2002

Manufacturing Sectoral Growth in the USA and Japan: Relevance to SMEs, Organizational Innovations, and Recent Economic Growth

E. Sanidas
University of Wollongong, elias_sanidas@uow.edu.au

Publication Details
Sanidas, E, Manufacturing Sectoral Growth in the USA and Japan: Relevance to SMEs, Organizational Innovations, and Recent Economic Growth, Working Paper 02-09, Department of Economics, University of Wollongong, 2002.

University of Wollongong
Department of Economics
Working Paper Series 2002

Manufacturing Sectoral Growth in the USA and Japan: Relevance to SMEs, Organizational Innovations, and Recent Economic Growth

Elias Sanidas

WP 02-09

MANUFACTURING SECTORAL GROWTH IN THE USA AND JAPAN: RELEVANCE TO SMEs, ORGANIZATIONAL INNOVATIONS (OIs), AND RECENT ECONOMIC GROWTH

Elias Sanidas

Department of Economics
University of Wollongong
Northfields Avenue
Wollongong NSW 2522
Australia

ABSTRACT

Although economic growth is inherently linked with the structure and nature of SMEs (e.g. their number, industry concentration, size, degree of outsourcing, etc), as this has been shown in the existing literature, OIs [1], more generally, are the context in which SMEs operate and hence OIs ought to be more closely examined in order to further understand the complex process of economic growth and the particular impact of SMEs on the latter. In this paper, a detailed comparison of the growth of manufacturing sectors in the USA and Japan is used as an indirect way to demonstrate the following proposition. Although SMEs have played a positive role in the postwar economic Japanese miracle, they are not a sufficient force for a sustainable economic growth, as the recent protracted recession in Japan shows. It is only when technological innovations and in particular OIs take place in the economy that this type of growth is possible, as this is also demonstrated in the recent American prolonged economic growth.

INTRODUCTION

The importance of SMEs in contributing to economic growth has been emphasized in many papers and books (e.g. *Acs et al*, 1998). Sanidas (2002b) has provided some evidence on the links between SMEs, organizational innovations (OIs)[2], and economic growth across OECD countries with particular reference to Japan and the USA. In this paper, a close comparison between the manufacturing sectors in these two countries reveals that there is evidence that the recent American economic survival and the recent Japanese protracted economic downturn can be related to the existence of OIs, and that the relative importance of SMEs in the two countries is only a contingent factor necessary but not sufficient for economic growth.

OIs are the context in which SMEs operate and hence OIs ought to be more closely examined in order to further understand the complex process of economic growth and the particular impact of SMEs on the latter. In this paper, a detailed comparison of the growth of manufacturing sectors in the USA and Japan is used as an indirect way to demonstrate the following **proposition**. Although SMEs have played a positive role in the postwar economic Japanese miracle, they are not a sufficient force for a sustainable economic growth, as the recent protracted recession in Japan shows. It is only when technological innovations and in particular OIs take place in the economy that this type of growth is possible, as this is also demonstrated in the recent American prolonged economic growth.

[1] Examples of OIs are: production and distribution forms such as the factory system or the integration of mass production and distribution; the management structure of the firm such as the M-form; the production process from the organization point of view, such as the just-in-time (JIT) process; the organization of the shop floor, for example according to scientific management; clusters of SMEs, etc. See beloow and references for further details.

[2] For a good summary of OIs historically see Sanidas, 2002a.

Another way of expressing the above proposition is to make the following remark. The same SMEs, which played a positive role in generating a fast industrial growth in Japan during the 1970s and 1980s, have not been able to sustain a similar growth during the prolonged recession of the 1990s and probably the 2000s. A brief analysis of the number of SMEs and their corresponding employment shows that only a very slight increase in the size of firms is taking place in the 1990s in Japan, despite a substantial drop in the total number of SMEs and corresponding employment due to the negative effects of recession (see Table 1). Similarly for the USA, but in the opposite direction, the same SMEs, which played their role in generating a rather poor industrial growth in this country during the 1970s and 1980s, have been able to induce a much faster growth during the 1990s and probably the 2000s. Consequently, the explanation in these two opposite phenomena for the two countries can only be explained by referring to other factors such as the OIs. Effectively, Sanidas, 2001 provides extensive evidence that the imitation of the just-in-time cum quality control (JIT/QC) holistic system (an OI) by an increasing number of American manufacturing firms and sectors in the last 15 years or so has significantly contributed to the revival of the American economy during this period.

Table 1 Japan: recent developments in establishments, employment and size

	Total manufacturing			Automobiles sector			TVs and radios sector		
Year	Est/ts	Empl/nt	Size	Est/ts	Empl/nt	Size	Est/ts	Empl/nt	Size
1990	436	11173	25.6	11184	789	70.5			
1991	430.4	11351	26.4	11201	829	74			
1992	415.1	11157	26.9	10997	812	73.8			
1993	413.7	10885	26.3	11098	800	72.1			
1994	382.8	10416	27.2	10467	788	75.3	8887	434	48.8
1995	387.7	10190	26.3	10648	767	72	8628	427	49.5
1996	369.6	9990	27	10126	769	75.9	7944	408	51.4
1997	358.3	9835	27.4	9963	769	77.2	7885	406	51.5

Sources and notes: UNIDOb, 1996 and 2000. 'Est/ts' stands for number of establishments; 'Empl/nt' stands for number of employees'; 'size' is the number of employees per establishment. For the sector of 'TVs and radios' it is not possible to have consistent data for the whole period in the Table.

In order to properly evaluate the importance of OIs and SMEs, the comparison between American and Japanese manufacturing sectors will take place in sections 1 and 2 for various periods between 1960 and 1998 and for the variables of real output and TFP. In section 3 the recent protracted Japanese economic downturn is analyzed in the light of OIs and other relevant issues. In section 4 OIs are compared with technical innovations (TIs) in the two countries. In section 5, two leading sectors in Japan and the USA, namely semiconductors and personal computers bring more evidence to the propositions of this paper.

Before starting the sectoral analysis it is necessary to briefly provide some definitions for OIs and TIs. The definition of technology provided by an international institution, the United Nations Centre on Transnational Corporations (UNCTC), in 1983 is revealing:

> "*…Technology may be embodied in the form of capital goods, such as machinery, equipment and physical structures; or it may be disembodied in such forms as industrial property rights, unpatented know-how, management and organization* (my emphasis), *and design and operating instructions for production systems…*" (UNCTC, 1985, p. 119)[3].

A key feature in this study is to separate embodied from disembodied in the definition of technology. Hence, OIs make part of disembodied technology (according to the above definition of the UNCTC). The term technical innovations (TIs)[4] is coined to refer to embodied technology.

[3] Also quoted in Dicken, 1998, p. 248.
[4] Good examples of TIs are the innovations of semiconductors, use of aluminum in many products etc.

Five sections constitute this paper. The first section presents a detailed sectoral comparison between the USA and Japan in terms of real output. The sectoral comparison in terms of TFP and real output from 1960 to 1985 is undertaken in the second section. The period 1987 to 1997 is examined in the third section, in which some explanations of the recent Japanese economic downfall are provided. In order to separate more effectively the role of OIs and TIs in the process of sectoral growth, section four examines the performance of three key sectors. Finally, section five examines two other key sectors in terms of OIs. The role of SMEs in all this sectoral comparison will be indicated whenever necessary.

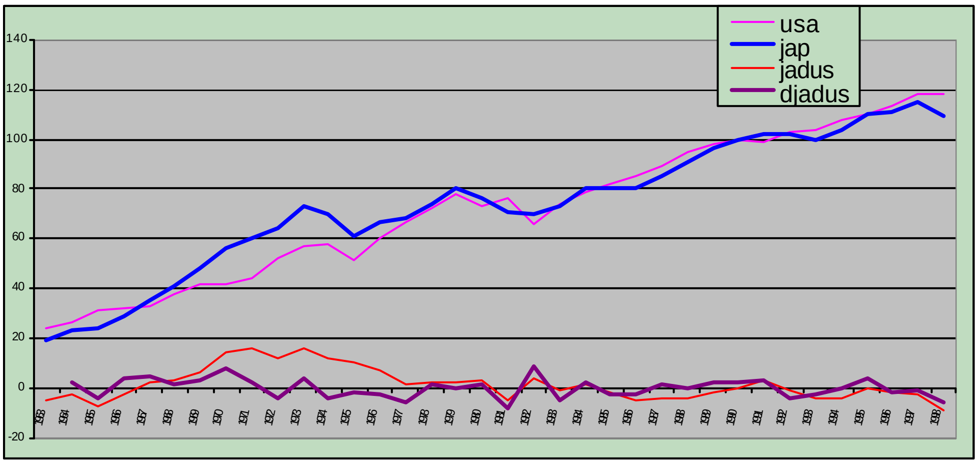
1 Analysis of the American and Japanese Series of Manufacturing Sectoral Real Output

1.1 Analysis from 1963 to 1998

The following Figures 1 and 2 show the growth patterns of real output for the USA and Japan from 1963 to 1998, for two manufacturing sectors (another sector is shown further below and the remaining sectors are shown in Appendix A1). Also on the same graphs, two more variables are shown, namely the first difference of the two indexes of industrial production (called 'jadus'), and the second difference of the two indexes (called 'djadus'). These last two series offer a way of detecting stationarity and cointegration, which in turn can be used to conclude whether a given sector followed the same pattern of growth or not through time in the two countries. A formal test of cointegration was also carried out for each pair of sectoral series to confirm these conclusions (some of these tests for the 'non-ferrous metals' sector are shown in Appendix A2).

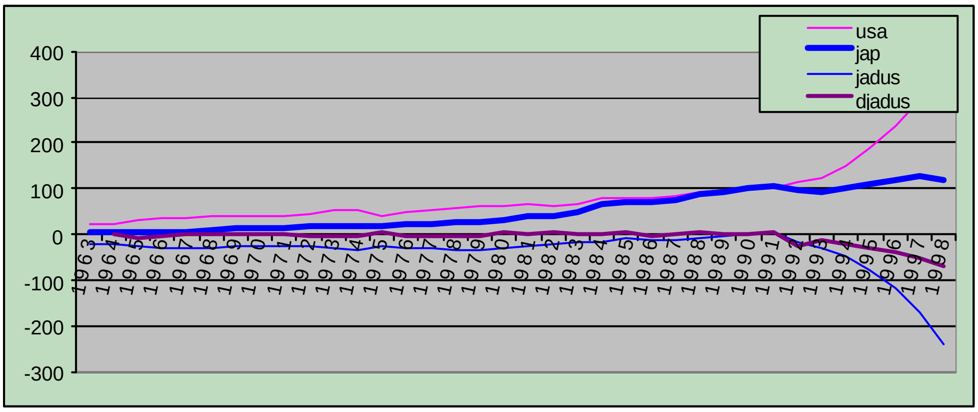
From these Figures we can draw some interesting conclusions. First, for almost every sector, the Japanese growth was very strong up to the mid 1970s (the catching-up stage with the USA), and then it slowed down, and finally decreased in the 1990s. However, over the whole period, the Japanese growth rates have been higher than the American ones in most sectors as Figure 4 shows. Table 2 summarizes the relative strength of each sector's growth between the two countries.

Figure 1 Industrial Chemicals



Source: Based on UNIDO, 1999.

Figure 2 Electrical Machinery



Source: Based on UNIDO, 1999.

Table 2 Growth Rates in Real Output from 1964 to 1998, Industry differences

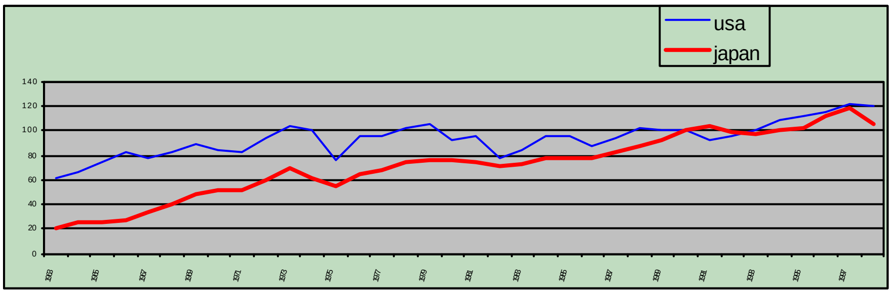
Category (1) American growth was higher than that of Japan	**Category (2) American growth was close to that of Japan**	**Category (3) American growth was lower than that of Japan**
1. Beverages	1. Food	1. Other Chemicals
2. Textiles	2. Industrial Chemicals	2. Petroleum Refineries
3. Wood	3. Rubber	3. Miscellaneous Petroleum and Coal
4. Furniture	4. Pottery and China	4. Iron and Steel
5. Printing	5. Glass	5. Non-Ferrous Metals
6. Plastic	6. Other Non-Metal Minerals	6. Fabricated Metals
7. Non-Electrical Machinery		7. Electrical Machinery
8. Others		8. Transport Equipment
		9. Professional and Scientific Equipment
		10. Apparel
		11. Leather
		12. Footwear
		13. Tobacco
		14. Paper

Source: Based on UNIDO, 1999.

For the first category, out of the 8 sectors, it is worth noting the substantial gradual decline of the main leading sector of the Japanese economy up to the 1930s (Minami, 1986), namely the Textiles. Also, it is worth noting the Non-Electrical Machinery (it includes computers) for which the Americans have always been the leaders (however, note that the higher American growth in this sector is not substantial). In the second category, it is worth mentioning the equal strength of the Industrial Chemicals and Rubber. In category (3) out of the 14 sectors almost all the heavy manufacturing industries have been more dynamic in Japan than in the USA during the whole period 1964 to 1998. It will be indicated in this study that it is precisely in these 'heavy' sectors that the Japanese firms, entrepreneurs and managers have been mostly innovative in terms of OIs. Overall, the Japanese growth rates have been higher or almost as high in 20 out of the 28 sectors considered.

Furthermore, and as the Figures (see this text and Appendix A1) for each sector show, the two national real output series for every industry need in most cases to be twice differenced in order to be cointegrated. This means that the two national economies have been following their own independent paths of growth. These paths have been much more dependent on their underlying historical background and their own OIs than their own TIs since Japan has always been in most cases an imitator of foreign and especially American technology (see section 4 below). An example will demonstrate the evidence given by formal cointegration methodology. This example is based on the Non-Ferrous Metals industry, which shows a steadily faster growth of the Japanese sector than the American one during the period 1963 to 1998 as the Figures 3a and 3b exhibit.

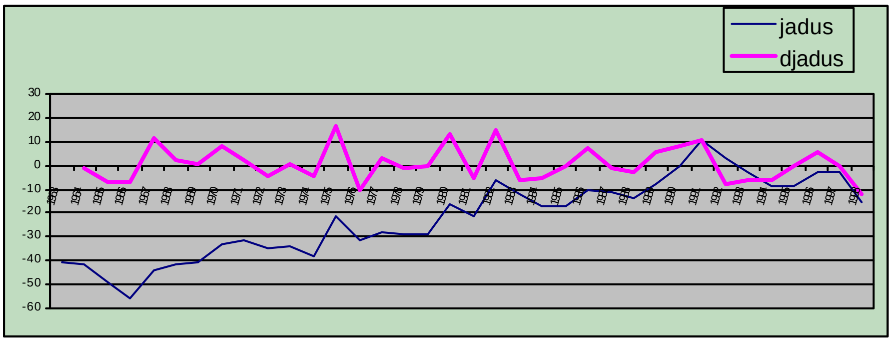
Figure 3a Non-ferrous metals, indices of industrial production



Source: Based on UNIDO, 1999.

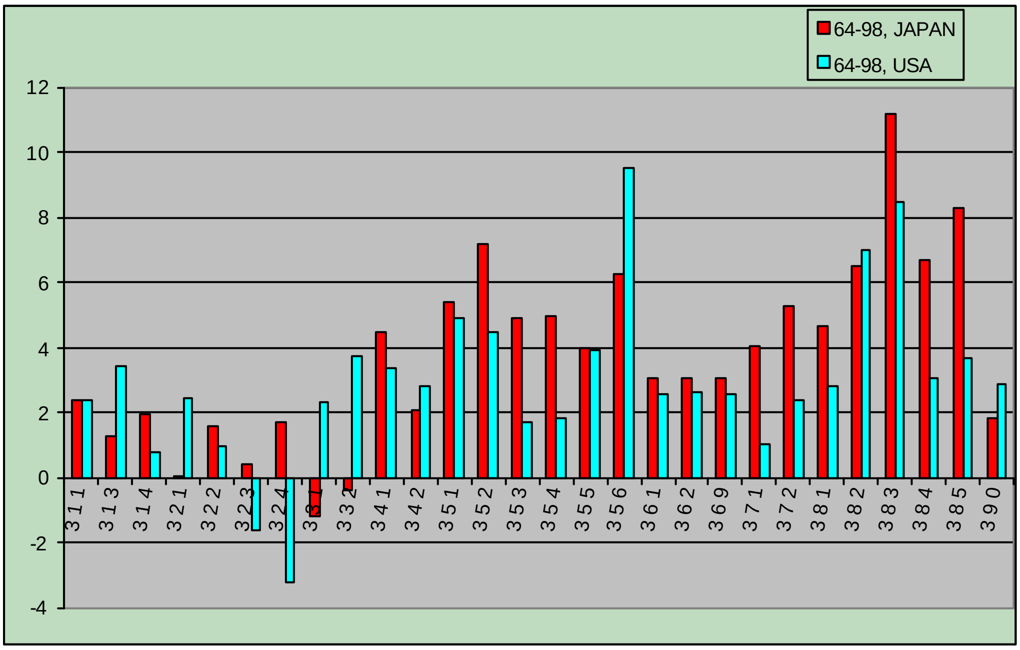
From Figure 3a we would expect no cointegration as the two national series grow in different speeds. Effectively, as the full printout shown in Appendix A2 indicates, all the appropriate tests such as the one based on maximum eigenvalue of the stochastic matrix confirm the non-cointegration of the two indexes of real output for non-ferrous metals. From Figure 3b we can conclude that the first difference between the Japanese and the American series of output ("jadus") is not enough to produce a stationary series; however, when "jadus" is differenced once more ("djadus"), then we have a stationary series; the unit root tests conducted for the four time series (the two original ones plus jadus plus djadus) confirm these conclusions.

Figure 3b Non-ferrous metals, first and second differences



Source: Based on UNIDO, 1999.

Figure 4 Real output, growth rates, for the USA and Japan, 1964-98

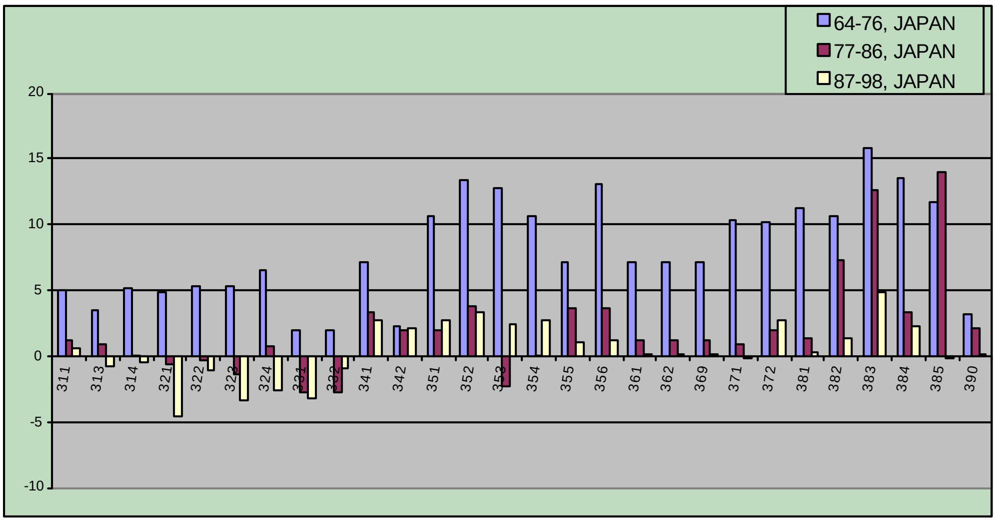


Source: UNIDO, 1999. Note: the code numbers of each sector are indicated on the x-axis. See Appendix A3 for the corresponding names.

1.2 Analysis of three sub-periods

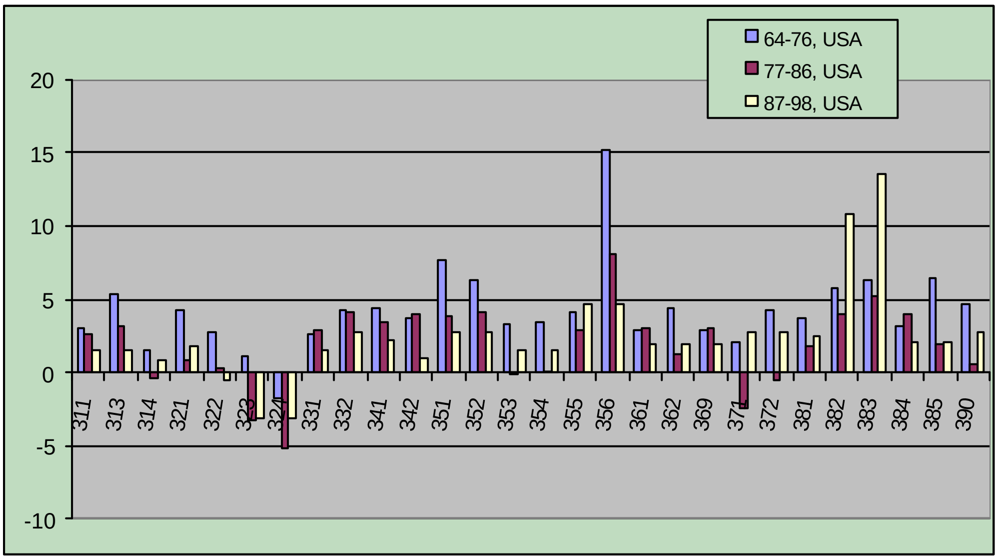
The period 1964 to 1998 will now be split into 3 sub-periods so that more appropriate conclusions can be drawn upon. These sub-periods are between 10 and 13 years long and each one of them includes a major depression (the two oil shocks plus the beginning of the 1990s). The Figures 5 and 6 show the changes in growth between the 3 sub-periods considered.

Figure 5 Japan, Real Output, growth rates, for 3 sub-periods



Source: Based on UNIDO, 1999.

Figure 6 USA, Real output, growth rates, for 3 sub-periods



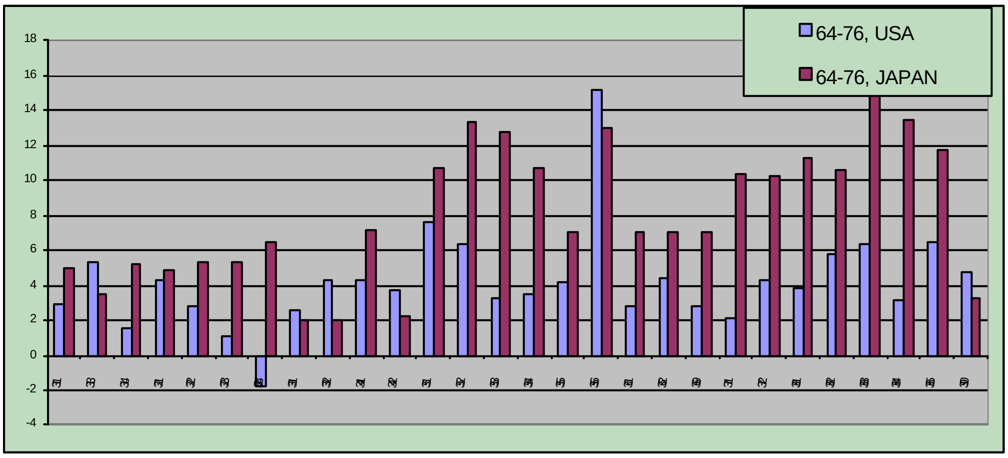
Source: Based on UNIDO, 1999.

From these Figures (5 and 6) it is worth making the following comments. For the USA, the period 1964 to 1976 saw the highest growth rates almost in all sectors, followed by the period 1977 to 1986, with the lowest growth rates occurring in the third period 1987 to 1998. However, there are some outstanding exceptions to these patterns. For the latter period, two industries are now leading the American economy, namely the Non-Electrical Machinery (mainly the computers component) and the Electrical Machinery (mainly the semiconductors component). These two sectors have been experiencing the highest growth rates (at least double the others) amongst all 28 industries during 1987-98 and higher growth rates than in the other two sub-periods. Also, during 1987-98 Iron and Steel has been strongly reviving, and Rubber continued its steadily high growth. It will be further emphasized in this paper that these currently leading sectors of the American economy have been more than any other sector following and imitating the Japanese OIs.

For Japan, it is remarkable how the two oil price shocks have slowed down almost all sectors considerably during the second period 1977 to 1986. The three exceptions to this pattern were the two Machinery sectors, especially the Electrical Machinery (in which the Japanese semiconductor sub-sector was booming during that period), and the Professional and Precision Instruments sector (in which the photographic equipment and the watches sub-sectors established themselves in the world). During the third sub-period 1987 to 1998, all sectors experienced a deep plunge, with the least affected sectors being the Electrical Machinery, the Chemicals, the Non-Ferrous Metals, the Petroleum, the Paper, and the Transport ones. Some explanations will be provided in section 3 regarding the Japanese manufacturing industries' protracted recession during the 1990s.

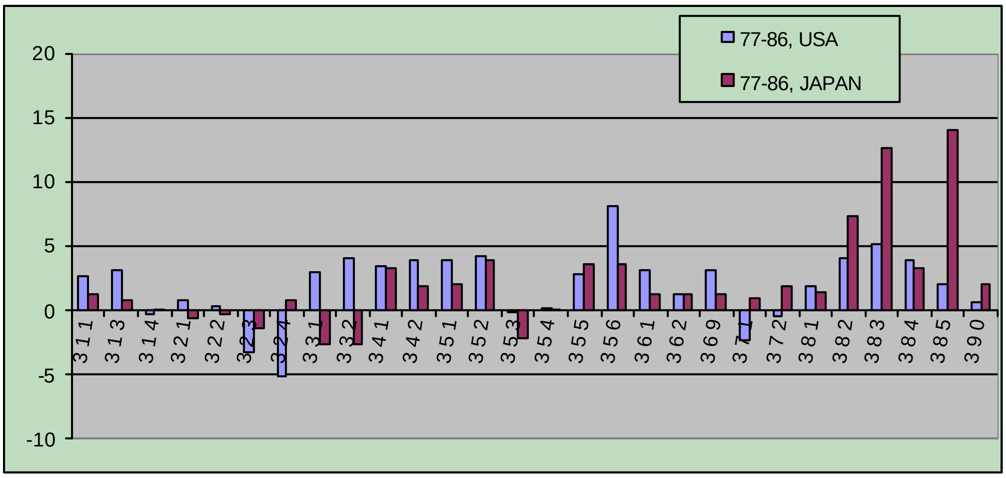
In addition, for each sub-period the growth rates are compared for each sector between the two countries (see Figures 7a, 7b, and 7c). Some remarks are necessary. First, during the period 1964 to 1976, only a limited number of industries showed a higher growth rate in the USA than in Japan (Beverages, Wood, Furniture, Printing, Plastic, and Others). Second, during both periods 1977 to 1986, and 1987 to 1998 the Americans did perform better than the Japanese in most industries. However, an interesting reversal took place between these two periods. Whereas, during 1977 to 1986 the Japanese grew faster in the three leading sectors of Non-Electrical Machinery, Electrical Machinery, and Professional and Precision Instruments, the situation was reversed during the period 1987 to 1998. This is an important finding and is further explored in Sanidas, 2001 where it was shown that when the Americans imitated the Japanese in terms of OIs they started performing like the Japanese (which means they grew very fast).

Figure 7a Real output, growth rates for the USA and Japan, for 1964-1976



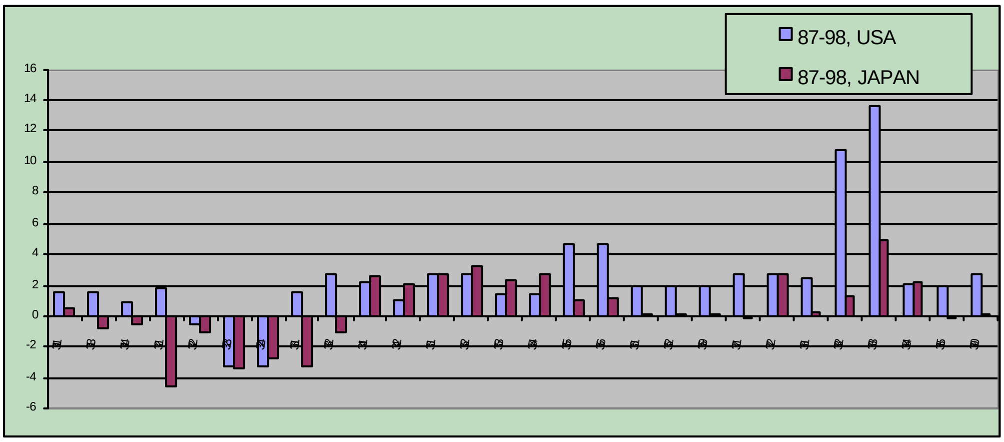
Source: Based on UNIDO, 1999.

Figure 7b Real output, growth rates for the USA and Japan, for 1977-1986



Source: Based on UNIDO, 1999.

Figure 7c Real output, growth rates for the USA and Japan, for 1987-1998



Source: Based on UNIDO, 1999.

Second, there are some sectors (chemicals, petrol, non-ferrous metals, and paper) for which the Japanese growth was still positive in the 1990s. It is especially remarkable for the chemical industries to have been growing strongly and continually during the whole period of 1963 to 1998, despite some criticisms. For example, Arora *et al* (1999) observed "…The availability of imported technology and the general backward state of the chemical industry itself enabled users – firms in downstream sectors - to play a more prominent role in the chemical industry…The *keiretsu* structure therefore exacerbated the tendency, caused by import protection, toward production at scales that were too small to be economic…" (p. 245). However, it was precisely the Japanese characteristics of the chemical industry organization –*keiretsu* structure, many producers, and high degree of product customization etc- that was the reason of the strong continuous growth of that industry. Furthermore, as it can be seen in Figure 1, that both the American and Japanese chemical sectors grew in the same or parallel way after the mid 1970s, despite substantial differences in OIs traits between the two countries.

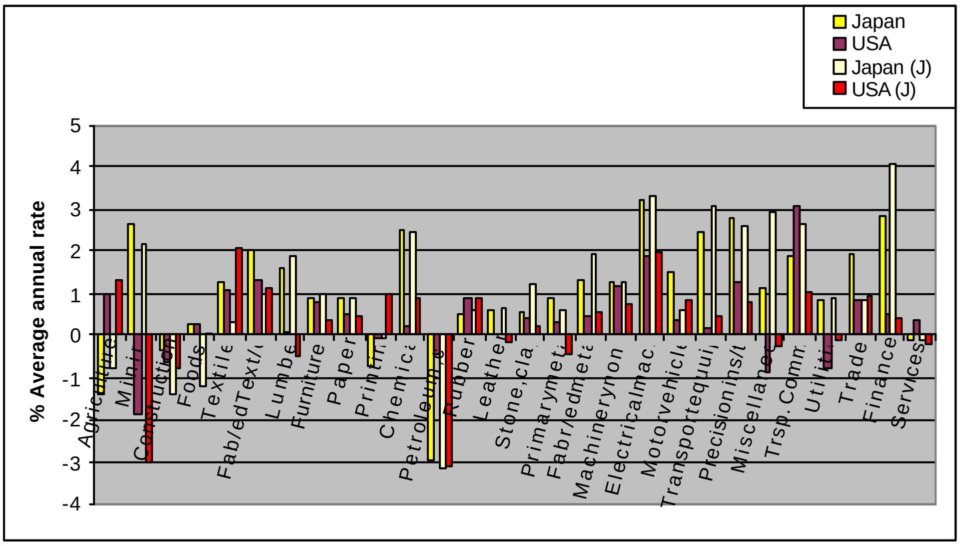
2 TFP and Real Output in the USA and Japan from 1960 to 1985

Figure 8 shows the average annual rate of change in TFP for Japan and the USA, for 28 2-digit sectors, from 1960 to 1980, as they have been calculated by two expert panels, namely, first by Jorgenson *et al* (1995), and second by Kuroda *et al* (1996). The methodology both panels used was quite similar and based on Jorgenson's work (e.g. 1990). The Figure shows, that there are some differences but not significant. Other similar work (for example, Denny *et al*, 1992) confirms these results. The main conclusion out of this comparison is the higher TFP in Japan than in the USA in almost all industries, the clear exceptions being the sectors of agriculture, construction, printing, petroleum, rubber, and services. Hence, the overwhelming majority of the manufacturing 2-digit sectors exhibited higher TFP growth rates for Japan than for the USA during that period.

Another conclusion out of this Figure is that both countries have been experiencing higher growth rates in TFP almost in the same sectors, namely the electrical machinery, precision instruments, non-electrical machinery, transport and communication, and fabricated metals. Japan's growth has been more pronounced in the chemicals, fabricated metals, lumber, leather, transport equipment, miscellaneous manufacturing, and finance.

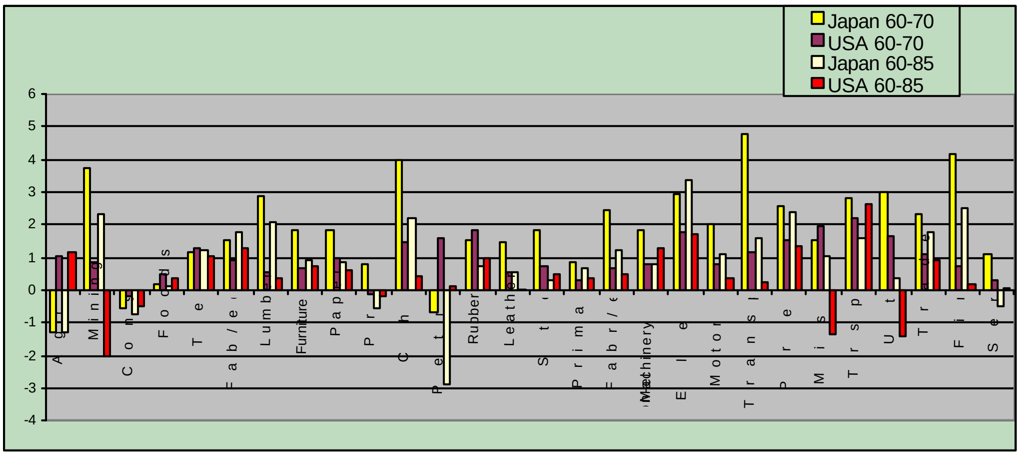
Figure 9 concentrates on the TFP growth rates from 1960 to 1970 and from 1960 to 1985, as calculated by Kuroda *et al* (1996). As expected, TFP was much higher in general for the former period in Japan because the 1960-1985 period included two major depressions due to the oil price shocks. On the contrary, these depressions did not affect the USA to the same extent (which is not a surprising result for this country on account of its large natural resources). Furthermore, the comments made for the Figure 8 are also valid also for this Figure.

Figure 8 TFP for 1960-1980, for both the USA and Japan



Source: Jorgenson *et al* (1995), and Kuroda *et al* (1996); Japan (J) refers to Jorgenson *et al* (1995).

Figure 9 TFP, 2-digit sectors, for 1960-70 and 1960-85, for both the USA and Japan



Source: Kuroda *et al* (1996).

Figure 10 shows the rates of growth of real output for Japan and the USA, for 1960-1985. These rates are consistent with the rates of TFP. It is striking how much higher are the Japanese growth rates both for real output and TFP.

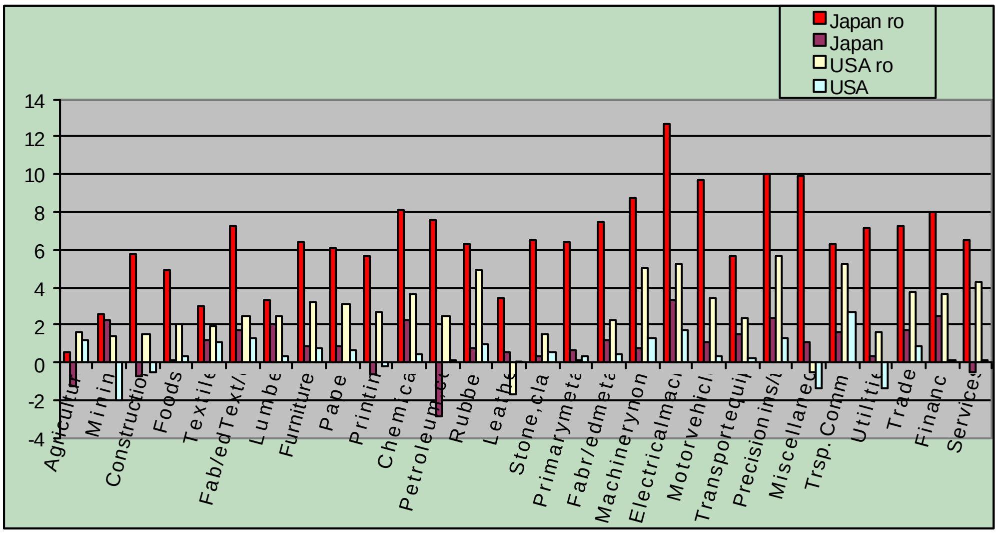
Why did the Japanese economy achieve such a high and sustained economic growth during 1960 to 1985, which was much higher than what the USA experienced during the same period? What role did the OIs play in this development?

The leading manufacturing sectors have been mainly the electrical machinery, motor vehicles, precision equipment, miscellaneous manufacturing, and to a lesser extent fabricated metals, chemicals and fabricated textiles. In all these principal industries (and others in general), the **quality** of the product has been the principal force through which the Japanese firms quickly penetrated foreign markets such as the American ones[5]. However, this statement about quality

[5] This openness started after WWII, contrary to Japan which kept being more protective of its infant industries until quite recently.

begs the question of why the Japanese firms achieved such reputation about quality in their products after WWII. The answer to this question lies in the OI of the JIT/QC system as many scholars have testified (e. g. Porter and Takeuchi, 1999; Womack *et al*, 1990; Abegglen and Stalk, 1985, and others). Here, it is worth reminding the reader that Japanese products were not always renown for their quality. On the contrary before WWII quality was rather absent in these products (for confirmation of this historical fact see Best, 1990; Odagiri and Goto, 1996; and Juran, 1995).

Figure 10 Real output and TFP, for 1960-85, USA and Japan



Source: Kuroda *et al* (1996).

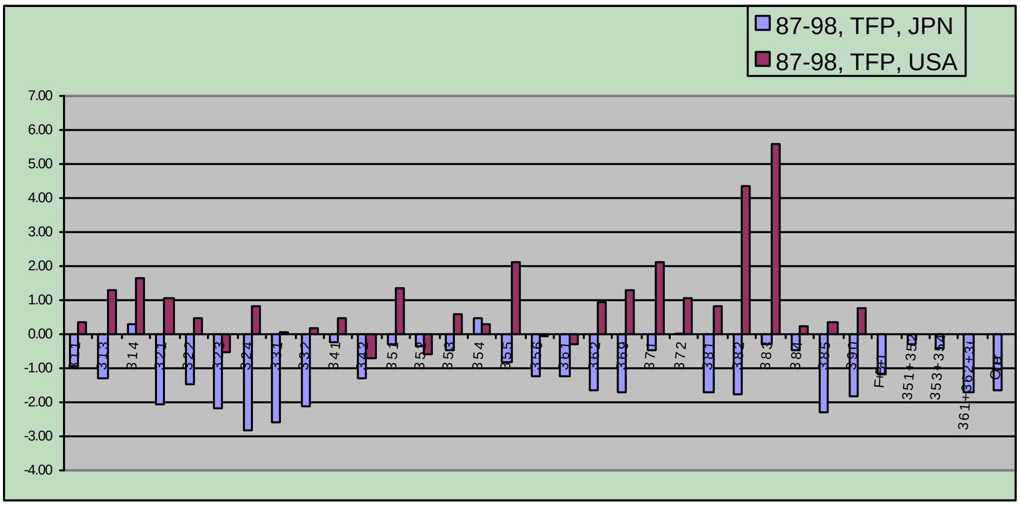
In addition, Japanese firms had a good background of pre-conditions in order to produce several products of a very high quality. These pre-conditions were the existence of a cooperative focal firm specializing in its core competences, with a strong emphasis on human development, strong networks, and cooperation with a patriotic government. The new structure was the establishment of a practical spirit for quality products through the implementation of philosophies such as the TQC, the JIT and low inventories, the market penetration criterion in business, a new production process involving all these elements together, a large number of SMEs, and a strong domestic competition for many manufacturing sub-sectors under new more democratic institutions (for more details see Sanidasa, 2002, and Sanidasb, 2002).

3 TFP and real output in the USA and Japan from 1986 to 1997: Explanations of the recent Japanese Economic Downfall

The following Figures (11 and 12) summarize the comparative data for TFP and real output between the two countries during the period 1987 to 1998. Clearly, these Figures show that Japan has been going through a deep recession during the last 10 years or so, especially in comparison to the USA. The manufacturing sectors that exhibited the least downfall are Non-Ferrous Metals, Transport, Electrical machinery, Chemicals, Iron and Steel, and Paper Products. A full examination and explanation of this recent Japanese economic diving cannot be undertaken here. However, in relation to this study some partial relevant views will now be offered.

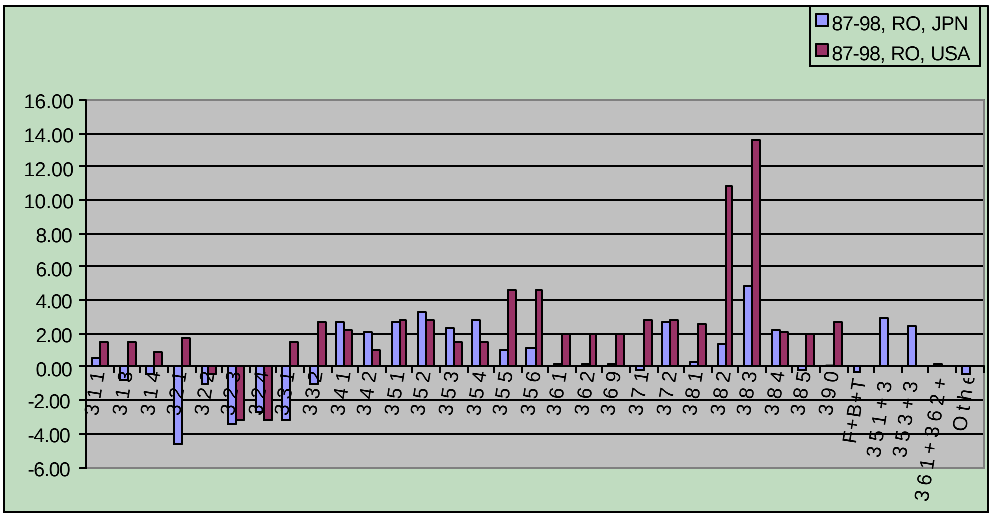
If we have a look again at the graphs of sectoral manufacturing real output for Japan and the USA since 1963 (see Appendix A1), it is easily noticeable that many sectors in Japan stopped growing since a certain date prior to the recent recession. So, though for both these countries, Leather, Footwear, Apparel, and Tobacco have been declining or remained stagnant since the 1970s, many other sectors declined or remained stagnant only for Japan and not for the USA. These were Furniture, Wood Products, Textiles, and Beverages. In total, eight sectors out of the 28 3-digit manufacturing sectors have been performing poorly or even negatively. If on top of these industries we add several service sectors notorious for their inefficiency in Japan (such as public services, and banks) then it becomes evident that Japan is still a dual economy. Thus, we have the leading sectors –transport, machinery- and their satellites –iron and steel, other metals etc- which have been the pioneering moving forces of the Japanese economic miracle, and on the other side we have all the remaining sectors in manufacturing and services which lag behind in performance and effectiveness.

Figure 11 1987-1998, TFP in Japan and the USA



Source: Based on UNIDO, 1999 for both countries; the capital stock data were obtained from NBER, 2000 for the USA, and from EPA, 2000, for Japan.

Figure 12 1987-1998, Real Output (RO) for Japan and the USA



Source: Based on UNIDO, 1999 for both countries.

Many scholars have made similar comments. Porter and Takeuchi (1999) have emphasized the micro-economic nature of recent Japanese failures. First, they stress "…the consensus over Japan's past success has come overwhelmingly from the robust growth of a relatively small number of industries…" (p. 67) such as semi-conductors, machine tools, steel and vehicles. In addition Japan's exports are dominated by a relatively small number of industries in "…automotives, consumer electronics, office machines, and production machinery. In huge areas of the economy there are few if any successful exporters, including chemicals, packaged goods, services, and health care…" (p. 72). Second, the same authors in their extensive study (1999, p. 78) remark:

"…Many of Japan's failures can also be traced to fragmented, inefficient, and anachronistic domestic sectors such as retailing, wholesaling, logistics, financial services, health care, energy, trucking, telecommunications, housing, and agriculture. By design, government policies have created two Japans: one composed of highly productive export industries, the other containing domestic sectors…The inefficient Japan drives up business costs across the board, weakening the competitiveness of the export industries…"

From the OIs point of view, the same writers Porter and Takeuchi (1999) recognize the importance of JIT/QM in Japan's economic growth (p. 71):

"…The model of Japanese corporate success centers on the notion that a company can achieve both high quality and low cost by employing- and continuously improving- fundamentally better managerial practices. The idea is that companies compete by relentlessly staying at the frontier of best practice. This model is not an abstract theory but stems from extraordinary advances made by Japanese companies after the introduction of now well-known managerial practices, such as total quality management (TQM), lean production, and close supplier relationships…"

However, still from the OIs view, the same authors pinpoint some relative weaknesses in Japan's organizational structures. These are various activities such as planning and control, finance, logistics, distribution, order processing, customer information, and after-sale service, information technology, the Internet, marketing, and office operations. Consequently, Porter and Tekeuchi (1999, p. 81) suggest that the "…companies must move from an exclusively egalitarian, seniority-driven model to one where doing things differently is rewarded in compensation, advancement, and opportunities for entrepreneurship…" In the book version of the just cited article, Porter *et al* (2000, p. 189) recommended that Japan must move beyond competition just based on quality products to competing on strategy and innovation that result in 'true profitability'.

According to Mroczkowski and Hanaoka (1998), the following changes have already been taking place in Japan:

1. Performance-based evaluation and rewards: by 1995, 75% of Japanese companies administered pay by competency and merit (and hence not by seniority), whereas in 1987 the relevant percentage was 54%, and in 1978 it was 42%. These figures are supported by other surveys as well.
2. Evidence of change in social values: Japanese employees' attitudes are moving away from loyalty to the company and towards identification with their profession.
3. Manipulation of working time: overall hours worked (including overtime) are being reduced in larger companies. Also the use of flextime systems is increasing. However, both these elements are not true for SMEs.
4. Early retirement: this means a job transfer to a subsidiary or affiliated company under less attractive conditions. Again SMEs lag behind the larger firms in implementing this policy (in 1995, 17% as against 40% respectively).
5. Lifetime employment and transfers: the "koyochosei" (employment adjustment) is now replaced by the "shukko" system (either temporary or permanent transfer to other companies).
6. Employment of women and foreigners: between 1992 and 1995 the proportion of women in management positions has doubled, although still low by international standards. Though attitudes of employers change rapidly, 40% of Japanese companies employ foreigners whose status is still inferior to that of Japanese workers.

The same authors (1998) predict that probably by 2010 the Japanese management system, at least in terms of human resources will be like the Western one. This prediction is based on surveys they conducted with Japanese company managers, academics, and management consultants. However, it seems too difficult to change a history of more than a 100 years within a frame of 10 to 20 years. I think Japan will emerge out of this new crisis (yet another one in the last two centuries) with a new organizational outlook, which will be a marriage between the old features and some new ones and hence it will not be just another Western country.

The analysis in this sub-section so far shows that Japan still has much to accomplish in order to be considered a fully developed country. We often forget that this country's enormous progress since WWII does not necessarily mean that problems of under development do not exist any more. The Japanese dual economic nature will eventually disappear, but until then many changes in terms of OIs must take place. This is consistent with one point of this paper, namely that OIs which are good for one country's economic growth are not necessarily good for another, and that OIs which are good in one historical stage of economic development are not necessarily good for another historical stage. This point is consistent with the contingency theory of management.

Several other authors have taken the same stand vis-à-vis my last remark. It is worth noting that almost 20years ago, Abernathy *et al* (1983), have expressed the same ideas and somehow predicted a Japanese downfall:

> *"…The modern Japanese system of production is not some manufacturing Nirvana, free of all tensions and problems that beset such systems elsewhere. It is the result of a set of deliberate choices and trade-offs and is appropriate not to every economic context imaginable but, rather, to the specific context of postwar Japan. If that country's social or political stability becomes problematical, if the work force ages too greatly, if expectations about living standards rise too quickly, if key industries cannot sustain their rate of growth, if- in short- changing conditions give the lie to the assumptions on which much of that production system rests, it will inevitably show the strain…"* (p. 84)

This extract hints on the contingency theory of management and the 'changing conditions' the authors just mentioned are actually taking place in the most recent decade in Japan. In brief, there are no leading or key sectors any more in that country (as my sectoral analysis has demonstrated above), the work force 'ages too greatly', the younger generation has higher expectations about living standards without the willingness to do the 'dirty' jobs any more, and the social and political stability is no longer so strong in Japan.

The importance of leading sectors in the present economic situation in Japan has been apparently a key issue in economic circles of that country according to Ito (1996, p. 236): "…Unless there is some structural reform, new industries will not emerge and the slow growth will continue. The appropriate kind of reform and the new leading industries that might emerge are debated intensively in Japan…" This author then examined several sectors, which might benefit from structural reform in terms of promoting competition: airlines, telecommunications and broadcasting, financial services, distribution, and agriculture and land use. The same author, like many others, also analyzed the importance of the share and land prices bubble and its collapse in explaining the long recession in Japan. Finally, it is worth noting the role of the globalization tendencies present in many Japanese firms and its consequences in terms of growth in Japan and in terms of changes in OIs such as the sub-contracting process. Ito (1996, p. 220) quotes some figures of employment that are very revealing of the globalization tendencies: the number of employees in the Asian and North American subsidiaries have substantially increased between 1990 and 1994, whereas Japanese manufacturing employment fell in a comparable way during the same period.

Regarding the sub-contracting system and subsequently the role of SMEs, there is gathering evidence that it undergoes substantial changes to accommodate for the very weak demand of consumer products. Turner (1994) observed that Japanese companies were sub-contracting more labor-intensive work overseas, particularly within Asia; also, he remarked that the *keiretsu* system was beginning to loosen up. However, we cannot as yet generalize; for instance Lincoln *et al* (1998, p.242) concluded, "…While some prominent keiretsu partnerships are indeed loosening, elsewhere the form is alive and well…", whereas some other writers took a more extreme stand, e.g., Sugiura (2002) talked about the meltdown of the automobile *keiretsu,* the metamorphosis of industrial agglomerations, and the weakening of the entrepreneurial spirit.

This type of suggestions is also present in other studies such as that of Tezuka (1997); this author also proposes that the intense competitive nature of many Japanese industries might be an impediment to economic growth. In addition, other radical changes are taking place in the last few years; for example, the competition with imports is intensified (Lux, 1997); also, Japan finally ‘goes web crazy’ (Rohwer, 2000). This new direction will certainly alter several economic structures as this last author comments.

> *“…Japan is what you might call a middleman economy, and if there is anything the Internet is great at, it’s killing off middlemen. Whether it’s banking, retailing, or health care, the Internet will lower transaction costs, reduce the number of workers, and streamline communications…”* (Ibid, p. 116)

All these changes and perhaps many others such as firing of employees (a rare phenomenon before this prolonged recession) are indicative that many new OIs will eventually emerge and probably new leading sectors will come forward. Thus, Lux (1997, p. 38) suggests: “…By combining the best of Western management with the best of Japan and the dedication of Japanese employees, companies that will be able to accomplish this transformation process successfully will become awesome competitors again…” Kono and Clegg (2001) also suggest a new hybrid Japanese model of management and production that will retain many existing features and adopt new ones such as horizontal alliances and a more flexible employment. Finally It must be added that the dilemma about whether the ‘Western’ or ‘Japanese’ overall system of production is superior is only a rhetoric question. As I had the opportunity to emphasize several times so far, what is ‘good’ in one country or in one period is not necessarily ‘good’ in another country or in another period (for instance, regarding OIs or TIs).

4 The Role of TIs in the USA and Japan since WWII

In this section a comparison of TIs in the two countries will be outlined (the analysis is far from being exhaustive). This comparison is more an account of what happened in Japan than in the USA, but since Japan has been mainly an imitator of technologies the comparison is rather implicit. Both nations adopted similar technologies almost everywhere, despite some lags and leads of a short duration, mainly because the Japanese firms copied the Americans substantially. This process of technical copying was accompanied by adaptations and appropriate changes to fit the local circumstances; however, the Japanese also introduced new products mainly in the electronics industry (see below) and in personal items such as crystal quartz watches and automatic cameras (cf. Kono and Clegg, p. 206). Thus, the conclusions of this comparison will further support arguments of this paper that differences between the rates of growth of American and Japanese industries are due to differences in OIs and not TIs since the TIs have been basically similar in the two countries in most cases. Consequently, as SMEs function within the context of OIs (for example, SMEs are very important in the context of the JIT/QC system implemented originally in Japan and recently in the USA, cf. Sanidas, 2001) they also follow the impact of OIs on the economy, either negatively or positively.

Before briefly analyzing some major industries in terms of TIs (and incidentally of OIs) it is worth mentioning six important aspects of the Japanese way of importing foreign technology (Odagiri and Goto, 1996, pp. 39-40).

1. Imported machinery and equipment helped many industries in a critical way to improve the product quality and productivity. Domestic machinery manufacturing then tried to reverse-engineer, by copying the imported capital until eventually they completely replaced it.
2. Japanese firms eagerly sought technological agreements primarily with the USA and also with European firms.
3. Consultants, mostly Americans, were hired to help to modernize the production processes.
4. The purchase of blueprints was also common.
5. Japanese companies often sent their engineers abroad to seek promising technologies.
6. Japan restricted direct investment (DI) until the gradual liberalization in the late 1960s and the early 1970s. However, even today, DI still remains at a relatively low level.

4.1 Iron and Steel industries

These industries in Japan like the others described in this sub-section (and generally like all industries) were initially protected by government measures until they took off. At the same time, they were very competitive in their structure as oligopolies. This competition was one of the main reasons why some leading steel firms in Japan were the pioneers in introducing new imported technologies and subsequently improving on them substantially. Following Odagiri and Goto's (1996) account, some examples will illustrate the industry.

At the start of the 1950s, Kawasaki Steel decided to build a new large plant despite the fact that two-thirds of the existing furnaces were then idle in Japan. The real novelty of this plant was related not to TIs but to OIs in terms of location and layout. Whereas it was common to build an ironworks near a coal mine or an iron-ore mine, Kawasaki's entrepreneurial spirit (through its president) built the new plant near the huge market of Tokyo, and it made a layout such that movements of materials and half-made products were minimized. This OI was soon followed by the other steel producers in a very competitive oligopolistic market.

However, it was also TIs that made the Japanese firms the best in the world for the second half of the 20th century. In the first place, the new technology of basic oxygen furnace was imported from Austria, but it was soon found that there were major problems in operating such furnaces. These problems were resolved with some TIs introduced by the Japanese firms and in particular by the Yawata Company, which invented an oxygen converter gas recovery system that was soon adopted worldwide. Secondly, another technology known as continuous casting that was originally developed in Switzerland was imported by the Kawasaki firm who built a new plant with this technology in 1967, again pushed to take such a risky decision by the intense prevailing oligopolistic competition. By 1980, the process continuous casting had been adopted by 60% of the Japanese plants but only 20% of the American plants (Odagiri and Goto, 1996, p. 152). As these two authors remarked:

> *"…As a result of this and other innovations, Japan's productivity increase has outpaced that of other countries with companies starting to export technology and know-how in plant construction and operation to many countries, including both developing countries, such as Brazil, and developed countries, such as Italy and the USA. In 1974 receipt of royalties exceeded payments for the first time among Japanese industries…"*

These 'other innovations' of the above quote were not only TIs but also, and perhaps, mainly, OIs as these two writers emphasized. OIs included the active participation of workers in management and technical matters, so that firms attained company-wide involvement in productivity improvement. Florida and Kenney (1992) have analyzed some of these OIs in Japan and in Japanese direct investment in the USA; thus, the firm NKK, for example, pioneered the use of QC circles in the steel industry; the same authors have also stressed the differences between the American and Japanese TIs and OIs, for instance "…The US steel industry was the paradigmatic case of 'Taylorist' scientific management…In contrast, the Japanese steel industry developed a system of production organization and labor-management relations that harnessed workers' intellectual as well as physical capabilities…" (Ibid, p. 150).

4.2 Automotive industries

Cars were first developed by the Europeans at the end of the 19th century, but it was the Americans with Ford's mass production that popularized the car consumption in the 1910s and 1920s. The Japanese made many attempts to establish their own vehicle industry from the start of the 20th century (Odagiri and Goto, 1996), but it was only in the 1930s that they finally succeeded with Nissan and Toyota. Again, the technology was mostly imported or through reverse engineering adapted and probably improved. Odagiri and Goto, (1996) provide us with some details. Nissan, in their Yokohama plant before WWII bought the whole production equipment including jigs and tools as well as technology from the Graham-Paige Company in Detroit, and shipped them to Japan (this American company was the 14th largest auto producer in the USA but was planning to liquidate because of financial difficulties). Nissan repeated technology importation after WWII when it formed a tie-up with British Austin.

For Toyota, the story is similar to Nissan's but also more creative in terms of both TIs and OIs. One of its engineers stayed in The USA at Ford and other plants, and upon return to Japan he started to disassemble a Chevrolet engine and copy it in an experimental plant built within Toyoda

Automatic Loom. Eventually, Toyota decided to use many of Chevrolet's and Ford's parts and also buy many materials and components from outside suppliers. This was the origin of this company's supplier system. By 1938 Toyota had an R&D division, thus putting an official emphasis on its determination to create its own car technology. This took place much later after WWII with the Corolla model and so on.

The impossibility of foreign firms exporting to Japan or setting up production facilities within Japan led some of them to sell their technology to Japanese firms. Thus, Rootes (UK, producer of Hillman, later acquired by Chrysler and then Peugeot), Renault (France), and Willys-Overland (USA, producer of jeep, later acquired by American Motors and then Chrysler) consented to sell their technology to, respectively, Isuzu, Hino, and Mitsubishi. With these tie-ups started in 1952-3, the Japanese firms succeeded in complete domestic production within 5 years (Odagiri and Goto, 1996. p. 196).

These brief reports of some major car producers in Japan clearly show that the technology in both the USA and Japan was similar since the Japanese mostly imitated Western vehicle producers. Consequently, one can safely conclude that the success of the Japanese car industry did not lie in TIs but in OIs. Odagiri and Goto, 1996. p. 202 summed up the situation as follows.

> *"…The strength of the post-war Japanese automobile industry is probably most evident in the fields of production management and human resource management, including training programs and the TQC (total quality control) movement. Toyota's kanban and just-in-time production system and keiretsu supplier system are well-known…"*

4.3 Electrical and electronic industries

Table 2 shows the major electrical appliances introduced in the postwar era (Mowery and Rosenberg, 1998).

Table 3 Major Electrical Appliances Introduced in the Postwar Era

1950s	1960s	1970s	1980s
Refrigerator-freezer	Color television	Microwave oven	Home computer
Television	Dishwasher	Heat pump	Large-screen television
Clothes dryer	Central air conditioning	Trash compactor	Video cassette recorder
Automatic washing machine	Space heating	Food processor	Compact-disc player
Room air conditioner	Frost-free refrigerator-freezer		Home satellite receiver
	Waste disposal		

Source: Mowery and Rosenberg, 1998, p. 108

Although color TV was initially developed by the Americans and Europeans in the 1960s, the Japanese not only, once more, successfully imitated at the beginning, but they also introduced their own creations in terms of the Trinitron tube by Sony and a solid-state color receiver by Hitachi (Clark, 1987). Several other new products were developed in this industry, such as games machines, high quality LCDs and DVDs, as it is demonstrated below.

Although the Americans invented the transistor in 1947, it was only in 1955 that the Japanese succeeded in making a transistor themselves after some years of struggle especially in purifying silicon to almost 100%. Odagiri and Goto (1996, p. 166) quoted one of the Japanese 'inventors', Kikuchi saying: "…Some people say that the transistor was just a borrowed technology. I would like to say from my own experience that the transistor is a kind of thing that, if you can copy it, it in itself is a spectacular achievement…" Sony's transistor radio tells us a similar story. Though Sony had already developed and marketed tape recorders by 1952, it was not until it made the transistor radio another successful consumer product that this company became a household name and a multinational. At the beginning of production and marketing of this radio the ratio of defects was very high despite the huge efforts by Sony's Ibuka to technically improve the transistor quality; at the same time competition by other large producers became intense very soon. As Odagiri and Goto (1996, p. 168) narrated:

"…The only solution was to reduce defects. According to Ibuka, it was the instinct and insistence of a female production worker to scrutinize all the processes to find out the causes of defects. Following her suggestions, the engineers started the cumbersome task of testing every product at every point of the process and came to the conclusion that the use of antimony caused the problem. After several trials, they started using phosphorus instead and the yield rate greatly improved. This innovation helped Sony to solve both of the problems above and put the company in a more advantageous position in its competition against other larger rivals…"

Sony's case just briefly described also shows another aspect of interplay between OIs and TIs, that is, the workers' participation in improving the product and the production process, which is an OI, has a positive impact on TIs.

The integrated circuits (ICs) became a practical device around 1959 with the invention of solid-state circuits by the Texas Instruments, and the introduction of planar processing to interconnect circuit elements at Fairchild Semiconductors in the USA. Despite some new methods to bypass the planar processing by Hitachi and Toshiba, the semiconductor technology was initially developed in Japan because of the world's first electronic calculator introduced by Sharp in 1964 (Odagiri and Goto, 1996, p. 171) priced at US$1400. By 1969, Sharp had reduced its price to US$300 by using American large-scale ICs (LSI) (produced by Rockwell). Before this last version, Sharp had used Japanese metal oxide semiconductor ICs produced by Mitsubishi, Hitachi, and NEC. In 1971 there were at least 20 Japanese and several foreign firms (thus making a total of 33) producing a similar calculator to that one by Sharp. The calculator war eventually ended leaving only two survivors, Sharp and Casio.

However, as Odagiri and Goto (1996, p. 173) remarked: "…The Japanese suppliers had by then established LSI technology and their reliability in quality and delivery helped them to regain a position as the main suppliers of semiconductors to calculator producers…" For instance, in terms of quality, in a test of about 300,000 memory chips (bought from American and Japanese firms) conducted by Hewlett-Packard in the late 1970s, none of the Japanese lots was rejected because of failures, whereas the failures for American chips ranged from 0.11 to 0.19 per cent (Ibid, p. 274). As it was mentioned earlier, the quality control and just-in-time processes (JIT/QC) were the main weapons that Japanese firms had against the American technical superiority in order to establish themselves in world markets. Thus, once more, OIs seem to prove themselves as being very important in promoting industrial growth through leading firms.

Finally, regarding the origins of microprocessors, Intel in the USA was the innovator in 1971 with the 4004 model. Once again, the Japanese firms were the followers, though as Odagiri and Goto (1996, p. 173) remarked, it was also a Japanese engineer who helped Intel to develop the first two microprocessors, which triggered the PC (personal computer) revolution.

5 More evidence from two leading sectors

5.1 The Semiconductor Industry

(A story based on Langlois and Steinmueller's (1999, pp. 19-78) analysis of the world evolution of this industry).

This industry started with the invention of the transistor by American researchers in the Bell telephone Laboratories after WWII. This invention became innovation in business through AT&T's commercial applications and this company's policy to let the diffusion of the new technology to many other interested parties. Subsequent researchers and entrepreneurs gradually established what is known today as the 'Silicon Valley", a Marshallian industrial district in the 1950s. In the first place, the germanium metal was used for the transistor, but it was taken over by the silicon substance towards the end of the 1960s. During that time, the American Defense department was the main user. By 1960-61, the Americans were producing and consuming semiconductors about 10 times more than the Japanese, and 20 times more than the major European countries. Meanwhile, Japan through some governmental protectionist policies boosted the Japanese semiconductor industry, which thus, had an export surplus from 1956 to 1968. About 70% of this industry's market remained in consumer electronics such as transistor radio.

Then, the integrated-circuit (IC) era arrived. This era revolutionized the whole electronics industry and the whole economy eventually. This can be seen through the explosive way that IC grew in 30 years (from about 1960 to 1990): "…Transistor counts per IC increased from 10 to 4,000 in the first decade of the industry's history; from 4,000 to over 500,000 in the second decade; and from 500,000 to 100 million in the third decade…" (Ibid, p. 32). One of the impacts this new revolutionary technology had on the American semiconductor sector was that the vertically integrated American electronics companies that had led to the production of vacuum tubes, and that had been able to stay in the race during the discrete semiconductor era, became almost completely non-existent by 1975 from the top list of relevant leading firms. At the same time many relatively specialized new and smaller manufacturers entered the market; this was consistent with the strategy of 'core competences' (Prahalad and Hamel, 1990) as the authors Langlois and Steinmueller remarked (1999, p. 33).

Meanwhile, a parallel strong development of the computers industry helped IBM become the dominant firm not only in computers but also in semiconductors during the 1970s. Thus, in the USA, there was, besides the two giant captive producers AT&T and IBM, a cluster of many, small, highly specialized merchant firms, which focused on their core competences while expanding their technical abilities. All these companies faced two options, either to produce high volume standard products such as memories, or/and to produce differentiated products. For a time, they were able to do well with both sets of strategies.

However, during the period between late 1970s and late 1980s, the situation changed dramatically. Whereas in 1978, American sales of semiconductors and IC constituted 59% and 74% respectively of the world market as against 28% and 20% for Japan, in 1989 the corresponding figures were 43% (semiconductors), 45% (IC) for the USA and 48%, 47% for Japan. The authors (Ibid, p. 41) explained that since the profit margins of the American semiconductor (and IC) industry has always been relatively low, not enough investment was possible from retained earnings for a flexible and dynamic production path with serious ups and downs of economic activity. On the contrary, the Japanese firms being more vertically integrated than the American ones in this particular industry were able to mobilize internal capital resources to make the necessary investments to expand capacity and enhance manufacturing quality.

Indeed, the Japanese firms expanded their production of IC capacity in order to produce the emerging dynamic random-access memory (DRAM) market in very large quantities. This strategy was assisted by a strong internal end-use demand originating mainly from consumer electronics and to a lesser extent from telecommunications. This entire situation was further assisted by the active involvement of NTT (Nippon Telegraph and Telephone) and of MITI. Did the Japanese finally dominate the world semiconductor industry? (Meanwhile the Europeans were never able to threaten the American-Japanese supremacy in this field)

The answer is no. The American resurgence took place from the late 1980s and still runs its course. Despite the concentration of American firms on producing NMOS (negative metal oxide semiconductor) in the first place, they switched on to the more used CMOS (complementary MOS) with considerable success. Overall, "…What evidence is there that American firms improved their manufacturing productivity significantly?" the authors asked (Ibid, p. 49). Besides the indirect evidence that they held their market shares in a number of product segments,

> *"…There is also more direct evidence. One of the factors driving the success of Japanese firms in memory products in the early 1980s was the higher quality of the chips they produced. For Japanese chips, defect rates- the fraction of chips that prove to be defective – were probably half to one-tenth the rates for American products. By the second half of that decade, however, American firms had dramatically increased expenditures for quality control, imitating Japanese practices such as total quality management (TQM), greater attention to preventive maintenance, and automated process control and monitoring. By the early 1990s, American manufacturers had probably begun to match the defect levels of their Japanese counterparts. Intel reportedly reduced its defect rate by a factor of 10. There is also evidence that American firms have improved manufacturing yield rates and direct labor productivity since the early 1990s…"* (Ibid, p. 49).

Furthermore, the American semiconductor (and CI) industry (ASI) became gradually more narrow-product focused, and more specialized, building on existing competences in design (especially of logic and specialty circuits, such as the microprocessor unit (MPU). The increasing decoupling of design from production reinforced this specialization; at the same time, the ASI became more globalized.

Finally, the governments' role in shaping the new situation was positive but not significant to the point of being predominant. For instance, the American and Japanese authorities signed the Semiconductor Trade Agreement (STA) in 1986 to control prices and monitor outputs, which induced the MITI to create a mechanism to police and manage the Japanese cartel of chip producers. Eventually, for other reasons as well, that cartel collapsed. In the USA, the Semiconductor Manufacturing Technology Consortium (Sematech) mainly contributed in the enforcement of cooperation between the American chip producers, thus imitating again the "Japanese Model" of collaboration, cooperation, and coordination within the system of *keiretsus*.

Table 4 Differences between ASI and JSI

The ASI	The JSI
Smaller independent firms clustered in industrial districts	IC producers are also typically computer producers
Efforts concentrated in core competences	Failure to develop a vibrant domestic personal computer industry
Fragmentation and vertical specialization	More vertically integrated firms
Finer division of labor	Consumer-related applications
Wider network of capabilities	Memory -intensive chips production (e.g. DRAMs)
Burgeoning domestic personal computer industry and market	Mass production and low value per unit produced
Computer-related applications	No major consumer-related new products in the last 12 years or so
Design-intensive logic chips production (e.g. MPUs)	Intense competition between large producers, mainly *keiretsus*
High value per unit produced	The DRAMs market penetrated by other Asian countries (especially Korea, Taiwan)
Recent practices of TQC, JIT	Traditional practices of TQC, JIT

Source: Based on Langlois and Steinmueller's (1999)

The revival of the ASI can be gauged by considering the firm Intel, which became the largest IC producer in the world, with sales of $9.85 billion in 1994, $1 billion more than the second largest producer NEC of Japan. Intel's principal competitors are also American firms, such as Motorola, Cyrix and AMD.

Based on the same source, Table 4 summarizes the differences between the ASI (especially during its revival between the late 1980s and now) and the Japanese semiconductor industry (JSI). The emphasis in this Table is put onto various aspects of OIs.

5.2 The Personal Computer (PC) Industry and the Dell Computers Corporation (Dell CC)

(A story based on Thomson and Gamble's (2001, pp. C-132 to C-173) analysis of the evolution of this industry in the USA in the most recent period).

DELL CC is one of the most successful business stories in the USA in the last 20 years. It is also an excellent example of how an entrepreneur (M. Dell), his managers and his personnel have pioneered in introducing OIs (and not TIs) in order to become the industry's leader not only in the USA but also in the whole world. The initial OIs were marketing-oriented: Dell's new company in 1984 was able to sell IBM clones at about 40% below the price of an IBM PC; also, Dell sold his computers directly to large customers and eventually to individual customers through the internet. By late 1997, Dell had become the global industry leader in keeping costs down by achieving what Dell called a 'virtual integrated' firm- "…a stitching together of Dell's business with its supply partners and customers in real time such that all three appeared to be part of the same organizational team…" (p. C-136).

Overall, Dell's three golden rules have become: (1) Disdain inventory, (2) Always listen to the customer, and (3) Never sell indirect. The first rule will now be closely scrutinized.

The companies, which started the PC industry in the 1980s, manufactured many of the components themselves, thus being at least partially vertically integrated. However, as the industry grew very rapidly, as TIs were introduced more frequently, the PC manufacturers could not keep pace with being experts on all fronts, thus more and more specialist firms emerged that could mass-produce cheaper and technologically advanced components. Consequently, vertical disintegration became more and more prevalent in PC producers. DELL CC's first steps consistent with its established rule to sell directly to customers have captured this tendency for vertical disintegration. All this entailed two fundamental features of this company: an extensive outsourcing and virtually no in-house stock of finished goods inventories. Dell's build-to-order policy has been working in all directions.

DELL CC established long-term relationships with its best suppliers, such as Intel and Sony, and laid the basis for JIT delivery of suppliers' products to Dell's assembly plants. At the same time, DELL CC itself practiced JIT, thus yielding major cost advantages and shortening the time it took for Dell to get new generations of its computer models into the marketplace. The authors Thomson and Gamble (2001, p. C-150) quoted Dell himself explaining the economics of minimal inventories.

> *"…If I've got 11 days of inventory and my competitor has 80 and Intel comes out with a new 450-megahertz chip, that means I'm going to get to market 69 days sooner. In the computer industry, inventory can be a pretty massive risk because if the cost of materials is going down 50% a year and you have two or three months of inventory versus 11 days, you've got a big cost disadvantage. And you're vulnerable to product transitions, when you can get stuck with obsolete inventory…"*

The results of this deliberate JIT philosophy are impressive: only a few days of inventory for some components and a few hours for others. In 1995, DELL CC averaged an inventory turn ratio of 32 days; in 1999, the ratio was 6 days' supply; the long-term goal is to reach a 3-day average supply. All these efforts have made DELL CC the low cost leader of the PC industry, and a high profit company.

Still regarding the JIT system, it is worth quoting the authors Thomson and Gamble (2001, p. C-147-48) about a change of the operations on the shop floor that generated a huge productivity increase. This quote shows in a very concrete manner a good example of the POM and its related kinetic costs as these were fully explained in the previous chapter.

> *"…Until 1997, Dell operated its assembly lines in traditional fashion, with each worker performing a single operation. An order form accompanied each metal chassis across the production floor; drives, chips, and ancillary items were installed to match customer specifications. As partly assembled PC arrived at a new workstation, the operator, standing beside a tall steel rack with drawers full of components, was instructed what to do by little red and green lights flashing beside the drawers containing the components the operator needed to install. When the operator was finished, the drawers containing the used components were automatically replenished from the other side, and the PC chassis glided down the line to the next workstation. However, Dell reorganized its plants in 1997, shifting to 'cell manufacturing' techniques whereby a team of workers operating at a group workstation (or cell) assembled an entire PC according to customer specification. The shift to cell manufacturing reduced Dell's assembly times by 75 percent and doubled productivity per square foot of assembly space…"*

DELL CC's OIs will now summarized so that a whole picture can be obtained.

- Build-to-order manufacturing
- Partnerships with suppliers
- JIT components inventories
- Direct sales to customers

- Award-winning customer service and technical support
- Pioneering use of the Internet and e-commerce technology
- Strong demand forecasting skills
- Comparative advertisements
- Team work at all levels
- Avoidance of hierarchical structures in governance

All these OIs (the TIs were almost absent) made DELL CC the leader in the PC industry surpassing previous leaders such as IBM and Compaq in a very short time. Now, DELL CC's main competitors are trying to imitate the leader by introducing their own JIT process, their build-to-order manufacturing and to speed new models to market. However, it is hard to duplicate Dell's approach, as previous cases in other industries have shown. Thus, as of mid-1999 Compaq's order-to-delivery time was approximately 12 days versus 3.1 days at Dell (Thomson and Gamble (2001, p. C-165).

To sum up this fascinating story, M. Dell started his company from zero in 1984 and today is the world leader followed by Compaq, IBM, Hewlett-Packard, Gateway, Toshiba, about 30,000 resellers of generic or 'house-label' PCs in North America alone and countless thousands more worldwide. All this was achieved by adopting or introducing OIs and virtually no TIs at all. Dell's story in the PC industry is similar to Toyota's story in the car industry, as far as the importance of OIs is concerned (that is, regarding the JIT/QC or LP system).

CONCLUSIONS

The analysis presented in this paper has attempted to show –in an indirect way, through a comparison between American and Japanese firms and sectors -that the same SMEs that played a positive role in the Japanese economic miracle during the 1970s and 1980s were not sufficient to restore the Japanese economy in the last 10 years or so. At the same time, the same American SMEs that did not perform well during the 1970s and 1980s did exceptionally well during the 1990s. It is thus proposed in this paper that the positive role of SMEs in economic growth can only be properly appreciated if examined within the context of OIs. The latter are the real moving force in accelerating manufacturing growth as it was shown in this study and in Sanidas, 2001.

Three more general conclusions can be drawn from this paper. First, during the period 1964 to 1998, the manufacturing sectoral growth in the two counties was quite different; the differences, as detected by graphs and some cointegration tests, were due to differences in the adopted OIs amongst other factors. Thus, during the 1960s up to the mid 1980s, most Japanese industries exhibited very high growth rates both in the real output and TFP, contrary to the American industries. This was primarily due to the high quality and low cost of many Japanese products, and hence it became easy for Japanese firms to penetrate national and foreign markets. This last conclusion is supported by the review of TIs in the two countries, which confirms the tendency by Japanese firms to imitate foreign TIs, though in some instances these firms dominated world markets by launching new products (mainly in the consumer electronics sector); thus, the common TIs used in the majority of both American and Japanese firms reinforces the conclusion that it was in the area of differences in OIs that a more comprehensive explanation can be sought for the substantial differences in manufacturing sectoral growth in real output and TFP between these two countries in the period between the 1960s and the mid 1980s. During this period, the most notorious Japanese leading firms were in the transport, electrical and electronics sectors, which all adopted the holistic JIT/QC system as the fundamental OI in their production processes.

Second, during the sub-period 1987 to 1997, the situation was reversed between the two countries in several ways. Whereas the machinery, both mechanical and electrical, industries led the American revival of the American economy, in Japan there was no leading sector for the first time in a long time in the Japanese economic history. The Japanese industries are still in a deep and prolonged recession since the beginning of the 1990s; a brief review of the reasons for this downfall seems to strongly indicate that the dual character of the Japanese economy, the inexistence of leading firms and sectors, and a search for new OIs in the management of firms in Japan are the main factors that are contributing to this recession.

And third, more detailed accounts of two leading industries and their corresponding leading firms add more evidence of the importance of OIs in manufacturing sectoral growth as discussed in this paper. In particular, the outstanding importance of JIT/QC was recognized in these case studies.

REFERENCES

Abernathy W. J., Clark, K. B. and Kantrow, A. M. (1983), *Industrial Renaissance, Producing a Competitive Future for America*, Basic Books Inc. Publishers, New York.

Acs, Z. J., Carlsson B. and Karlsson C. (Eds), (1998), *Entrepreneurship, Small and Medium-Sized Enterprises and the Macroeconomy*, Cambridge University Press, New York.

Arora, A. A., Landau, R. and Rosenberg, N. (1999), "Dynamics of Comparative Advantage in the Chemical Industry", in Mowery, D. C. and Nelson, R. R. (Eds), *Sources of Industrial Leadership, Studies of Seven Industries*, Cambridge University Press.

Best, M. H. (1990), *The New Competition, Institutions of Industrial Restructuring*, Polity Press.

Clark, P. A. (1987), *Anglo-American Innovation*, Walter de Gruyter, Berlin

Denny, M., Bernstein, J., Fuss, M., Nakamura, S. and Waverman, L. (1992) "Productivity in Manufacturing Industries, Canada, Japan and the United States, 1953-1986: Was the 'Productivity Slowdown' Reversed?", *Canadian Journal of Economics*, **25** (3), pp 584-603.

Dicken, P. (1998), *Global shift : transforming the world economy*, Chapman, London

EPA (Economic Planning Agency), (2000), *Gross Capital Stock of Private Enterprises, 1983-1998*, Department of National Accounts, Economic Research Institute, February.

Florida, R. and Kenney, M. (1992), "Restructuring in Place: Japanese Investment, Production Organization, and the Geography of Steel", *Economic Geography*, **68** (2), pp 146-173.

Ito, T. (1996), "Japan and the Asian Economies: A Miracle in Transition", *The Brookings Papers on Economic Activity*, **2**, pp 205-272.

Jorgenson, D. W. (1990), "Productivity and Economic Growth" in E. R. Berndt and J. E. Triplett (Eds), *Fifty Years of Economic Measurement*, NBER, Studies in Income and Wealth, Vol 54, pp. 19-118, The University of Chicago Press, Chicago.

Jorgenson, D. W., Kuroda, M. and Nishimizu, M. (1995),"Japan-US Industry-Level Productivity Comparisons, 1960-1979", in Jorgenson D. W., *Productivity: vol. 2, International Comparisons of Economic Growth*, The MIT Press, Cambridge.

Juran, J. M. (Ed) (1995), *A History of Managing for Quality, The Evolution, Trends, and Future Directions of Managing for Quality*, ASQC Quality Press, Milwaukee, Wisconsin

Kono, T. and Clegg, S. (2001), *Trends in Japanese Management, Continuing Strengths, Current Problems and Changing Priorities*, Palgrave.

Kuroda, M., Motohashi, K. and Shimpo, K. (1996), "Issues on the International Comparison of Productivity: Theory and Measurement" in Chapter 2 of OECD's publication *Industry Productivity, International Comparison and Measurement Issues*.

Langlois, R. N. and Steinmueller, W. E. (1999), "The Evolution of Competitive Advantage in the Worldwide Semiconductor Industry", in Mowery, D. C. and Nelson, D. D. (Eds), *Sources of Industrial Leadership, Studies of Seven Industries*, Cambridge University Press.

Lincoln, J .R., Ahmadjian, C. L. and Mason, E. (1998), "Organizational Learning and Purchase-Supply Relations in Japan: Hitachi, Matsushita, and Toyota Compared", *California Management Review*, Spring, **40** (3), pp 241-264.

Lux, W. (1997), "Japanese Management Evolves Again", *Management Review*, June, **86** (6), pp 36-38.

Mowery, D. C. and Rosenberg, N. (1998), *Paths of Innovation, Technological Change in 20th-Century America*, Cambridge University Press.

Mroczkowski, T., and Hanaoka, M. (1998), "The End of Japanese Management: How Soon?", *Human Resource Planning*, **21** (3), pp 20-30.

NBER (National Bureau of Economic Research), (2000), *NBER-CES Manufacturing Industry Database*, E. J. Bartelsman, R. A. Becker, and W. B. Gray, June, NBER Internet Site: www.nber.org.

Odagiri, H. and Goto, A. (1996), *Technology and Industrial Development in Japan, Building Capabilities by Learning, Innovations and Public Policy*, Oxford University Press, Oxford.

Porter, M. E. and Takeuchi, H. (1999), "Fixing What Really Ails Japan", *Foreign Affairs*, May/June, **78** (3), pp 66-81.

Porter, M. E., Takeuchi, H. and Sakakibara, S. (2000), *Can Japan Compete?*, MacMillan Press, London.

Rohwer, J. 2000), "Japan Goes Web Crazy", *Fortune*, February 7, **141** (1), pp 115.

Sanidas, E. (2001), "The Successful Imitation of the Japanese Lean Production System by American Firms: Impact on American Economic Growth", Refereed Paper, *Proceedings of the Academy of International Business (AIB) South East Asia Region (AIBSEAR) 2001 Conference*, Jakarta, Indonesia, 4-6 July, CD.

Sanidas, E. (2002a),

Sanidas, E. (Forthcoming, 2002b), "On the Evolution of Organization of Firms, SMEs, and Economic Growth in the USA and Japan", in C. Harvie and Boon-Chye Lee, (Eds.), *Sustaining Growth and Performance in East Asias: The Role of Small and Medium Sized Enterprises,* Edward Elgar, Cheltenham.

Sugiura, K. (Forthcoming. 2002), "Japan: The Role of SMEs in the Mature Economy", in C. Harvie and Boon-Chye Lee, (Eds.), *The Role of SMEs in National Economies in East Asia,* Edward Elgar, Cheltenham.

Tezuka, H. (1997), "Success as the Source of Failure? Competition and Cooperation in the Japanese Economy", *Sloan Management Review*, Winter, pp 83-93.

Thomson, A. A. and Gamble, J. E. (2001), "Dell Computer Corporation: Strategy and Challenges for the 21st Century", in Thomson, A. A. Jr. and Strickland A. J. III, *Strategic Management, Concepts and Cases,* 12th edition, Mc-Graw-Hill/Irwin, Boston.

Turner, L. (1994), "Japan Suffers in the Slump", *International Management*, March, **49** (2), pp 30-32.

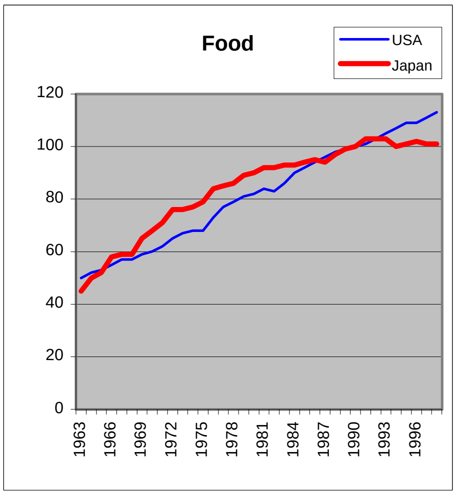
UNCTC (United Nations Centre on Transnational Corporations), (1985), *Transnational Corporations in World Development, Third Survey*, UN and Graham and Trotman, London.

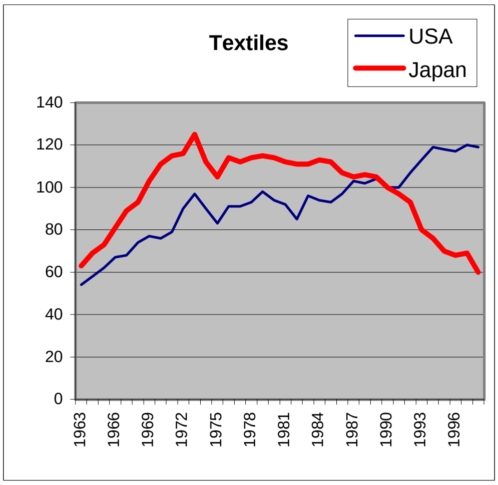
UNIDO (United Nations Industrial Development Organization), (2000a), *Industrial Statistics Database, 3-digit ISIC 2000*, CD.

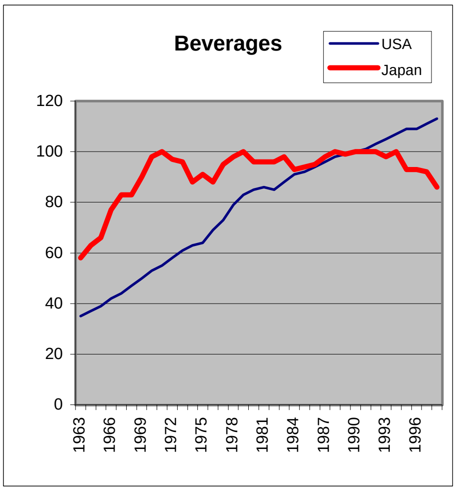
UNIDO (1996, 2000b), *International Yearbook of Industrial Statistics,* Vienna

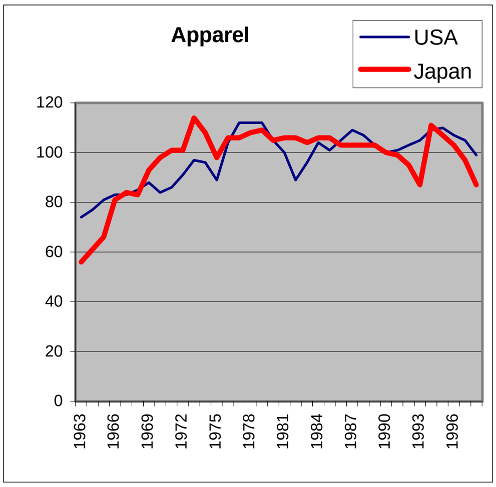
APPENDIX 6.A1:

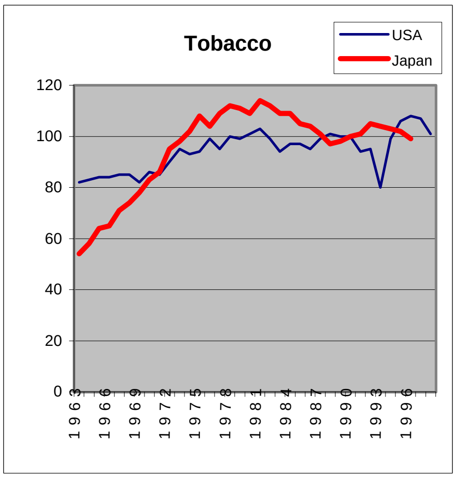
Indices of real output in 3-digit SIC sectors in the USA, 1963 to 1998

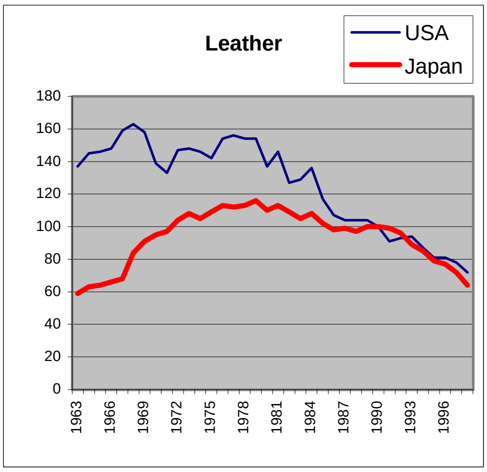








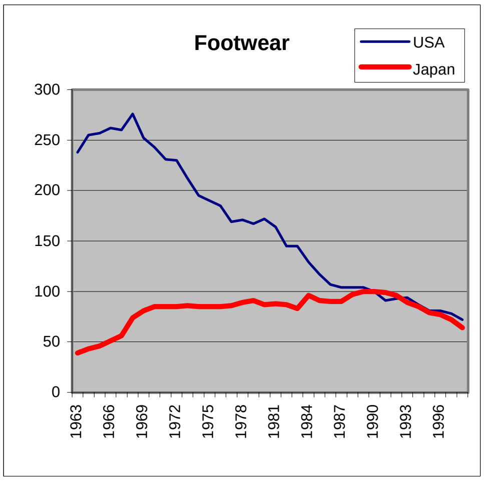


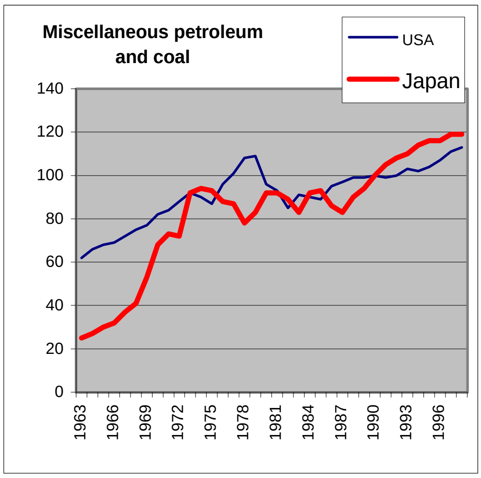


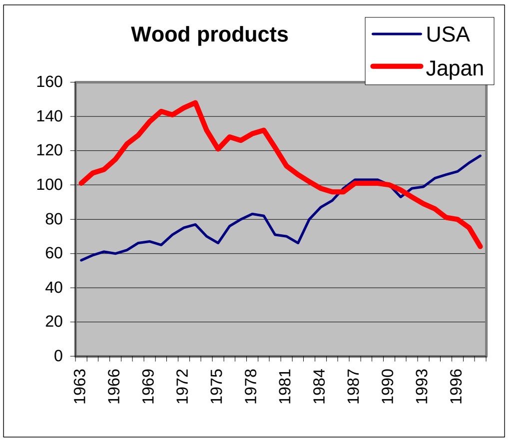
APPENDIX 6.A1:

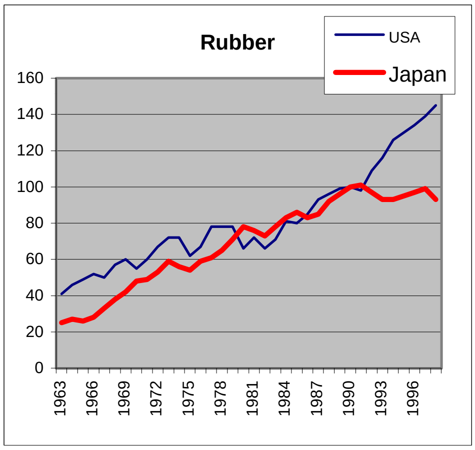
Indices of real output in 3-digit SIC sectors in the USA, 1963 to 1998

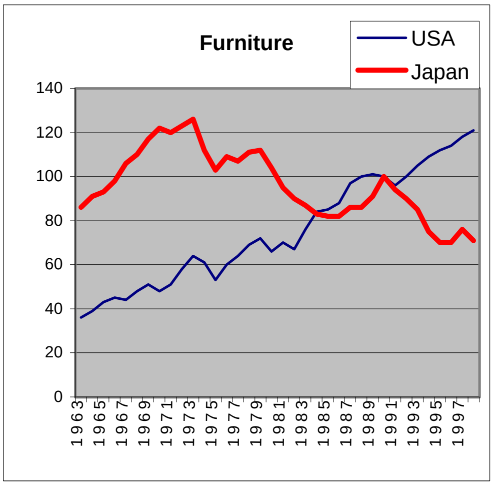
cont…

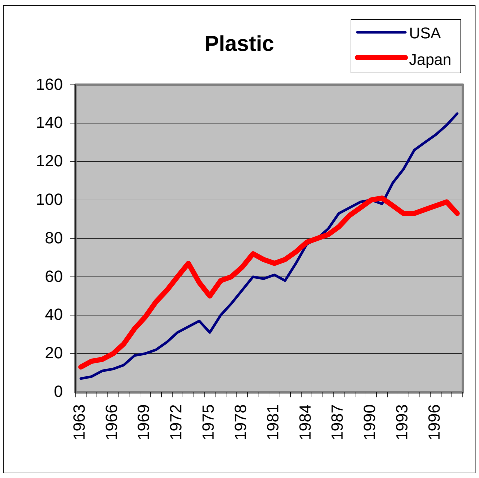






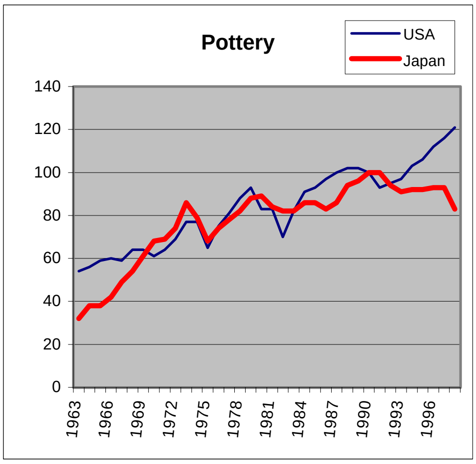


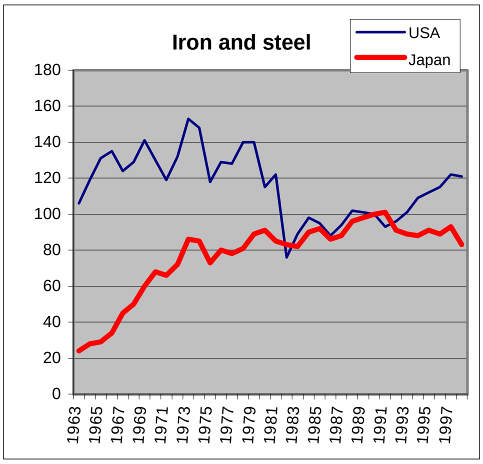


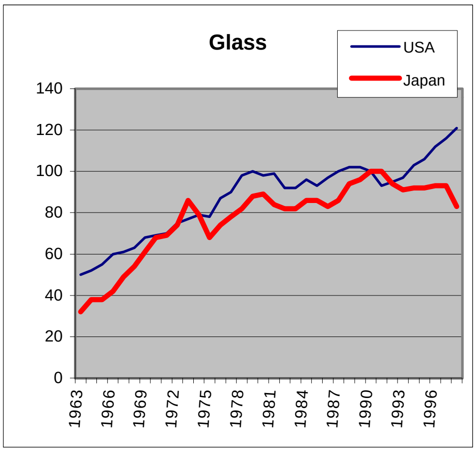


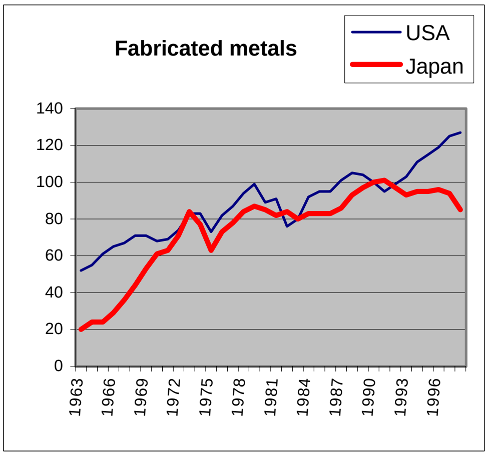
APPENDIX 6.A1:

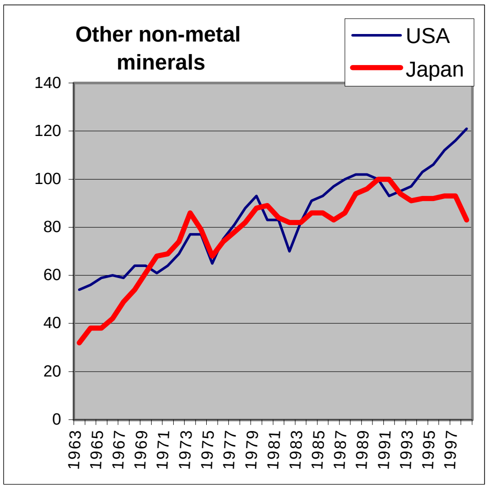
Indices of real output in 3-digit SIC sectors in the USA, 1963 to 1998
cont…

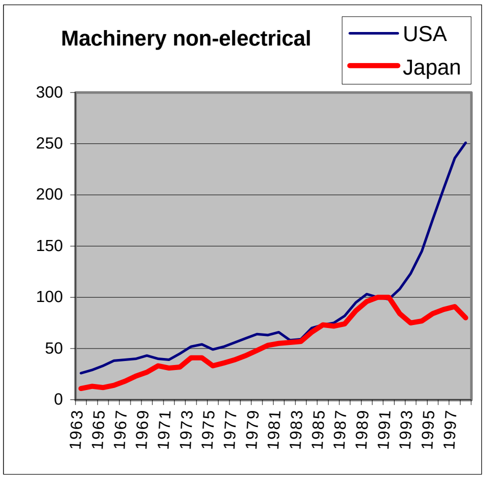






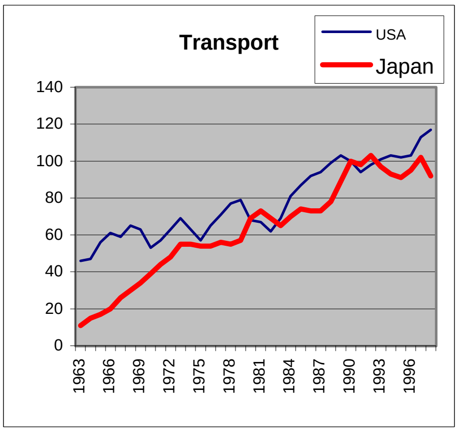


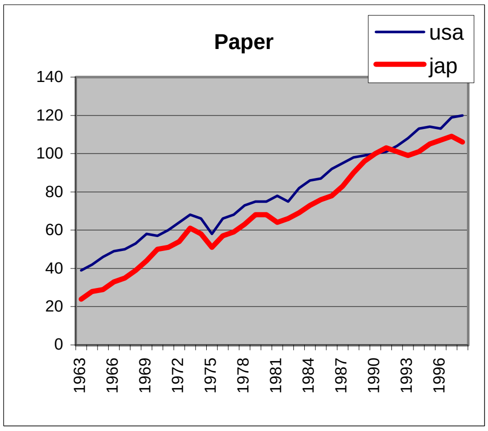


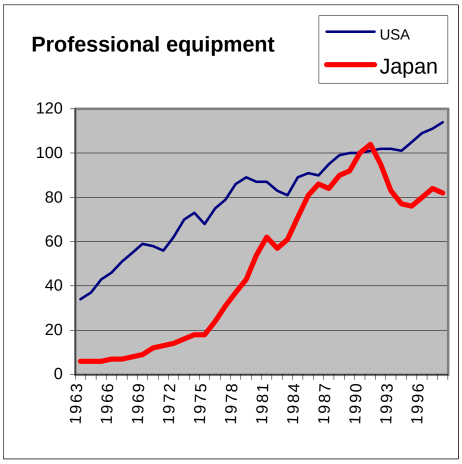


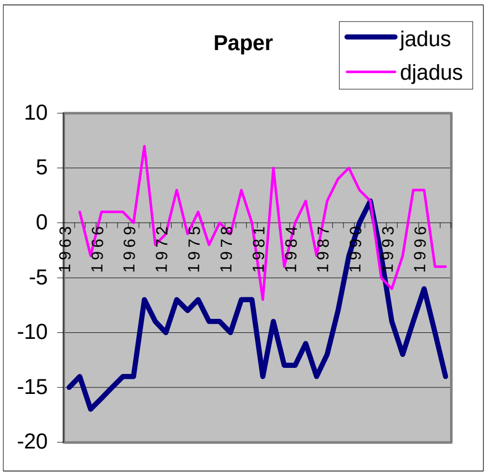
APPENDIX 6.A1:

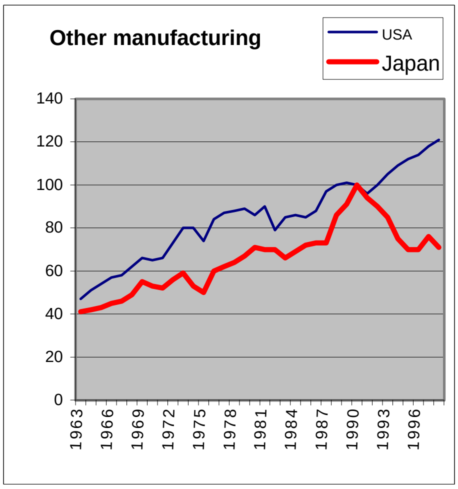
Indices of real output in 3-digit SIC sectors in the USA, 1963 to 1998
cont…

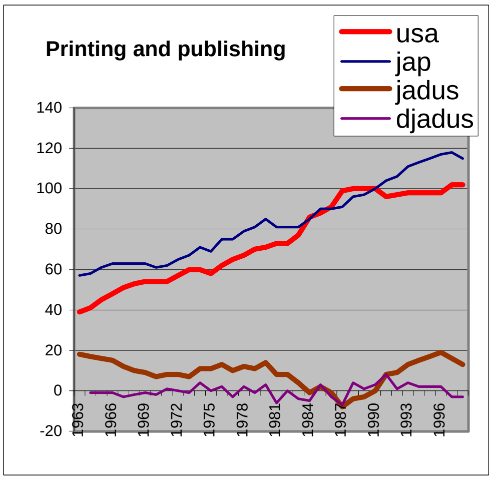






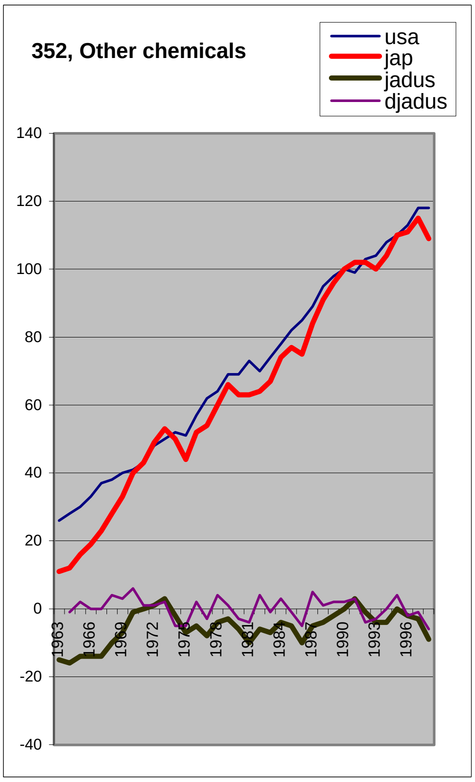


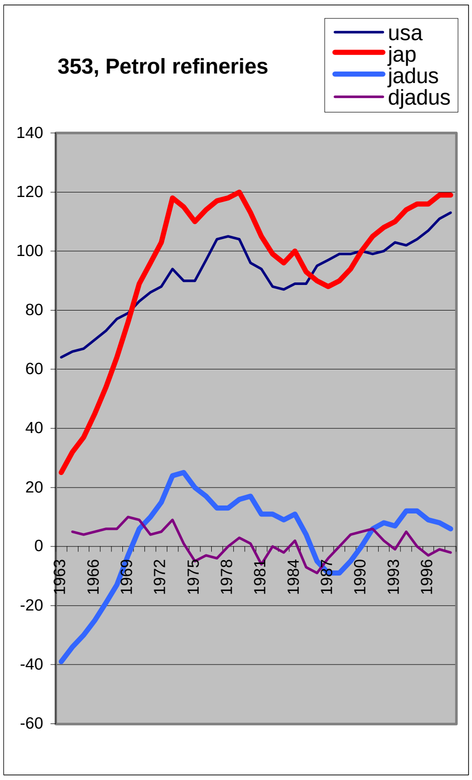




APPENDIX 6.A1:

Indices of real output in 3-digit SIC sectors in the USA, 1963 to 1998
cont…





APPENDIX A2 Tests for unit roots and cointegration

For the sector “Non-ferrous metals”

A] Unit root tests for variable USA

The Dickey-Fuller regressions include an intercept but not a trend

31 observations used in the estimation of all ADF regressions.
Sample period from 1968 to 1998

Test	Statistic	LL	AIC	SBC	HQC
DF	-2.0274	-108.4781	-110.4781	-111.9121	-110.9456
ADF(1)	-1.6705	-108.4724	-111.4724	-113.6234	-112.1735
ADF(2)	-1.1805	-108.1228	-112.1228	-114.9908	-113.0577
ADF(3)	-84227	-107.6555	-112.6555	-116.2404	-113.8241
ADF(4)	-.71227	-107.4071	-113.4071	-117.7090	-114.8094

95% critical value for the augmented Dickey-Fuller statistic = -2.9591
LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable USA

The Dickey-Fuller regressions include an intercept and a linear trend

31 observations used in the estimation of all ADF regressions.
Sample period from 1968 to 1998

Test	Statistic	LL	AIC	SBC	HQC
DF	-3.0186	-106.1405	-109.1405	-111.2915	-109.8417
ADF(1)	-2.8184	-105.8907	-109.8907	-112.7587	-110.8256
ADF(2)	-2.3285	-105.8900	-110.8900	-114.4750	-112.0586
ADF(3)	-1.9179	-105.8690	-111.8690	-116.1710	-113.2713
ADF(4)	-1.7177	-105.8637	-112.8637	-117.8826	-114.4997

95% critical value for the augmented Dickey-Fuller statistic = -3.5615
LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

B] Unit root tests for variable JAP

The Dickey-Fuller regressions include an intercept but not a trend

33 observations used in the estimation of all ADF regressions. Sample period from 1966 to 1998

Test	Statistic	LL	AIC	SBC	HQC
DF	-1.7628	-100.1977	-102.1977	-103.6942	-102.7012
ADF(l)	-1.7876	-100.0085	-103.0085	-105.2533	-103.7638
ADF(2)	-1.9259	-96.0344	-100.0344	-103.0274	-101.0415

95% critical value for the augmented Dickey-Fuller statistic = -2.9528
LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable JAP

The Dickey-Fuller regressions include an intercept and a linear trend

33 observations used in the estimation of all ADF regressions. Sample period from 1966 to 1998

Test Statistic		LL	AIC	SBC	HQC
DF	-2.9427	-96.9774	-99.9774	-102.2221	-100.7327
ADF(1)	-3.4806	-95.3083	-99.3083	-102.3013	-100.3154
ADF(2)	-2.4837	-93.6186	-98.6186	-102.3599	-99.8775

95% critical value for the augmented Dickey-Fuller statistic = -3.5514
LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

C] Unit root tests for variable JADUS

The Dickey-Fuller regressions include an intercept but not a trend

32 observations used in the estimation of all ADF regressions.
Sample period from 1967 to 1998

Test Statistic		LL	AIC	SBC	HQC
DF	-2.4976	-105.6847	-107.6847	-109~1504	-108.170S
ADF(1)	-2.2933	-104.6291	-107.6291	-109.8277	-108.3579
ADF(2)	-2.1649	-104.5057	-108.5057	-111.4372	-109.4774
ADF(3)	-1.9885	-103.7160	-108.7160	-112.3803	-109.9306

95% critical value for the augmented Dickey-Fuller statistic = -2.9558
LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable JADUS

The Dickey-Fuller regressions include an intercept and a linear trend

32 observations used in the estimation of all ADF regressions.
Sample period from 1967 to 1998

Test Statistic		LL	AIC	SBC	HQC
DF	-3.0638	-103.2447	-106.2447	-108.4433	-106.9735
ADF(1)	-2.3074	-103.1999	-107.1999	-110.1314	-108.1716
ADF(2)	-2.1433	-103.08S2	-108.0852	-111.7495	-109.2998
ADF(3)	-1.4563	-103.0516	-109.0516	-113.4488	-110.5091

95% critical value for the augmented Dickey-Fuller statistic = -3.5562
LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

D] Unit root tests for variable DJADUS

The Dickey-Fuller regressions include an intercept but not a trend

32 observations used in the estimation of all ADF regressions. Sample period from 1967 to 1998

Test Statistic		LL	AIC	SBC	HQC
DF	-7.1986	-107.2957	-109.2957	-110.7615	-109.7816
ADF(1)	-4.9865	-106.9819	-109.9819	-112.1805	-110.7107
ADF(2)	-4.7891	-105.9027	-109.9027	-112.8342	-110.8744

95% critical value for the augmented Dickey-Fuller statistic = -2.9558
LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

Unit root tests for variable DJADUS

The Dickey-Fuller regressions include an intercept and a linear trend

32 observations used in the estimation of all ADF regressions. Sample period from 1967 to 1998

Test Statistic		LL	AIC	SBC	**HQC**
DF	**-7.4789**	**-105.9851**	-108.9851	-111.1837	-109.7139
ADF(1)	**-5.2220**	-105.5991	-109.5991	-112.5305	-110.5708
ADF(2)	-5.0663	-104.3061	-109.3061	-112.9705	-110.5208

95% critical value for the augmented Dickey-Fuller statistic = -3.5562
LL = Maximized log-likelihood AIC = Akaike Information Criterion

SBC = Schwarz Bayesian Criterion HQC = Hannan-Quinn Criterion

E]Cointegration with unrestricted intercepts and no trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

35 observations from 1964 to 1998. Order of VAR = 1.
List of variables included in the cointegrating vector:
USA JAP
List of eigenvalues in descending order:

.26229 .070828

Null	Alternative	Statistic	95% Critical Value	90% Critical value
r = 0	r = 1	10.6473	14.8800	12.9800
r<= 1	r = 2	2.5712	8.0700	6.5000

Use the above table to determine r (the number of cointegrating vectors).

Cointegration. with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

35 observations from 1964 to 1998. Order of VAR = 1.
List of variables included in the cointegrating vector:
USA JAP

List of eigenvalues in descending order:

.26229 .070828

Null	Alternative	Statistic	95% Critical Value	90W Critical Value
r = 0	r>= 1	13.2185	17.8600	15.7500
r<= 1	r = 2	2.5712	8.0700	6.5000

Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR

Choice of the **Number of Cointegrating** Relations Using Model Selection Criteria

35 observations from 1964 to 1998. Order of VAR = 1.
List of variables included in the cointegrating vector:
USA JAP
List of eigenvalues in descending order:

.26229 .070828

Rank	Maximized LL	AIC	SBC	HQC
r = 0	-225.5383	-227.5383	-229.0936	-228.0752
r = 1	-220.2146	-225.2146	-229.1030	-226.5569
r = 2	-218.9291	-224.9291	-229.5951	-226.5398

AIC = Akaike Information Criterion SBC Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion

APPENDIX A3

List of manufacturing sectors on a 3-digit basis with their code numbers

311	Food
313	Beverages
314	Tobacco
321	Textiles
322	Apparel
323	Leather
324	Footwear
331	Wood products
332	Furniture
341	Paper products
342	Printing and publishing
351	Industrial chemicals
352	Other chemicals
353	Petroleum refineries
354	Miscellaneous petroleum and coal
355	Rubber
356	Plastics
361	Pottery and china
362	Glass products
369	Other non-metallic minerals
371	Iron and steel
372	Non-Ferrous metals
381	Fabricated metals
382	Machinery (not electric)
383	Electric and electronic machinery
384	Transport equipment
385	Scientific equipment
390	Other