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Manufacturing and Economic Development

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Abstract

This paper examines the theoretical and empirical evidence for the hypothesis that manufacturing is the main engine of growth in developing countries. The paper opens with an overview of the main arguments supporting the engine of growth hypothesis and then examines each of these arguments using a mix of statistical analysis of secondary data and secondary literature. The paper concludes that manufacturing will continue to be important in accelerating growth and achieving catch-up in developing countries. However, compared to the past 60 years, market service sectors will become relatively more important as potential sources of growth and catch up.

Keywords: structural change, manufacturing, engine of growth, catch-up

JEL classification: O14, N6

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Tables appear at the end of the paper.

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1 Introduction

Since the industrial revolution in the eighteenth century manufacturing has been considered to be the main engine of economic growth and development. In development theory structural change was associated specifically with a shift of resources from the primary sector to the manufacturing sector. In recent years, however, the role of the manufacturing sector has been increasingly questioned. First, it is clear that the advanced economies are now predominantly service economies. Second, economic historians increasingly recognize the importance of service sectors such as trade, transport, and financial intermediation which have contributed to industrialization and development. Finally, the recent experiences of India and other emerging economies raise the question whether services have become the key sector in economic development in the twenty-first century.

This paper contributes to this debate by examining some of the theoretical and empirical evidence for the proposition that manufacturing has acted as the main engine of growth in developing countries in the period 1950–2005. The remainder of the paper is structured as follows. Section 2 provides an overview of the main eight arguments for the hypothesis that manufacturing is the main engine of growth. In Section 3.1–3.8 these arguments are examined one by one on the basis of secondary literature and available secondary statistics. Section 4 concludes.

Before proceeding, however, we need to enter an important caveat. Even if we were to conclude that manufacturing has indeed been one of the most important engines of growth, this does not mean that other sectors of the economy such as agriculture or services should be neglected. One of the classic failures of post-war industrial policy has been the favouring of manufacturing and the discrimination against the agricultural sector in Latin America, Africa, and Asia. This has tended to retard agricultural development and indirectly has harmed industrial development and the overall rate of growth through the intersectoral linkages between agriculture and manufacturing (Szirmai 2005). Similar intersectoral linkages exist between manufacturing and services. From a policy perspective one should always keep the balance and the linkages between sectors in mind.

2 The case for manufacturing

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

1. There is an *empirical correlation* between the degree of industrialization and the levels of per capita income in developing countries. More industrialized developing countries tend to be richer than less industrialized 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 realized 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 manufacturing (and also in other industrial sub-sectors such as mining, utilities and construction. It is much lower in agriculture and services. Capital accumulation is one of the aggregate sources of growth. Thus, an increasing share of manufacturing and industry 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 is concentrated 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, they 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 rises, the share of agricultural expenditures in total expenditures declines and the share of expenditures on manufactured goods increases (Engel's law*)*. Countries specializing in agricultural and primary production will not profit from expanding world markets for manufacturing goods.

The arguments mentioned under points 4, 5, 6, and 7 refer to specific characteristics which supposedly make the manufacturing sector more productive and more dynamic than other sectors. Arguments 2 and 3 about the structural change bonus and burden depend on the assumption of higher productivity levels and growth rates in manufacturing. Point 7 points to the positive externalities which transmit growth from manufacturing to other sectors. Point 8 brings in the role of demand and suggests that the demand elasticities interact with supply effects to produce more rapid economic development. The first point is an empirical proposition about the relationship between industrialization and the level of development. Logically it follows from the arguments discussed under points 8.

3 Examination of the arguments for the engine of growth hypothesis

In this section, we provide a further elaboration of the debate on the role of manufacturing. We also examine some of the empirical evidence for the different propositions, using a mix of secondary data and secondary literature.

3.1 Empirical correlations between industrialization and economic development

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

Statistically the correlation is less easy to demonstrate, because the advanced economies have become service economies where service sectors account for over two thirds of GDP. This makes the relationship between industrialization and per capita income a curvilinear one with a positive relationship between the share of manufacturing and GDP per capita at lower levels of per capita GDP and a negative relationship at higher levels (Rodrik 2009). 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 (Szirmai 2005).

Contributions of manufacturing to growth can be measured in different ways: using growth accounting techniques and econometric analysis (Bosworth, Collins and Chen 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 (argument 7). 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 emphasize 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 1950–73 than in the period after 1973.

Fagerberg and Verspagen (1999) regress real GDP 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 a second paper by the same authors (Fagerberg and Verspagen 2002), they examine the impact of shares of manufacturing and services on growth in three periods: 1966–72, 1973–83, and 1984–95 and for a sample of 76 countries. They find that manufacturing has much more positive contributions to growth before 1973 than after this year. The interpretation in both papers is that the period 1950–73

offered special opportunities for catch-up through the absorption of mass production manufacturing techniques from the USA. After 1973, information and communications technologies (ICTs) started to become more important as a source of productivity growth, especially in the 1990s. These technologies are no longer within the exclusive domain of manufacturing, but also operate in the service sector.

An 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 (2008) conclude on the basis of vector autoregression analysis that manufacturing is still one of the important drivers of growth, though more and more activities are becoming independent of the manufacturing sector. Kathuria 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 significant relationships between the shares of manufacturing in GDP at the beginning of five-year periods and average growth rates in five-year periods for a panel dataset of 90 countries for the period 1950–2005. However, when the sample is split into different sub-periods or different groups of countries the relationship is much less straightforward.

In Table 1, we try to capture the empirical relationship between industrialization 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, Ansari, and Singer 1982). 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 industrialization than in terms of income. Nevertheless, the table illustrates the general point about industrialization. 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 industrialized ones.

3.2 Structural change bonus

A second argument in favour of industrialization 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 (Chenery, Robinson, and Syrquin 1986; Fagerberg and Verspagen 1999; Fei and Ranis 1964; Lewis 1954; Rodrik 2009; Temple and Woessman 2006; Timmer and Szirmai 2000; Timmer and de Vries 2009; van Ark and Timmer 2003).

Table 2 presents data on value added per worker for a selected number of developing countries for which data are available for longer periods. It is immediately clear from this table that value added per worker is much higher in manufacturing 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 in Latin America 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 counter-intuitive. From 1980 onwards, however, productivity in manufacturing is substantially higher than in services, which is more in line with our expectations.[1]

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 world's richest countries growth of labour productivity in agriculture in the post-war period has been higher than in industry—particularly due to bio-technological innovation (see Maddison 1991). However, in

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1 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.

most developing countries productivity growth in manufacturing has been more rapid than in the agricultural sector between 1950 and 1973.

In Table 3, 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 per cent versus 3.9 per cent). Manufacturing is clearly a very dynamic sector contributing to overall growth performance. Between 1950 and 1973, productivity growth in manufacturing is higher than in agriculture in ten out of 14 countries. In the case of value added, all countries show higher growth in manufacturing in this period.

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 developing countries in Table 3. However, in terms of value added the growth rate in manufacturing is still much higher in ten out of 16 developing countries in the table. 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 growth in the total economy is much more rapid than in agriculture. Agriculture's share in valued added has systematically been shrinking. Summarizing the information in Table 3, we may conclude that in developing countries manufacturing is indeed one of the more dynamic sectors in terms of productivity and output growth, especially in the period 1950–73. In the period 1973–2003, productivity growth in agriculture surpasses that of manufacturing, but manufacturing still dominates in terms of output growth.

3.3 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, Baumol 1967). 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 services, transport and logistics and

retail sales and distribution where there are major productivity improvements, often based on ICTs (Triplett and Bosworth 2003; de Vries 2010). Nevertheless, the working hypothesis is that countries with very large service sectors will tend to grow at a slower rate than countries with a smaller service sector. Advanced economies are predominantly service economies and these are all characterized by slower aggregate growth rates (Hartwig 2011; Nordhaus 2008). 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 characterized by a rather large share of the service sector at rather early stages of development in the 1950s. 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 post-war developing countries consisted of large, inefficient and extremely unproductive government sectors, developing countries suffered 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. But, in recent years in countries such as India, larger parts of the service sector consist of dynamic activities such as IT services, which would tend to reduce or even eliminate the structural change burden.

Unfortunately, it is hard to test these hypotheses 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 growth, service sector shares will not be negatively correlated with per capita income levels.[2]

3.4 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 4, 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. This table provides some very interesting results

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

- In developing countries, capital-intensity in manufacturing is much higher than in agriculture (as expected).[3] The shift from agriculture to manufacturing is important in the process of aggregate capital accumulation.
- Between 1970 and 1990, capital-intensity in manufacturing as a 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 'industrialization 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, use of 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.
- 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 (Bosworth, Collins, and Chen 1995; Nadiri 1972; Hoffman 1965; Pilat 1994; Thirlwall 1997).

3.5 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

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3 The same is true for mining and utilities (figures not reproduced here).

productivity in manufacturing depends positively on the rate of growth of output (Kaldor 1966, 1967; Verdoorn 1949).

With the rise of ICTs this may have changed from the 1990s onwards. 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. The question is justified whether the role of manufacturing in future growth may become less important than in the past 60 years. The service sector might become 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, and personal care—still suffer from the Baumol's disease. In the case of digitalized services, the marginal costs may be close to zero, but there is an increasing problem of appropriation of revenues from these services, as the flow of services becomes impossible to control and valorise.

3.6 Technological change

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 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, technological advance has been concentrated in the manufacturing sector and diffuses 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. Even in the IT sector, advances in software applications are dependent on advances in hardware chip technologies and information transmission technologies such as fibre optics and satellite technologies.

Some brief remarks need to be made here about the difficulties in unscrambling capital accumulation and technological change. From the perspective of a developing country, the use of more capital goods per worker in itself represents an important kind of technological change. The mode of production changes dramatically, and the mastering of new, usually imported, technologies requires major innovative efforts on behalf of developing countries and their firms. In this sense, all capital accumulation in developing countries represents technological change. It involves the diffusion of machinery from the advanced economies and diffusion of the technologies embodied in them.

But, one needs to distinguish between the increase in the pure volume of existing capital goods (more of the same) and the shift over time from technologically less sophisticated to technologically more advanced capital goods. This is called *embodied technological change*, still a form of international diffusion of technology through capital imports, but now with the emphasis on the upgrading of the capital stock.

Next, in the course of economic development, output per unit of input (total factor productivity) can increase due to various factors—shifts from one economic sector to another, economies of scale, and more efficient allocation of resources within sectors. One of the most important factors, which can cause increases in output per unit of input, is so-called

disembodied technological change. Disembodied technological change refers to general advances in science, technology, and the state of knowledge; changes in the stocks of knowledge available to firms, sectors, or countries; improvements in the level of knowledge absorbed by employees and managers in educational institutions and on the job (Maddison 1987); learning-by-doing by workers and managers on the job; improvements in the collective technological capabilities of firms or the social capabilities of countries and finally positive external effects of investment in knowledge; and new technologies, through spillovers from firm to firm or from country to country.

3.7 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 on 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 characterized 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 IC hardware technologies produced in the manufacturing sector (silicon chips, glass fibre cables) fuel technological change in the software producing and software using service sectors.

3.8 Engel's law

The argument in the previous paragraph was couched in terms of supply factors. But demand relationships and factors are also relevant for the debate about the role of manufacturing. The lower the per capita income of a country, the larger the proportion of that income will be spent on basic agricultural foodstuffs—this is known as the Engel's law (Engel 1857). As per capita incomes increase, 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 could be made for services at higher levels of per capita of income. At higher levels of economic development, the income elasticity of service consumption is quite high (Chakravarty and Mitra 2009). This is an argument in favour of

service-led growth at higher levels of development. However, one has to distinguish between real changes in the composition of demand and price effects. Due to Baumol's law, productivity in services will lag behind that of manufacturing. If service wage levels follow manufacturing wage levels, then the price of services will increase, leading to higher proportions of income being spent on services.

4 Conclusion

This paper has presented an overview of theoretical arguments and empirical evidence for the proposition that in the past 50 years, manufacturing has functioned as an important engine of growth in developing countries. There is no doubt that manufacturing has been an important driver of growth and catch-up. But not all expectations of the engine of growth hypotheses are supported by the statistical evidence, in particular not with regard to the presumed higher capital-intensity in manufacturing and the productivity dynamics of manufacturing. In more recent years, productivity growth in agriculture has even been higher than in manufacturing.

The review of the secondary literature also presents a mixed picture. The older literature tends to emphasize the importance of manufacturing, the more recent literature finds that the contribution of service sectors has increased. Manufacturing is definitely important, especially in the period 1950–73 and much more so in developing countries than in advanced economies. It continues to act as a vehicle of catch-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.[4]

The more general historical evidence provides stronger support for the engine of growth thesis. There are no important examples of success in economic development in developing countries since 1950 which have not been driven by industrialization. All the Asian catch up stories are stories of successful industrialization. Neither tourism, nor primary exports, nor services have played a similar role, with the possible exception of IT services in India since 2000. But even in India manufacturing has been and still is of great importance.

Sub-Saharan African countries are underrepresented in most statistical exercises and statistical databases. With the exception of South Africa, Mauritius, Botswana, and Namibia, they all have very low per capita incomes, disappointing long-run growth performance and they have all failed to industrialize. Their development experiences provide further support for the engine of growth hypothesis.

What can one conclude with regards to the future role of manufacturing in the twenty-first century? The answers can at best be somewhat speculative, but let us nevertheless try to formulate some expectations.

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4 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.

1. Given the sheer size of the service sector in the advanced economies, productivity advances and technological change in the service sector have inevitably become more important in explaining differences in growth performance between the advanced economies. Thus in recent years, more rapid productivity growth in key service sectors in the USA is one of the factors explaining the productivity gap between the USA and Europe (van Ark, O'Mahoney, and Timmer 2008).
2. Manufacturing will continue to be important in accelerating growth and achieving catch-up in developing countries, especially in countries at lower levels of per capita income.
3. Compared to the past 60 years, market service sectors will become relatively more important as potential sources of growth and catch-up.
4. As developing countries become richer and their economic structure becomes more similar to that of the presently advanced economies, the importance of manufacturing will tend to decline. But as developing countries come closer to the technological frontier, their rates of growth will also tend to slow down as a consequence of the structural change burden.
5. With the exception of small island economies, which are a special case, it is hard to imagine sustained growth spurts in less developed countries exclusively driven by the primary sector, by the construction sector, or by market services alone.
6. One of the most important lessons from past experiences is that industrial policy should not over-emphasize the importance of a single sector, however important it seems to be. Linkages between agriculture and manufacturing, between services and industry, have been important in the past and will continue to be so in future patterns of economic development.

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Table 1: Industrialization 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
USA	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
UK	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	8,910	18
Argentina	55	22	7,460	19
Mexico	63	12	5,070	20
Chile	36	32	4,590	21
Venezuela	35	34	4,310	22
Brazil	67	5	3,580	23
Malaysia	58	19	3,380	24
Turkey	36	30	3,100	25
South Africa	55	21	3,020	26
Peru	41	26	2,080	27
Colombia	31	36	2,020	28
Thailand	63	13	2,000	29
Egypt	38	29	1,490	30
Nigeria	38	28	1,180	31
Philippines	48	24	1,040	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

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

(b) Manufacturing share OECD countries, latest year in period 1998–2000.

Sources: GNP per capita and shares from World Bank, World Development Indicators (2002), except: Zaire from World Bank, available at: www.worldbank.org/data/countrydata/countrydata.html.

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Table 2: 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 America	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 America	33	379	156	148	119	100	43	439	157	144	107	100	51	631	170	153	94	100

Note: At constant prices. The base-year varies per country, but all base-years are in the mid-1990s.
Source: GGDC, ten sector database, downloaded February 2009.

Table 3: Growth of output and productivity in agriculture and manufacturing, 1950–2005

	1950-1973						1973-2005					
	Labour productivity			Value added			Labour productivity			Value added		
Country	Agric-	Manu-	Total	Agri-	Manu-	Total	Agri-	Manu-	Total	Agri-	Manu-	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

Source: Own calculations using data from the following sources: Advanced economies plus South Korea, 1973–2005: Groningen Growth and Development Centre, EUKLEMS database, downloaded July 2008.

Developing countries, 1950–2005 and. South Korea, 1953–1973: Groningen Growth and Development Centre, 10-sector database, downloaded 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).

Table 4: Sector capital-intensity in agriculture and manufacturing
(Sectoral capital-intensity as % of total)[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

Notes: [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.

Source: own calculations from the following sources, capital stock developing countries, Larson et al. (2000); persons engaged developing countries, GGDC 10 sector database, except Egypt, Morocco, Pakistan from ILO, Labour Statistics Database (2008).
Advanced economies: Groningen Growth and Development Centre, available at: http://www.ggdc.net/index-dseries.html, EUKLEMS database (downloaded September 2008).