Productive articulation as a determinant of potential growth

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Abstract

This article analyzes the intersectoral relationships that characterized the economic structures of three countries during the 1980s and the first half of the 2000s (Mexico, 2003; South Korea and Spain, 2005). The present article attempts to explain potential growth trajectories using structural sensitivity analysis and the important coefficients (IC)by tolerable limits (LT) methodology, elaborating a typology of intersectoral articulation in each economy based on the characteristics of the countries' respective productive structures. This typology also accounted for the article's approach to the structural changes registered in each economy.

Keywords: economic structure; productive articulation; sensitivity analysis; structural change; economic growth.

1. INTRODUCTION

The economic crisis that erupted in 2008 seriously questions the prevailing economic development model at the international level, as well as the very economic policies which drive the integration of economies into the global market. The evident infectiousness of financial crises – along with increasing international integration, national disarticulation of most internationalized sectors and the separation between the real and financial spheres as the most outstanding features of national economies – shows that the most virulent effects of recent economic crises are not easily countered by simple policy measures. Quite the contrary, they require more complex actions which also affect the economic structure.

An essential feature of the current economic model is that, in the pursuit of efficiency, companies are under strong pressure to compete better with their peers in other parts of the world. This competition is then felt in either the drive for dynamic advantages -associated with better technological performance-, or in fostering traditional static advantages -related to low costs, mainly labor. The former creates a disarticulation between sectors – specifically in the real sphere – a phenomenon which reflects two sides of the same coin: one side highlights the destruction of internal productive chains in more developed individual economies; the other, greater international integration based on a process of global productive fragmentation, which means the dispersion of production stages across different geographical spaces (Gatto, 1989; Feenstra, 1998; Gereffi, 2001; Godínez and Ángeles, 2006).

Naturally, how companies become internationalized has important repercussions on countries' economic development. At the same time, how companies act is the result of industrialization processes and deliberate steps taken to avoid the total dismemberment of the economic structure. It is along these lines that we seek to prove that although globalization favors the weakening of national productive chains, the economies that manage to insert themselves into the international stage without dismantling their productive structure will attain a greater growth potential, such that the best economic performance depends on the ability to achieve an articulated productive structure so that more dynamic activities become seeds of productive and technological invigoration, even when new methods for organizing production at the international level create, among other phenomena, breaks in national productive chains.

Simply put, productive articulation, or lack thereof, is the final factor to determine each economy's potential growth. This approach, which recalls the hypotheses of theorists from the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), (Prebisch, 1959, 2008; Sunkel, 1991; Fajnzylber, 1976, 1983, 1992) and Hirschman (1958, 2013), suggests that the type of articulation is a result of the industrialization processes, which in turn are defined by the characteristics of each country's international economic integration.

This work is organized into four sections including this introduction: the second section develops the analysis of South Korea's, Spain's and Mexico's typical structures in the year 1980 and the early 2000s, first in an aggregate study and then individually. The third section compares the economic structures of the analyzed countries and then come the conclusions.

2. TYPICAL STRUCTURES IN SOUTH KOREA, SPAIN AND MEXICO: AN ANALYSIS OF IMPORTANT COEFFICIENTS AND TOLERABLE LIMITS

The identification of the potential growth trajectory for each country in the study first requires an analysis of the structural characteristics of the three economies and the identification of those activities with the greatest capacity to influence sectoral production, defined here as "important sectors." To

achieve this, the methodology of important coefficients (IC) by tolerable limits (TL) is used, a methodology included within the various techniques for studying structural sensitivity (Tarancón, 2004; Soza, 2007; García *et al.,* 2007; Tarancón *et al.,* 2008), based on input-output (IO) analysis. This methodology is based on the assumption that each element in the matrix of technical coefficients (a_{ij}) can be modified as a product of changes in the technology employed by each sector buying intermediate goods (*j*). These coefficients reflect the direct exchange relations between the productive sectors. Such changes will result in the inputs of the inverse Leontief matrix $(I–A)^{-1}$, also known as the multiplier matrix (**B**). As such, the value of the product will also be modified by a non-linear proportion, as the relationship between technical coefficients and multipliers are not proportional for they depend on the indirect relationships between sectors *i, j*, which each coefficient a_{ij} involves. If all the coefficients are modified by a given proportion, they will cause differentiated changes in the product and, as such, can be classified by their potential to affect it. Those which cause greater change are called “important” (Schintke and Stäglin, 1988; Skolka, 1982; Forssell, 1988; Tarancon, 2004; García *et al.,* 2007).

The TL method allows one to find the importance of an input coefficient for sectoral production by means of dummy errors in the individual coefficients. The rows and columns of intermediate transaction matrices are classified according to their influence on sectoral production (Schintke and Stäglin, 1988). The formula used to determine the coefficient’s sensitivity is:

$$r_{ij} = \frac{1}{a_{ij}\left[\alpha_{ij} + \alpha_{ii}\left(\frac{\tau_i}{\tau_j}\right)\right]} \qquad (1)$$

Where r_{ij} is the maximum variation percentage for coefficient a_{ij}, associated with alterations in production of less than 1%; a_{ij} is an element in matrix **A**; α_{ij} is an element in matrix **B**; α_{ii} is an element on the main diagonal of **B**; τ_i is the gross product of sector *ith*, and τ_j is the gross product of sector *jth*. As such a coefficient will be “important” (IC) when the maximum variation percentage allowed is less. In other words, if a minimum variation in it provokes large changes in the product (Tarancón, 2004; Tarancon *et al.,* 2008). In practical terms, due to convention we adopt the practice that a coefficient is important when the value of r_{ij} does not exceed 20; likewise, the unimportant coefficients (uIC) are those whose r_{ij} has values equal to or greater than 100 and the absence of sectoral interrelationships is defined as when the r_{ij} is equal to zero, that is, if the entry is null.

This work functions on the assumption that in order to reach a potential path of sustained growth, the economy must undergo a constant transformation which perforce implies an increase in the technological, structural and productive complexity of the system as a whole and, in particular, of those sectors with the greatest capacity to influence activity. According to this, we will take on the following aspects: on the one hand we will analyze the structure of interrelationships and the changes they experience over time; on the other hand, we will study the direction taken by structural change with the goal of establishing whether the type of existing interrelationships can have positive effects on the potential for economic growth in the form of a strong relationship between technological progress, structural change and economic growth, as pointed out by theorists such as Chenery (1980, 1988), Pianta (1998) and Pasinetti (1993).

In order to carry out the study of the typical productive structures in the three countries, IC by TL will be used to determine the structural change and identify the industries with the greatest potential for influence. The section is subdivided into two parts: the first is devoted to studying the economic structure as a whole, essentially its level of productive articulation and its degree of international integration, as well as the changes that occurred between 1980 and 2000. The second part entails an individual study with the goal of classifying the different activities based on the number of ICs.

For the empirical analysis, we used the databases from different information sources. The 1980 input-output matrices (IOM) were made using data from Spain’s National Institute of Statistics (INE)[1] , the Bank of Korea, and Mexico’s National Institute of Statistics and Geography (INEGI)[2] . The tables for the second period come from the STAN Structural Analysis Database, from the Organization for Economic Cooperation and Development (OECD), 2003 for Mexico and 2005 for Spain and South Korea. Because the information was not directly compatible due to the variety of data sources used, it was essential to standardize and aggregate the different matrices to 30 sectors.[3] It should be clarified that the years chosen for the analysis respond to the concern for studying the characteristics of productive structures during two periods characterized by two distinct development models. Likewise, due to changes in the level of aggregation of OECD IOMs, the last year that could be homologated with the 1980 matrices corresponded to the early 2000s.

Comparison of economic structures: aggregate analysis of important coefficients by tolerable limits

It is common to associate the development of an economy with a greater number of ICs in sensitivity analyses of coefficients (Aroche, 1996, 2002, 2005; Ghosh and Roy, 1998; Tarancon *et al*., 2008). According to Aroche (1996), as an economy develops and the division of labor continues, there are greater interrelations –direct and indirect– between different productive activities; this means that on the one hand, a greater number of ICs and a smaller number of null inputs in matrix **A** and, on the other, a decrease in uIC. As such, in the proposed comparative analysis between South Korea, Spain and Mexico, we establish that the growth rate level of growth achieved by these economies is defined in function of the number of ICs, null inputs and uIC. It should be noted that, with the aim of measuring the dependence on imports, we started the analysis with IOMs for total transactions (see table 1) and, subsequently, with the IOMs of internal transactions (see table 2).

Table 1. Important coefficients. Total transactions for South Korea, Spain and Mexico

	South Korea			
	1980 [a]		*2005* [b]	
	Important Coefficients		*Important Coefficients*	
	Num.	*(%)*	*Num.*	*(%)*
$10 < r_{ij} \leq 20$	127	14.1	137	15.2
$20 < r_{ij} \leq 100$	173	19.2	182	20.2
$r_{ij} > 100$	538	59.8	492	54.7
$r_{ij} = 0$	62	6.9	89	9.9
Total	900	100	900	100
	Spain			
	1980 [a]		*2005* [b]	
	Important Coefficients		*Important Coefficients*	
	Num.	*(%)*	*Num.*	*(%)*
$0 < r_{ij} \leq 5$	41	4.6	36	4.0
$20 < r_{ij} \leq 100$	267	29.7	281	31.2
$r_{ij} > 100$	432	48.0	583	64.8
$r_{ij} = 0$	160	17.8	0	0.0
Total	900	100	900	100
	Mexico			
	1980 [a]		*2003* [b]	
	Important Coefficients		*Important Coefficients*	
	Num.	*(%)*	*Num.*	*(%)*
$0 < r_{ij} \leq 20$	102	11.3	118	13.1
$20 < r_{ij} \leq 100$	153	17.0	160	17.8
$r_{ij} > 100$	513	57.0	602	66.9
$r_{ij} = 0$	132	14.7	20	2.2
Total	900	100	900	100

Source: created by the authors based on published input-output tables: [a] for 1980 by the National Institute of Statistics and Geography (INEGI), Mexico; Economic Statistics System of The Bank of Korea, and the National Institute of Statistics (INE), Spain; and [b] for the years 2003 (Mexico) and 2005 (South Korea and Spain) from the STAN Structural Analysis Database, OECD.

Table 2. Important coefficients. Internal transactions for South Korea, Spain and Mexico

	South Korea			
	1980 [a]		2005 [b]	
	Important Coefficients		Important Coefficients	
	Num.	(%)	Num.	(%)
$10 < r_{ij} \leq 20$	108	12.0	119	13.2
$20 < r_{ij} \leq 100$	171	19.0	180	20.0
$r_{ij} > 100$	559	62.1	509	56.6
$r_{ij} = 0$	62	6.9	92	10.2
Total	900	100	900	100
	Spain			
	1980 [a]		2005 [b]	
	Important Coefficients		Important Coefficients	
	Num.	(%)	Num.	(%)
$10 < r_{ij} \leq 20$	101	11.2	109	12.1
$20 < r_{ij} \leq 100$	185	20.6	174	19.3
$r_{ij} > 100$	453	50.3	617	68.6
$r_{ij} = 0$	161	17.9	0	0.0
Total	900	100	900	100
	Mexico			
	1980 [a]		2003 [b]	
	Important Coefficients		Important Coefficients	
	Num.	(%)	Num.	(%)
$10 < r_{ij} \leq 20$	90	10.0	92	10.2
$20 < r_{ij} \leq 100$	153	17.0	121	13.4
$r_{ij} > 100$	516	57.3	667	74.1
$r_{ij} = 0$	141	15.7	20	2.2
Total	900	100	900	100

Source: created by the authors based on published input-output tables: [a] for 1980 by the National Institute of Statistics and Geography (INEGI), Mexico; Economic Statistics System of The Bank of Korea, and the National Institute of Statistics (INE), Spain; and [b] for the years 2003 (Mexico) and 2005 (South Korea and Spain) from the STAN Structural Analysis Database, OECD.

The aggregate analysis of important coefficients yields three relevant results for economic structures in the three countries. First, according to the information in Table 1, for the first year South Korea's economy is comparatively the most developed, or the one whose productive structure is the most complex. This is because it presents the greatest degree of intersectoral articulation, possibly as a consequence of the policies the Korean government promoted for fostering and planning industrial development (Bustelo, 1994).

According to the number of ICs and null inputs, in 1980 Spain specialized in basic and consumer industries, quite articulated, and which coexisted with a significant number of unconnected branches; that is, the typical structure of Spain in spite of distinguishing itself with a lower amount of uIC, when compared to Korea, the ICs are only lower by one percentage point and the null entries add up to more than double.

Contrary to Korea's evolution, Mexico, in the final stage of the import substitution model, demonstrates a relative sectoral disarticulation with the lowest proportion of IC, a significant number of null inputs and uIC. This data confirms Ortiz's (1994) idea, who through the analysis of links argues that the Mexican economy's degree of structural interdependence is in decline.

Second, we observed in the next period significant changes in all three countries' economic structures.[4] The greater degree of vertical integration which the three economies have gained over the course of 20 years is undeniable; the structures become more articulated, at least with regard to the increase in the number of important coefficients, with Mexico showing the largest increase (15.68%), while South Korea recorded an increase of 7.87% and Spain of 12.82%.

The third result indicates that from 1980 to the early 2000s there are substantial differences in the type of specialization for all three countries. In South Korea, due to the increase in the number of ICs and null inputs together with a decrease in uICs, one can deduce that while the links between some industries were reduced, there are signs of greater specialization in sectors with longer sequences of direct and indirect connections with other activities, mirroring the increasing effects on sectoral production stemming from any change in input coefficients – due, for example, to technical change. On the other hand, despite an apparent increase in complexity of the Spanish productive structure – an increase in the number of ICs and a decrease in null inputs – the gains in sectoral interrelations do not imply the creation of long sequences of indirect connections due to the high increase in the number of uICs. For its part, Mexico – like Spain – presents growth in the number of intersectoral interrelations, but without an increase in the sequence of indirect connections; this means that in both countries any drive for growth does not create enough direct and indirect effects in the economic activity as a whole.

Although the results of the total transaction matrices are very suggestive, since intermediate imports are accounted for within intersectoral transactions, it is not possible to observe the actual impact had on the domestic economy by strengthening or weakening production chains. As such, we will compare the evolution of total IOMs and its data will be compared with the internal ones which do not include imports within the intersectoral relations.

By contrasting the data derived from the IOMs of total transaction (see Table 1) with those of internal transactions (see Table 2), it is clear the significant weight that imports take on to complement the productive chains in all three countries; however, its importance changes according to the country and the period studied, thus demonstrating dissimilar degrees of dependence on imports. While South Korea has a slight increase in the difference in IC between the two types of transactions, going from 18 in 1980 to 19 in 2005, in Spain there is an increase from 16 to 23 and in Mexico from 12 to 26, corroborating for the latter the growing importance of imports with the current development model.[5]

To identify a sector's type of specialization according to their degree of vertical integration, the number of null entries is added with those where the value r_{ij} is equal to or greater than 100, which indicates the level of direct and indirect connections. South Korea in particular presents a decrease of 3.22%, while the number of uICs grows for Spain and Mexico (14.86 and 4.56%, respectively). These results allow us to draw some preliminary conclusions. First, the level of vertical integration that South Korea attains over time is evident, with an increase of 10.18% in the number of ICs and a reduction of 3.22% in uICs, which corroborates this economy's high degree of specialization in sectors with high direct and indirect connections. Second, Spain experiences an increase of 7.92% in IC and 14.82% in uIC, which reflects that intersectoral interrelations create little drive in the economic structure. Third, in Mexico there is an undeniable strong vertical disintegration evident from an increase of just two ICs in 23 years and an increase of 4.56% in the number of uIC.

Along these lines, in spite of imports being an indispensable component for all three countries to complete their productive chains, in the case of Mexico these imports are substitutes for domestic production. This means that changes in the development model imply a reorientation in production and national and international relationships, giving way to a growing need for imports as substitutes for national production chains.

Characterization of industrial activity: disaggregated analysis

In this section we present the industries most likely to cause changes of greater magnitude in the three economies and delineate, in general terms, the direction taken by structural transformations during the period of study. To achieve this, we classified each sector by the number of ICs registered in the two years studied and incorporated Aroche's (2005) criteria, which classifies branches as *important* if they have at least four ICs. As we seek to determine the capacity of the potential of industries as disseminators of technological change or productive/technological improvements, we only looked at the sum of ICs per row for each activity, following the logic that an industry with a significant number of ICs in a row has the ability to create strong direct and indirect effects on the rest of the system by providing inputs. The OECD's classification according to technological intensity is also used (see Appendix).

According to the amount of IC each industry has per year, we created a classification system which differentiates between *important* and *unimportant industries* in each period, resulting in the following groups: *a) Sectors on the rise technologically,* made up of industries which have at least four ICs only in the last year analyzed; *b) Technologically consolidated sectors* are those with four ICs or more in both years; *c) Sectors in technical decline*, industries which were important only in 1980 and which lost ICs in the second year. The industries that do not have a significant number of IC in either year either do not have the capacity to disseminate or are isolated sectors and will not be analyzed given their low capacity for technological dissemination.

Overall, the information in Table 3 confirms the results of the aggregate study, specifically in four regards: *i)* structural transformations in the South Korean economy resulted in a process of specialization; *ii)* a radical modification of Spain's productive structure with evidence of deindustrialization; *iii)* a sharp structural change in the Mexican economy with clear signs of deindustrialization and a growing dependence on imports, and *iv)* profound differences in the productive structures of the three economies.

Table 3. Number of important coefficients per sector

South Korea				Spain			
1980 [a]		2005 [b]		1980 [a]		2005 [b]	

		Internal transactions	Total transactions	Internal transactions	Total transactions			Internal transactions	Total transactions	Internal transactions	Total transactions
Sectors on the rise						*Sectors on the rise*					
MHT	(16) TRANS. E.	1	2	4*	5*	MT	(2) MIN	1	1	0	4*
HT	(24) FIN	3	3	6*	6*	MT	(18) EWG	2	3	4*	4*
MHT	(13) M&E	1	3	4*	8*						
HT	(26) BUS	1	1	12*	16*						
Consolidated sectors						*Consolidated sectors*					
HT	(14) COM. E.	3	4*	5*	8*	MLT	(11) Fe	8*	9*	3	5*
LT	(30) SERV	2	4*	11*	11*	MLT	(12) MM	3	4*	6*	6*
LT	(1) AGR	6*	9*	4*	4*	MHT	(8) CHEM	8*	9*	2	9*
I	(22) TRANS	6*	7*	7*	7*	LT	(19) CONST	11*	11*	15*	15*
MLT	(11) Fe	10*	11*	8*	8*	I	(22) TRANS	8	8	14*	15*
MLT	(7) PET	18*	19*	6*	8*	LT	(20) COM	10*	11*	21*	21*
MHT	(8) CHEM	12*	12*	12*	12*	HT	(26) BUS	3	4*	22*	23*
LT	(20) COM	16*	17*	13*	14*						
Sectors in decline						*Sectors in decline*					
LT	(4) TEXT	6*	6*	2	2	LT	(4) TEXT	4*	4*	1	1
LT	(3) FBT	3	4*	3	3	LT	(3) FBT	5*	6*	3	3
LT	(6) PAP	2	4*	3	3	LT	(1) AGR	7*	8*	3	3
MLT	(9) PLAS	3	4*	2	3	HT	(24) FIN	10*	10*	2	2
						MLT	(7) PET	9*	13*	1	2

Mexico					
		1980 [a]		*2005* [b]	
		Internal transactions	*Total transactions*	*Internal transactions*	*Total transactions*
Sectors on the rise					
MHT	(16) TRANS. E.	1	2	1	4*
HT	(14) COM. E.	1	1	0	8*
HT	(26) BUS	2	2	19*	20*
Consolidated sectors					
LT	(2) MIN	2	4*	4*	4*
MLT	(11) Fe	8*	8*	2	5*
LT	(25) RE	8*	8*	5*	5*
I	(22) TRANS	8*	10*	9*	9*
MHT	(8) CHEM	4*	5*	9*	12*
LT	(20) COM	28*	28*	27*	27*
Sectors in decline					
LT	(3) FBT	5*	6*	3	3
MLT	(7) PET	5*	5*	1	1
LT	(30) SERV	5*	3	0	0
LT	(1) AGR	4*	5*	3	3

Source: created by the authors based on published input-output tables: [a] for 1980 by the National Institute of Statistics and Geography (INEGI), Mexico; Economic Statistics System of The Bank of Korea, and the National Institute of Statistics (INE), Spain; and [b] for the years 2003 (Mexico) and 2005 (South Korea and Spain) from the STAN Structural Analysis Database, OECD.

The South Korean economy has become significantly more complex, demonstrating high growth possibilities due to greater vertical integration, productive specialization in sectors which are highly sophisticated technologically and a lower dependence on imports. As such, for example, if one compares the IOMs of total transactions in 1980 and 2005, one can see that while in both years there are an equal number of *important sectors* (12 out of 30), the South Korean economy tends to specialize itself over time in technology-intensive industries, with mature and traditional technology activities in 1980, while in 2005 the economy has gained connections in sectors with greater technological complexity.[6]

In this way, the industries in *decline* are four traditional technology manufactures (Food, Textiles, Paper and Plastic). The *consolidated sectors* consist of a low-tech extractive industry (Agriculture, forestry and fishing), three low-tech service activities (Other services, Transportation and Commerce), four manufacturing industries, two of which are medium-low technology (Iron and Petroleum) and two high-tech (Computer Equipment and Chemistry). While activities on the rise consist of two high-tech manufactures (Machinery and equipment and Transportation equipment) and two non-manufacturing high-tech activities (Finance and Business deals). In short, in the South Korean economic structure four low-tech industries lose interrelationships, four more technical sectors gain them and eight branches retain their character as important.

Another aspect of South Korea's productive structure's increased complexity that is worth noting is that over time it has become less dependent on imports despite its high degree of internationalization. If one compares the results of total transactions with internal ones in the two years, one can see that while in 1980 seven of the *important* industries do not show a dependence on imports, by 2005 their external vulnerability decreases; this means to say that none of the *important* sectors has a significant dependence on imports. In short, it is evident that high productive articulation, lower external dependence and high specialization in technologically sophisticated sectors bolsters this economy's growth dynamics.

With regards to Spain's sectoral behavior in the two years studied, one can clearly see the economy's deindustrialization; the manufacturing sector loses importance, particularly with respect to the construction and services industries, which implies the productive structure's move towards the services sector. As such, between 1980 and 2005, the economy lost important links in fundamentally manufacturing sectors not dependent on imports, only to gain them in two non-manufacturing activities, one of which is highly dependent on purchases abroad. As for technological specialization, industries which gained links have a medium technological level, while those which lose important connections do not have a well-defined technological development.

The Spanish sectors *in decline* are composed of a low-tech extractive activity (Agriculture), three low- and medium-low technology manufactures (Food, Textiles and Coal and oil refining) and one high-tech service sector (Finance). The *consolidated* industries are three manufactures, two of medium low technological intensity (Iron and Metal Products) and one high-tech (Chemistry) and four service activities, three of low technological intensity (Construction, Commerce and Transportation) and only one high-tech (Business deals). As for the activities *on the rise,* two activities are non-manufactures of medium technological complexity (Mining and Electricity, gas and water).

Upon comparing the matrices' data for the two types of transactions (total and internal), one sees that the Spanish economy loses articulation with the international economic integration process. In other words, while in 1980 only two sectors out of 12 show a high vulnerability to imports, by 2005 not only does this number of *important* industries drop to nine, but three of them are dependent on acquiring supplies from abroad in order to complete their production chains. At the same time, the growing importance of service activities, to the detriment of the manufacturing industry, is evident, which shows that the Spanish economy is going through a pronounced process of deindustrialization with a transition into the services sector.

Meanwhile, data for the Mexican economy from 1980 and 2003 show that structural change means disarticulation, high vulnerability and dependence on imports, which results in a deep process of deindustrialization. However, if one only looks at the total transaction matrices for the two years, the Mexican economy shows some specialization in sectors that the OECD classifies as having greater technological complexity; for 1980 there are 10 *important* industries, while in 2003 nine sectors have high direct and indirect connections. Nevertheless, while links are gained in high and medium technology industries, connections are lost in traditional and technologically mature activities, apparently reflecting technological specialization, though in reality they are activities where maquiladoras and assembly practices dominate in Mexico.

The industries *in decline* consist of one extractive, two manufacturing and one service activities classified as having low technological intensity (activities in Agriculture, the Food industry, Oil and Other services). The *consolidated sectors* are an extractive industry of medium technological intensity (Mining), two manufacturing industries, one of medium-low tech (Iron) and another which is high-tech (Chemistry) and three low-tech services (Commerce, Transportation and Real Estate). The apparent technological specialization of the Mexican economy is explained by the three industries *on the rise,* classified by the OECD as having a high technological intensity (Computer and electronic equipment, Transportation equipment and Business deals).

When one compares the information for the two types of transactions, the Mexican economy's specialization in more advanced sectors and the greater degree of articulation are not verified. The *important* activities in 1980 were not very dependent on imports; however, the greater international integration that characterizes the new development model results in a greater vulnerability for the Mexican economy as dependence on imports has become more pronounced. An example is how the electronics and transportation equipment industries, known for their high technological sophistication and commercial dynamism, are dependent on imports in Mexico, demonstrating their maquiladora and assembly natures; this limits the positive effect on the Mexican economy's potential growth. As such, the Mexican economy's structural change has resulted in a profound process of deindustrialization.

3. COMPARISON OF THE THREE COUNTRIES' PRODUCTIVE STRUCTURES AND THEIR CHANGES BETWEEN 1980 AND THE EARLY 2000s

This section contains a comparison of Korea's, Spain's and Mexico's productive structures, highlighting the structural transformations, type of specialization and productive profile characteristic of each economy during the periods studied, in order to associate structural change with productive articulation and its implications within the more general process of continued economic growth.

One should keep in mind that as the number of connections between sectors grow, the more developed an economy is supposed to be (Leontief, 1973). This statement leads us to reflect on two possibilities: articulation implies reaching a particular fixed goal, that is, one can follow a path for development in which it is necessary to cover certain general requirements related to the sectors and interconnections each economic structure requires; or, there are features unique to the characteristics of different economies that require different responses. In this regard, the structural transformations that have occurred in the analyzed economies lead to the formulation of a specific line of questioning for each country in accordance with the results presented so far.

The analysis in the previous section shows that South Korea's productive structure, in spite of undergoing major transformations, is less significant than those observed in the other two economies, thereby indicating certain stability. Hence the following question needs to be asked: is this stability synonymous with stagnation or rather a deliberate effort at specialization? If it is a question of specialization, has structural change made possible a process of continuous growth based on the development of industries with a high technological potential?

Facing Spain's deindustrialization process and shift towards the services sector, the following concern arises: could it be assumed that this shift leads to a new organization in which modern industries dominate over traditional ones? That is, does the transition to service activities imply greater technological and, therefore, economic development?

Finally, the acute structural transformation in Mexico is evident, demonstrating a phenomenon of deindustrialization with disarticulation. Here the question is: is structural change always synonymous with both technological progress and sustained growth?

The study shows that in 1980 the three economies had a manufacturing profile in industries with low and medium-low technological complexity, stemming from the greater number of strong local chains, mainly in traditional manufacturing. For example, in South Korea, intersectoral connections are higher and denser in manufacturing than in service activities. Spain on the other hand has a greater productive diversification, with traditional manufacturing prevailing to a certain degree. Finally, we have Mexico somewhere between South Korea and Spain, presenting a greater productive diversification – similar to that of Spain – but, at the same time, it has a greater specialization in manufacturing like South Korea.

In short, despite differences in the economic development that the three analyzed countries may present in 1980, in terms of productive structures there are certain similarities, which can be summed up in two points: *i)* despite greater diversification – especially in the case of Spain and, to a lesser extent, Mexico – one can identify a traditional manufacturing productive profile, and *ii)* greater productive articulation, observable in the density of sectoral interrelations.

For the second year studied (2003 for Mexico and 2005 for Spain and Korea), we see a radical transformation. Not only are the possible structural similarities between the three countries eliminated, but there is a substantial change in their type of specialization, reflecting the different ways in which each country has inserted itself in a development model more open to the international economy. The only feature in common they potentially maintain is how an increasing number of activities in the service sector increase their chains of interconnections within each country's productive structure, though the importance and strength of these interrelationships varies considerably, implying that while South Korea and, to a lesser extent Mexico, exhibit a more manufacturing profile, Spain's economy has largely shifted toward the services sector.

In response to the questions posed above, we believe that South Korea is not going through a phase of stagnation, quite the contrary, that economy's structural change indicates its transition from more traditional and mature industries to more dynamic sectors in technological and productive terms. While the industries which had a greater number of IC in 1980 were basically traditional sectors, whose technological complexity was low or medium low, in 2005 a greater specialization in activities with a greater technical content is evident. These have a great ability to disseminate technological efforts and therefore have a high potential to boost the economy. In short, the high specialization in more technologically sophisticated sectors strengthens the dynamics of the South Korean economic system's growth process due to its strong productive articulation and lower external dependence.

Spain is a clear example of the importance which service activities acquire. In 1980, industries which are primarily manufacturing in nature have greater weight, though they have little growth potential due to their nature as mature and traditional activities with low technological intensity. By 2005, the configuration of inter-industrial relationships shows how service sectors take on a fundamental importance. These are activities that are generally believed to have a growth potential as they are defined as being more sophisticated and technologically intensive. However, the growing importance of service activities – to the detriment of the manufacturing industry, which is even more marked by its heavy dependence on imports – may be an obstacle to the growth of this economy.

The Mexican economy underwent a profound structural transformation from 1980 to 2003, but such changes do not result in greater specialization, as in the case of Korea, nor in a shift towards services, similar to Spain. On the contrary, a phenomenon of deindustrialization is evident with which the economy is disarticulated internally, making it evident that imports substitute national production in order to complete productive chains, be it in sectors with greater productive dynamism or in less dynamic ones. This means that in Mexico we do not see a change in the productive profile, but rather a profound process of deindustrialization wherein the loss of productive articulation is added to a clear productive and technological regression with a high dependence on imports. Therefore, the case of the Mexican economy does not seem to fully coincide with the theoretical postulates where a

positive relationship between structural transformation, technological progress and economic growth is assumed (Chenery, 1980, 1988; Pianta, 1998; Pasinetti, 1993) given that the structural change seen in this country results in deindustrialization with disarticulation, leading to a very low growth potential.

To wrap up, based on the previous results, we identify major differences in the productive structures of Korea, Spain and Mexico, which in turn produce three different articulation models that determine their economic performance:

a) South Korea maintains a specialization in high-tech sectors, which, together with a high degree of international integration, makes it have a positive articulation which this study calls *articulation with manufacturing specialization,* based on a strong link with the internal productive structure.

b) Spain displays a profound structural change headed to productive deindustrialization with a shift towards services. In short, the sectors with the strongest links with the productive structure as a whole are predominantly services, with the manufacturing branches losing importance. We therefore call it *articulation with shift to services.*

c) In Mexico, the phenomena of vertical disintegration, deindustrialization and external vulnerability define the productive structure, negatively affecting the country's economic development. This means that the economy is simply not articulated, therefore, the *disarticulation* within the productive structure stands out.

4. CONCLUSIONS

This paper shows that in the first year, despite the possible differences in the three countries' economic development, their differences were not so profound in terms of productive structures. However, a substantial change in each economy is seen in the second year, with a divergence in their productive profiles. The result is that the modifications in their development strategies vary markedly, influencing their respective structural transformations and the very process of economic growth. The results obtained from the study of IC by TL confirm the existence of a profound structural change in each of the economies analyzed and the importance certain activities have in invigorating economic activity.

A relevant result derived from the analysis of structural change and its possible relationship with technological progress and economic growth, is that productive articulation is a requirement for this association to occur in a positive manner. This complements the contributions of authors such as Chenery (1980, 1988), Pianta (1998) and Pasinetti (1993), among others, who establish that economic growth is associated with structural change and that technological progress drives transformations in productive structures. As was seen in previous sections, the level of development achieved varies considerably between countries depending on their level of productive articulation, which in turn determines how each economy integrates itself into THE international stage, which is characterized by the neoliberal model.

At the beginning of this work, we established that in order to reach a potential path of sustained growth, an economy must undergo constant structural transformations that imply an increase in complexity – both technological and structural – of the system as a whole. To this end, we analyzed the structure of interrelationships, their changes over time and the direction taken by such structural change with the aim of establishing whether the type of interrelationships and specialization in certain activities had effects on the growth potential of the different economies.

It is possible to declare that globalization process effectively meant a weakening of national production chains. But, without a doubt, South Korea retains a certain level of productive articulation and strengthens its productive profile with greater technological specialization. Spain does away with manufacturing activities, but increases the sequences of interconnections in the provision of services. Mexico undergoes disarticulation with a marked process that combines deindustrialization, destruction and regression. The level of development attained varies considerably between the countries studied. This too is a result of how each economy joins the world stage and the level of productive articulation they maintain in the process.

APPENDIX

Table A1. List of sectors with their OECD technological classification

Num.	*Activity sector*	*Abbreviation*	*OECD technological classification*
1	Agriculture, hunting, forestry and fishing	AGR	ALT
2	Mining and extraction	MIN	AMT
3	Foodstuffs, beverages and tobacco	FBT	LT
4	Textiles, textiles, leather and footwear	TEXT	LT
5	Wood and wood and cork products	MAD	LT
6	Pulp, paper, paper products, printing and publishing	PAP	LT
7	Coal, oil product refinery and nuclear fuel	PET	MLT
8	Chemistry (including pharmaceutical)	CHEM	MHT
9	Rubber and plastic products	PLAS	MLT
10	Other non-metallic mineral products	MnM	MLT
11	Iron, steel and non-ferrous metals	Fe	MLT
12	Manufacture of metal products, except machinery and equipment	MM	MLT
13	Machinery and equipment	M&E	MHT
14	Machinery and equipment; computing, communication, medical and precision instruments	COM E.	HT
15	Machinery and electrical appliances	MELEC	MHT
16	Motor vehicles and other transport equipment	TRANS E.	MHT
17	Other manufactures	MANUF	LT
18	Production, collection and distribution of electricity, gas and water	EGW	AMT
19	Construction	CONST	ALT
20	Wholesale and retail trade	COM	ALT
21	Hotels and restaurants	HOTR	ALT
22	Transportation and transportation ancillary activities, travel agencies	TRANS	I
23	Postal service and telecommunications	TEL	AHT
24	Finance and insurance	FIN	AHT
25	Real estate rentals	RE	ALT
26	Business Deals	BUS	AHT
27	Educational services	EDU	I
28	Health and social work	HEALTH	I
29	Public administration and defense, compulsory social security	APUB	ALT
30	Other services	SERV	ALT

Notes: nomenclature according to technological intensity (OECD); (HT) High Technological Intensity; (MHT) Medium High Technological Intensity; (MLT) Medium Low Technological Intensity; (LT) Low technological intensity; (AHT) High-Tech non-manufacturing activities; (AMT) Medium-Tech non-manufacturing activities; (ALT) Low-Tech non-manufacturing activities; (I) Non-manufacturing activities without technological classification.

Source: created by the author based on Hatzichronoglou, T. (1997). Revisión del Sector de Alta Tecnología y Clasificación de Productos. Documentos de Trabajo del STI 1997/2, OECD.

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[1] TL note: from the original Spanish Instituto Nacional de Estadística.

[2] TL note: from the original Spanish Instituto Nacional de Estadística y Geografía.

[3] The comparative analysis requires that the information sources be completely homogeneous; although the OECD matrices are at the same level of aggregation (48 sectors), those from 1980 are not directly compatible, so it was necessary to standardize them and aggregate to 30 sectors.

[4] One should not ignore certain factors in the handling of information and statistics that may have affected the accounting. We are primarily referring to two: changes in classifying IOMs, attributed to each country's statistics offices, and how the criteria this study uses for aggregation could alter, mainly, the number of null entries in the technical coefficients matrix.

[5] Number of important coefficients in the total transaction matrices minus the number of CIs recorded in the IOMs of internal transactions.

[6] The technological classification applied in this paper corresponds to the criteria defined by the OECD.