1973, the growth rate of labour productivity in manufacturing is substantially higher than in agriculture and also higher than that in the total economy. This is even more pronounced if we look at growth of output (8.6% versus 3.9%). Manufacturing is clearly a very dynamic sector contributing to overall growth performance.

In 10 of the 14 developing countries, productivity growth in manufacturing is higher than in agriculture. In the case of value added, all countries show higher growth in manufacturing.

Table 6
Growth of output and productivity in agriculture and manufacturing, 1950–2005.

Country	1950–1973						1973–2005					
	Labour productivity			Value added			Labour productivity			Value added		
	Agric.	Manuf.	Total	Agric.	Manuf.	Total	Agric.	Manuf.	Total	Agric.	Manuf.	Total
Argentina	2.8	2.6	1.3	1.9	3.6	2.6	3.0	1.5	0.5	1.9	0.7	1.8
Bolivia	1.9	2.1	2.7	1.2	3.3	3.0	2.5	−1.3	−0.4	2.7	2.6	2.4
Brazil	2.1	4.9	4.1	3.8	8.8	7.5	3.9	0.2	0.9	3.4	2.4	3.2
Chile	0.1	4.0	2.0	0.4	6.3	3.6	5.7	2.5	1.5	5.7	2.9	4.1
Colombia	2.3	3.8	1.0	3.4	6.5	3.5	1.3	0.3	0.7	2.6	3.0	3.7
Costa Rica	3.6	3.9	3.5	5.0	8.7	7.0	1.8	1.0	0.5	2.8	4.7	4.1
India	0.4	3.7	1.9	2.3	5.4	3.5	0.9	3.0	2.9	2.7	6.1	5.3
Indonesia	2.1	1.6	3.7	3.1	6.8	5.9	2.3	4.9	2.9	3.1	9.2	5.4
Korea	3.1	7.3	4.6	3.8	15.9	6.1	4.8	8.4	4.9	1.6	11.2	7.3
Malaysia							3.8	3.5	3.8	2.6	9.0	6.7
Mexico	2.8	3.0	3.6	3.6	7.7	6.2	1.7	0.6	0.4	1.8	3.5	3.4
Peru	5.4	19.3	16.6	3.2	7.4	5.9	1.5	0.7	0.1	2.9	1.8	2.3
Philippines							1.0	0.3	0.6	2.5	2.8	3.4
Taiwan	10.9	11.1	12.4	12.2	22.2	17.2	7.6	6.9	8.8	4.3	9.1	11.0
Thailand	3.1	5.6	4.9	4.7	9.4	7.1	2.6	2.9	3.5	3.2	8.1	6.1
Venezuela	5.3	3.5	2.1	5.3	8.9	5.5	1.1	0.7	−1.2	2.1	2.1	1.7
Australia							3.4	2.5	1.6	2.8	1.3	3.2
Austria							3.5	3.6	2.2	1.1	2.4	2.4
Belgium							3.7	4.1	1.7	1.6	2.0	2.1
Czech Republic							7.1	5.0	2.5	1.4	4.7	2.1
Denmark							6.3	1.9	1.5	2.9	0.4	1.8
Finland							4.5	4.8	0.0	0.7	3.9	0.0
France							4.7	3.1	1.7	1.4	1.5	2.2
Germany							4.1	2.4	1.5	0.7	1.0	2.0
Greece							3.4	2.5	1.6	2.8	1.3	3.2
Hungary							10.8	7.7	4.0	1.6	5.5	2.9
Ireland							4.2	6.8	2.9	1.8	7.4	4.8
Italy							5.7	2.4	1.5	1.5	2.0	2.1
Japan	5.7	8.3	6.4	2.4	12.5	8.4	2.6	4.5	2.7	−0.6	3.6	3.1
Netherlands							3.7	3.1	1.2	3.3	2.1	2.5
Poland							1.4	7.2	4.0	1.7	5.0	3.6
Spain							6.0	1.9	1.4	2.5	2.1	2.7
Sweden							3.6	4.4	1.9	0.4	3.0	2.2
UK							2.9	2.9	1.6	1.2	0.3	2.0
USA							5.3	3.7	1.3	4.9	2.8	2.9
Average												
Developing Countries	3.3	5.4	4.6	3.9	8.6	6.1	2.8	2.3	1.9	2.9	5.0	4.5
Advanced Economies							4.6	3.9	1.9	1.8	2.8	2.5

Own calculations using data from: Advanced economies plus South Korea. 1973–2005: Groningen Growth and Development Centre, *EUKLEMS Database*, downloaded September 2008; Developing countries, 1950–2005, incl. South Korea, 1953–1973; Groningen Growth and Development Centre, *10 Sector Database*, downloaded February 2009.
Developing countries with data which do not cover the full period 1950–2005 include the following: Bolivia (lab. 50-03); India (lab. 60-04); Indonesia (lab. 61-05; VA. 60-05); Korea (lab. 63-05; VA. 53-05); Malaysia (lab. 75-05; VA. 70-05); Peru (lab. 60-05); Philippines (lab. 63-05; VA 51-05); Taiwan (lab. 63-05; VA 51-05); Thailand (lab. 60-05; VA 51-05).

After 1973, the picture becomes more complicated. Our sample of developing countries starts looking more like the advanced economies in that productivity growth in agriculture is systematically higher than in manufacturing. This is true for 12 out of the 16 countries for which we have the data in the dataset (see Table 7). However, in terms of value added the growth rate in manufacturing is still higher in most of the countries (10 out of 16).

Table 7
Comparison of growth rates in agriculture and manufacturing, 1950–2005 (number of countries).

	1950–1973			1973–2005		
	AG > MAN	MAN > AG	MAN = AG	AG > MAN	MAN > AG	MAN = AG
Developing countries						
Labour productivity growth	4	10	0	12	4	0
Value added growth	0	14	0	5	10	1
Advanced economies						
Labour productivity growth				11	7	1
Value added growth				7	13	0

Source: see footnotes to Table 6.
Note: The table lists the numbers of countries where growth in agriculture exceeds that in manufacturing and vice versa.

This is consistent with a shrinking share of agriculture in total value added. The same pattern can be seen in the sample of advanced economies. In terms of productivity per person engaged, the agricultural sector systematically outperforms the manufacturing sector and the total economy. A smaller fraction of the total labour force is producing more and more output per person in agriculture. The only real exceptions are the European catch-up economies Poland and Ireland, where productivity growth in manufacturing is much higher than in agriculture.

However, in terms of value added, growth in manufacturing and total economy is much higher than in agriculture. Agriculture's share in valued added has been systematically shrinking.

Summarising the information in Tables 6 and 7, we can say that in developing countries manufacturing is indeed one of the more dynamic sectors in terms of productivity and output growth, especially in the period 1950–1973. In the period 1973–2003, productivity growth in agriculture surpasses that of manufacturing, but manufacturing still dominates in terms of output growth.

4.3. Structural change burden

In many service sectors, the possibilities for productivity growth are limited due to the inherently labour intensive nature of service production. This implies that an increasing share of services results in a productivity slowdown (Baumol's law). Such service sectors include personal services, restaurants and hotels, health care and medical services and government. What productivity improvement there is, often takes the place of reducing quality of output or simply providing less services for the same price, so it should not show up in productivity indices if these were correctly measured using hedonic price indices.

Baumol's law has recently come under fire, because there are some very important market service sectors such as the financial sector, software, retail sales and distribution where there are major productivity improvements, often based on ICT technologies.

Nevertheless, the working hypothesis remains that a country with a larger service sector will tend to grow at a slower rate than a country with a smaller service sector. As advanced economies are predominantly service economies, this creates new possibilities for catch-up in developing countries where the industrial and the manufacturing sector have a proportionately larger share in output.

On the other hand, developing countries are characterised by a very large share of the service sector at early stages of development. They did not follow the traditional linear sequence of a shift from agriculture to manufacturing, followed by a shift from manufacturing to services. As much of the large service sector in developing countries is accounted for by a large, inefficient and unproductive government sector, developing countries suffer from a structural change burden at early stages of development. Other parts of the service sector consist of activities of 'survival entrepreneurs' in the informal sector, which are also not very productive or dynamic.

Unfortunately, it is hard to test this hypothesis using regression analysis, because of endogeneity issues. Rich countries have larger service sectors because the demand for services increases at higher levels of income. So, even if the service sector acts as a brake on productivity growth, service sector shares will not be negatively correlated with per capita income levels.[6]

4.4. Opportunities for capital accumulation

The reasons for high labour productivity and rapid labour productivity growth in manufacturing are manifold. Important reasons included capital accumulation, economies of scale and technological progress. Spatially concentrated activities such as manufacturing offer better possibilities for capital accumulation and capital intensification than spatially dispersed agriculture. The most capital intensive sectors in the economy are manufacturing, mining, construction and utilities.

Internationally comparable data on capital stocks are scarce, especially for developing countries. In Table 8, we have put together data for a selected number of developing countries from a World Bank database compiled by Larson et al. (2000). We compared these with data for advanced economies from the EUKLEMS database. Sectoral capital intensity is measured relative to capital intensity in the total economy, which is set at 100. Table 8 provides some very interesting results

- In developing countries, capital intensity in manufacturing is much higher than in agriculture (as expected).[7] Therefore, the shift from agriculture to manufacturing is important in the process of aggregate capital accumulation.
- Between 1970 and 1990, capital intensity in manufacturing as percentage of the total economy capital intensity declines. Other sectors become more capital intensive. The importance of manufacturing as the sector driving capital accumulation declines.
- In the advanced economies the roles of agriculture and manufacturing have been reversed with regard to capital intensity. Capital intensity in the small sector of agriculture is much higher than in manufacturing. This has to do with the 'industrialisation of agriculture'. In the advanced economies the share of agricultural labour and value added has declined enormously, but agriculture has become much more productive due to the application of very capital intensive technologies such as greenhouse farming, intensive pig, cattle and poultry farming, combines and so forth. But there is also a measurement problem. The EUKLEMS data seem to include tree stocks and cattle stocks. This overstates the capital intensiveness of agriculture, because tree stocks and cattle stocks do not refer to capital accumulation in the modern technological sense. In the case of the developing countries, we have been able to exclude tree and cattle stocks.

[6] A better approach is to analyse the impact of the sectoral shares at the beginning of a period on growth rates of GDP per capita in that period (cf. Fagerberg and Verspagen, 1999).

[7] The same is true for mining and utilities (figures not reproduced here).

Table 8
Capital intensity in agriculture and manufacturing (total economy = 100).[a,b]

	1970		1980		1990		2000	
	Agric.	Manuf.	Agric.	Manuf.	Agric.	Manuf.	Agric.	Manuf.
India	25	199	24	210	20	206		
Indonesia	3	114	3	65	10	57		
Pakistan	34	93	27	120	22	134		
Philippines	42	138	14	166	9	168		
South Korea	18	159	25	100	42	87		
Sri Lanka			7	53	4	31		
Taiwan	32	131	29	85	27	77		
Turkey	26	188	22	173	16	88		
Argentina	59		52		52			
Chile	48	88	67	70	77	37		
Colombia	19	89	15	90	11	70		
Peru	13	133	14	130	16	97		
Venezuela	63	109	40	88	28	87		
Egypt	33	166	25	186	27	181		
Morocco					6			
Average developing countries	32	134	26	118	24	102		
Australia	114	50	125	55	112	71	105	81
Austria			59	69	60	81	62	90
Czech Rep.							59	64
Denmark	141	53	177	65	207	69	235	84
Finland	44	98	77	81	114	95	151	94
West Germany	71	61	83	68	97	74		
Germany							110	85
Italy	52	85	69	95	107	100	137	108
Japan	67	114	72	97	93	93	118	105
Netherlands	106	67	125	69	135	80	146	90
Portugal							33	95
Sweden							119	106
UK	207	76	226	84	205	95	178	98
USA	151	81	173	89	145	96	114	104
Average advanced economies	106	76	119	77	127	85	121	93

Own calculations from the following sources: capital stock developing countries. Larson et al. (2000); persons engaged developing countries. GGDC, *10 Sector Database*, 2009, except Egypt, Morocco, Pakistan from ILO, *Labour Statistics Database*, 2008. Advanced economies: Groningen Growth and Development Centre, *EUKLEMS Database*.

[a] Capital intensity total calculated excluding real estate for advanced economies. Real estate refers to the residential capital stock. We assume the totals for developing countries from Larson et al. (2000) also exclude real estate.

[b] Agricultural capital stock in developing countries refers to gross fixed capital stock excluding tree stock and cattle stock. In the advanced economy data. agricultural capital stock includes tree stock and cattle stock. This results in an upward bias in the estimates of agricultural capital intensity.

- The advanced economy data illustrate that manufacturing has become one of the less capital intensive sectors of the economy. The EUKLEMS data indicate that mining, utilities and transport are the most capital intensive sectors. Agriculture also has above average capital intensity. Manufacturing has become much less important as a key sector where capital accumulation takes place. There are again measurement issues. The data in the table refer to total fixed capital formation, including fixed structures. It is very likely that in terms of machinery and equipment the data would show a more important role for manufacturing.

In economic growth accounting studies, the contribution of growth of physical capital to growth of output in post-war advanced economies turns out to be less important than previously thought. Other factors such as growth of employment, growth of human capital and disembodied technological change are very important as well (Maddison, 1987; Thirlwall, 1997). However, for developing countries, physical capital accumulation still seems to be of great importance, because they start with so much less capital per worker (Nadiri, 1972; Thirlwall, 1997; Pilat, 1994; Hoffmann, 1965; Bosworth et al., 1995).

4.5. Opportunities for scale economies

Historically the industrial sector (including mining, manufacturing, construction and utilities) profited in particular from economies of scale, compared to service sectors and agriculture. This is partly due to the nature of technologies which are most productively applied in large scale production. But it also has to do with learning by doing. Expansion of production expands the scope for learning (Fagerberg and Verspagen, 1999). Thus, the rate of growth of productivity in manufacturing depends positively on the rate of growth of output (Verdoorn, 1949; Kaldor, 1966, 1967).

With the rise of ICT technologies this is changing since the 1990s. In certain service sectors, scale effects have become overwhelmingly important, as the marginal costs of providing an additional unit of service have come close to zero. It is justified to ask whether the role of manufacturing in the future will be less important than in the past 60 years. The service sector might emerge as the new engine

of growth. It is too early to say whether this is indeed the case. Many service sectors, such as government, medical services, education, tourism and personal care still suffer from Baumol's law. In the case of digitalised services, the marginal costs may well be close to zero, but they are faced with an increasing problem of appropriation of revenues from these services, as the flow of services becomes impossible to control and valorise.

4.6. Technological advance

The manufacturing sector offers special opportunities for both embodied and disembodied technological progress. Rapid capital accumulation is associated with embodied technological progress, as new generations of capital goods embody the latest state-of-the art of technology.

Disembodied technological progress refers to changes in the knowledge of product and process technologies in firms and in the economy as a whole. Since the industrial revolution, embodied and disembodied technological advance has primarily originated in the manufacturing sector and diffused from there to other economic sectors such as the service sector. Cornwall (1977) in particular has argued that manufacturing is the locus of technological progress.

4.7. Linkage and spillover effects

Linkage effects refer to the direct backward and forward linkages between different sectors or firms. Linkages are direct physical relations of intersectoral supply and demand. The positive external effect of linkages is that they can create economies of scale in the domestic economy. Spillover effects refer to the disembodied knowledge and technology flows between economic actors and economic sectors. Actors learn from each other, so that investment in technological knowledge or increased efficiency in one firm has positive external effects in the economy as a whole.

Intersectoral backward and forward linkages in manufacturing are perceived to be much stronger than in mining or agriculture which are typically characterised by weak linkages (Cornwall, 1977; Hirschman, 1958; Myint, 1980). Investment in one branch of manufacturing can have strong positive external effects on other sectors.

Spillover effects between manufacturing and other sectors are also very powerful. As indicated above, the manufacturing sector is one of the primary sources of technological advance in the economy as a whole. It is here that most product and process technologies are developed. One of the important spillover effects in modern economies is that from the industrial sector to other sectors, such as the service sector. Thus, advances in ICT hardware technologies produced in the manufacturing sector (silicon chips, glass fibre cables) fuel technological change in the software producing and software using service sectors.

4.8. The Engel law

The argument in the previous paragraph was couched in terms of supply factors. But demand relationships are also crucial for the argument that manufacturing is an engine of growth. The lower the per capita income of a country, the larger the proportion of that income that will be spent on basic agricultural foodstuffs. This is the famous Engel law (Engel, 1857). As per capita income increases, the demand for agricultural products will decline and the demand for industrial products will tend to increase. Economic development creates a mass market for industrial products. This creates dynamic opportunities for manufacturing. If a country remains in agriculture and fails to develop its domestic manufacturing industry, it will have to import increasing amounts of manufactured goods.

However a similar argument can be made for services at higher levels of per capita income. The elasticity of service consumption with respect to total consumption is quite high (Chakravarty and Mitra, 2009). This would be an argument for service-led growth at higher levels of development.

5. Conclusion

This paper presents an overview of theoretical arguments and empirical evidence for the proposition that manufacturing has functioned as an engine of growth in developing countries in the past 50 years. There is no doubt that manufacturing has been an important driver of growth in most developing countries. But not all expectations of the engine of growth hypothesis are borne out by the data, in particular not with regard to capital intensities and labour productivity growth.

The review of the secondary literature also presents a mixed picture. The older literature tends to emphasise the importance of manufacturing, the more recent literature finds that the contribution of service sector has increased. Manufacturing is definitely important, especially in the period 1950–1973 and more so in developing countries than in advanced economies. It continues to act as an engine of growth up to the present. But in the advanced economies, the contribution of the service sector has become more and more important and the share of services in GDP is now well above 70 per cent. These trends justifiably raise the question whether manufacturing will continue to be the engine of growth in catch-up economies that it has been since 1950.[8]

The historical evidence provides stronger support for the engine of growth thesis. This paper argues that there are no important examples of success in economic development in developing countries since 1950, which have not been driven by industrialisation. All the Asian success stories are stories of industrialisation. Neither tourism, nor primary exports, nor services have played a similar role, with the possible exception of software services in India since 2000.

The empirical data discussed in this paper are primarily data for developing countries in Asia and Latin America.

[8] As prices of services have increased far more than those of industrial goods, the share of the service sector in constant prices has increased far less and the contribution to growth will also be less than when measured at current prices.

Sub-Saharan African countries are underrepresented in most statistical exercises and databases, because long-run time series are not easily available. This is an interesting area for future research. With the exception of South African and Mauritius, sub-Saharan African countries have had very weak industrial performance as well as disappointing rates of economic growth. Including more African countries in the analysis would strengthen rather than weaken the case for the engine of growth hypothesis.

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Appendix A.

Table A.1
The share of manufacturing in GDP. 1950–2005 (shares at current prices. 90 countries).

	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Bangladesh[a]	7.2	9.8	5.3	5.4	5.8	7.0	13.8	14.2	13.1	15.3	15.2	16.5
Cambodia			8.5	8.4					8.6	9.1	16.0	17.8
China	14.1	16.8	31.3	29.2	33.7	38.1	40.5	34.9	32.9	33.7	32.1	33.5
Hong Kong. China							22.8	21.3	16.7	7.7	5.4	3.4
India	10.4	12.0	14.1	14.7	14.2	15.8	16.7	16.5	16.7	17.9	15.6	16.0
Indonesia	7.4	9.8	9.2	8.4	10.3	9.8	13.0	16.0	20.7	24.1	27.7	27.7
Iran. Islamic Rep.			9.5	8.7	10.1	7.3	7.8	7.2	11.8	11.9	13.2	11.8
Iraq	6.1	7.0	9.6	8.9							0.9	
Jordan			6.2	11.9	11.3	8.9	12.7	11.5	14.9	15.1	15.7	18.2
Lebanon	6.4			13.3						15.0	13.7	14.1
Malaysia		11.2	8.1	9.5	12.4	17.6	21.6	19.3	24.2	26.4	32.6	29.8
Pakistan[b]	7.2	9.8	12.1	14.5	16.1	16.7	15.9	15.9	17.4	16.3	14.7	18.6
Philippines	8.5	13.1	20.3	19.5	24.9	25.7	25.7	25.2	24.8	23.0	22.2	23.3
Republic of Korea	8.8	11.3	10.4	13.5	17.8	21.6	24.4	27.3	27.3	27.6	29.4	28.4
Sri Lanka	4.2	5.9	15.4	16.8	16.7	20.1	17.7	14.7	14.8	15.7	16.8	14.8
Syrian Arab Republic	7.2	8.3	9.0	8.3						6.4	5.9	8.5
Taiwan	15.0	15.8	19.1	22.6	29.6	31.5	36.2	36.9	32.7	26.5	24.6	22.1
Thailand	12.0	13.8	12.5	14.2	15.9	18.7	21.5	21.9	27.2	29.9	33.6	34.8
Turkey	10.7	12.4	13.2	15.3	15.8	16.3	17.3	18.8	22.7	23.4	20.0	21.8
Vietnam[c]			11.5	20.0				20.5	12.3	15.0	18.6	20.6
Argentina	23.4	30.4	32.2	33.8	31.5	38.2	29.5	29.6	26.8	18.4	17.5	23.2
Barbados		12.7	8.0		7.9	10.3	11.9	10.6	10.1	10.1	6.4	7.1
Belize							23.9	16.7	13.1	10.9	10.9	9.1
Bolivia		13.2	13.4	14.1	14.1	12.9	14.4	17.3	18.5	19.0	15.3	14.0
Brazil	18.7	20.4	29.6	26.2	29.3	30.3	33.5	33.7	26.5	18.6	17.2	18.4
Chile	17.1	19.3	24.9	26.1	25.9	20.4	21.5	16.2	19.6	18.1	19.5	15.7
Colombia	12.9	14.9	16.5	19.7	21.2	23.7	23.9	22.0	20.6	15.9	15.8	16.4
Costa Rica	10.3	11.4	16.2	16.6	18.2	20.4	18.6	25.1	22.6	21.8	25.3	21.8
Dominican Republic	15.9	15.0	17.5	15.6	18.5	20.9	15.3	12.3	18.0	18.2	16.8	15.1
Ecuador	15.7	15.0	15.6	18.5	17.6	16.4	19.5	19.1	19.2	14.0	13.6	8.9
El Salvador			15.6	18.9	20.2	20.0	16.5	17.8	22.1	23.1	24.7	22.9
Guatemala	12.0	12.2	12.8	14.1	15.8	15.1	16.6	15.8	15.1	14.1	13.2	18.7
Guyana	15.2	13.5	10.4	13.1	12.1	14.7	12.1	13.9	10.3	11.4	8.2	7.7
Honduras	8.6	8.7	12.5	12.4	13.8	15.7	15.0	14.5	16.3	17.8	22.7	20.9
Jamaica	11.3	13.4	13.6	15.0					17.2	16.0	13.7	13.6
Mexico	17.2	18.1	15.3	19.5	23.2	22.4	22.3	24.0	20.8	20.8	20.3	17.8
Nicaragua				20.2								
Panama	11.3	9.8	12.8	15.3			11.0	12.3	9.7	9.1	10.1	8.0
Paraguay	19.5	14.6	16.7	15.5	16.7	15.6	16.0	14.2	16.8	15.9	15.5	12.4
Peru	14.5	15.4	20.2	17.1	19.8	20.0	20.0	25.2	17.8	16.8	15.8	16.3
Puerto Rico	16.3	20.7	21.9	23.0	23.6	28.9	36.8	39.0	39.6	41.9	38.3	
Suriname		11.2	12.5	14.9		20.7	18.6	13.2	10.3	13.7	9.0	19.1
Trinidad and Tobago	13.2	12.5	12.5	13.2				8.7	14.0	8.6	7.3	6.5
Uruguay		19.4	21.2	24.4			25.4	29.4	28.0	19.7	16.9	22.5
Venezuela. RB	10.9	11.7	10.7	16.6	16.1	15.7	16.0	18.9	14.9	15.1	19.8	17.9
Botswana				11.6	5.9	7.2	5.1	5.4	5.1	5.5	4.4	3.7
Congo. Dem. Rep.	9.4	6.7		6.3	8.9		15.2	10.5	11.3	7.1	4.8	6.6
Cote d'Ivoire			7.5	9.1	10.3	9.4	12.8	14.6	20.9	15.0	21.7	19.3
Egypt. Arab Rep.	8.3		13.7			17.4	12.2	13.5	17.8	17.4	19.4	17.3
Eritrea									8.2	9.0	11.2	6.8
Ethiopia[d]			6.0	6.7				4.3	4.8	4.8	5.5	4.8
Ghana			5.1	9.8	11.4	13.9	7.8	11.5	9.8	9.3	9.0	8.7
Kenya	10.8	9.6	9.4	11.5	12.0	12.0	12.8	11.7	11.7	9.9	11.6	11.7
Libya			10.7	2.8	2.1	2.3	2.0	4.5	6.5			

Table A.1 (*Continued*)

	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005
Malawi		4.8	5.4	6.9	11.3	13.1	13.7	14.5	19.5	15.8	12.9	13.9
Mauritius	23.1	20.1	16.8	15.3		15.6	15.7	20.0	24.7	22.8	23.7	20.2
Morocco	14.7	11.5	13.4	15.7	16.2	17.1	16.9	18.4	19.0	19.0	17.4	17.2
Nigeria	1.8	3.0	3.8	5.4	3.7	5.0	8.4	8.7	5.5	5.4	3.7	4.6
Sierra Leone		0.0	6.0	6.1	6.3	5.5	5.3	5.7	4.6	9.3	3.5	3.7
South Africa	16.4	18.8	20.1	22.9	22.8	22.7	21.6	21.8	23.6	21.2	19.0	18.6
Sudan		4.4	4.7	6.1	7.8	6.9	7.5	8.6	8.8	9.2	8.6	6.8
Tanzania[e]	3.4	2.8	2.9	9.2			12.3		9.3	7.2	7.5	6.8
Togo			7.7	5.9	10.0	7.0	7.8	6.7	9.9	9.9	8.4	10.1
Tunisia		9.9		8.1	8.4	9.1	11.8	15.1	16.9	19.0	18.2	17.4
Uganda		7.9	8.5	8.4	9.2	6.3	4.3	5.8	5.7	6.8	9.8	9.3
Zambia		3.4	4.0	7.9	12.1	17.5	19.2	20.6	26.5	11.7	11.4	11.5
Zimbabwe/South Rhodesia		14.4	16.0	18.7	17.8	19.3	17.7	17.7	21.6	19.6	15.8	13.5
Cyprus	11.7	11.5	12.7	12.0		14.3	17.5	15.6	14.2	12.1		
Malta		8.2	16.1	19.3	21.8	30.5	33.1	29.5	27.0			
Australia	27.1	28.0	28.5	28.4	23.3	22.0	19.0	17.0	14.5	14.6	12.7	11.0
Austria	33.8	33.9	32.1	34.3	28.4	25.0	23.7	22.5	21.4	19.3	20.3	19.4
Belgium	30.1	28.9	29.5	30.7	30.4	24.6	22.6	22.4	21.9	20.2	19.3	17.1
Canada	28.6	27.9	23.3	26.3	25.9	22.2	18.8	17.9	16.9	18.4	19.2	16.5
Denmark	27.7	27.0	29.3	29.3	22.6	19.4	18.9	18.8	17.4	17.1	16.2	14.2
Finland	27.8	26.9	26.8	25.5	25.1	25.8	27.5	24.9	22.6	25.3	26.2	23.1
France	38.3	35.9	36.6	34.8	25.6	25.5	25.5	23.1	22.3	20.1	16.0	13.0
Germany, federal rep.	41.1	40.8	42.2	41.1	35.6	34.6	33.6	32.6	31.7	26.2	0.0	0.0
Germany, United										22.6	22.9	23.2
Ireland	13.5	26.1	28.4	31.5	32.6	30.4	0.0	0.0	0.0	0.0	0.0	0.0
Israel	19.3	22.5	24.0	24.0	23.2	22.0	16.4	20.0	18.5	16.9	17.9	14.5
Italy	31.1	27.1	27.2	27.7	27.6	27.5	28.9	25.2	23.3	22.2	21.0	18.2
Japan	24.8	25.9	32.0	31.1	32.9	27.4	26.6	26.8	25.5	22.5	21.3	21.0
Luxembourg	34.1	42.2	44.8	40.9	0.0	0.0	0.0	0.0	0.0	13.7	11.3	8.3
Netherlands	30.0	30.6	31.6	32.4	25.3	21.6	18.1	17.8	18.6	17.4	15.6	14.0
Norway	0.0	27.3	25.1	26.6	21.0	21.0	15.6	13.5	12.3	13.2	10.6	9.6
Portugal	35.3	26.4	29.9	33.3				19.6	19.4	18.4	17.1	14.7
Spain	21.3	23.4	22.5	25.8							18.6	16.2
Sweden	30.5	32.0	27.1	33.6	28.8	25.4	22.0	22.7	20.3	22.3	22.0	19.7
Switzerland									21.9	21.1	20.2	19.8
United Kingdom	34.6	36.3	36.2	34.5	31.7	28.1	26.5	23.9	23.2	21.7	17.9	13.6
United States	31.3	31.7	28.7	28.8	25.1	23.2	22.8	19.9	19.4	18.9	17.0	14.4
Average 20 Asian countries	8.9	11.2	12.5	13.8	16.8	18.2	20.5	20.1	19.9	19.0	18.7	20.1
Average 25 Latin America countries	14.7	15.2	16.6	18.4	19.2	20.1	19.9	19.6	18.7	17.0	16.4	15.4
Average 22 African countries	11.0	8.4	9.0	9.7	10.4	11.5	11.5	12.0	13.3	12.1	11.8	11.1
Average 67 Developing countries[f]	11.9	12.2	13.0	14.2	15.4	16.6	17.1	17.1	17.1	16.0	15.6	15.4
Average 21 advanced economies	29.6	28.6	30.4	30.5	23.3	19.6	18.3	17.5	17.7	16.8	16.2	13.3

Sources: The primary sources used are: UN, *Yearbook of National Accounts Statistics, 1957, 1962 and 1967*; Groningen Growth and Development Centre, *10 Sector Database*, http://www.ggdc.net/index-dseries.html; World Bank, *WDI Online*, accessed February 2009; World Bank, World Tables, 1980; Advanced economies, 1950, unless otherwise specified from OECD, *National Accounts*, microfiche edition, 1971, Japan 1953 from GGDC ten sector data base. For detailed source notes, see: Szirmai, Industrialisation as an Engine of Growth in Developing Countries, UNU-MERIT, Working Paper Series, 2009–2010, Maastricht, 2009.

[a] Bangladesh. 50–60 shares for Pakistan including Bangladesh.
[b] Pakistan including Bangladesh till 1972.
[c] South Vietnam till 1975. United Vietnam post 1975.
[d] Prior to 1993 including Eritrea.
[e] Till 1963 Tanganyika. excl. Zanzibar.
[f] Average developing countries excluding Malta and Cyprus.

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