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Manufacturing the only engine of growth? An extension of Kaldor´s first law

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Abstract

The economic development and growth literature continues to discuss the way to encourage economic growth in developing countries. For many decades structuralist have argued that manufacturing is the only engine of growth, however the role of manufacturing has been questioned lately due to failures of industrialization in several African and Latin American countries, empirical evidence that shows that some South Asian economies have a service-led growth and increasing literature that claims that countries should focus on the development of the services sector as the world is living in a post-industrial era well-known as the information age. This thesis contributes to the existing literature that deals with Kaldor´s first law of economic growth in three ways. First, provides current evidence for the manufacturing an engine of growth hypothesis by using an econometric technique (system GMM) that treats endogeneity bias for a sample of 119 countries over the period 1990-2011. Second, by extending the same approach to the services sector, the thesis analyses if it can also be consider a growth escalator and finds strong confirmation for this. Finally, derives results for countries by income levels and shows that manufacturing is the only engine of growth for low income economies, while for middle income countries both sectors can be consider a source of growth. In the case of high income nations manufacturing does not explain overall growth anymore, but services play the major role.

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1. Introduction

The economic development and growth literature continues to discuss the way to encourage economic growth in developing countries. Traditional theories states that to trigger growth, countries should specialized on those sectors where they have comparative advantages and can produce commodities at a lower marginal and opportunity cost compared to other nations. While modern theories claim that economies should focus on strategic sectors, such as manufacturing, which has special characteristics to promote higher productivity and technology improvement, considering the former is the major source of economic growth and explains differences among countries.[1] One of the main representatives of this theory is Nicolas Kaldor, who back in the 60´s discussed about manufacturing being the only engine of growth.

For many decades this growth hypothesis was extensively recognized, but lately the role of manufacturing has been questioned due to failures of industrialization in several Latin American and African countries, in addition to empirical evidence that shows that some developing countries such as South Asian economies have a service-led growth. Moreover, there is a growing literature that claims that countries should focus on services to accomplish economic growth (Ghani, 2010) since the world is living in a post-industrial era, well-known as "the information age", where globalization of services is expanding, modern services are becoming more impersonal over the time, and ICT improvements are enormous. This is supported by the fact that the services sector has increased its contribution on total GDP during last years as countries increase their per capita income level (Park and Shin 2012).

This debate encourages the importance to analyze whether manufacturing continues to be an engine of growth and more importantly, if it is the only growth escalator. Therefore, the intention of the thesis is to test if manufacturing stills play a major role in the economic growth process by using Kaldor´s theoretical approach, but utilizing a modern econometric technique (System Generalized Methods of Moments based on Cantore, et al. 2013) to improve the results presented by Kaldor. Moreover, the objective is to extent this approach to services to confirm or reject the hypothesis of manufacturing being the only engine of growth and evaluate whether the services sector can be recognized as a source of growth.

To derive conclusions about these questions, the thesis is structured as follows. Section 2 sets the theoretical background based on Kaldor´s first law of economic growth and discusses the transmission mechanisms between manufacturing and economic growth. Section 3 summarizes findings from literature review about the topic. Section 4 introduces a modern view towards services as a growth escalator. Section 5 presents empirical facts about why manufacturing and services matter. Section 6 and 7 are devoted to explain data issues and the econometric technique. Section 8 reports results from the regressions for a world panel and also according income levels. Section 9 concludes and establishes general policy implications.

[1] (Thirlwall, A plain man´s guide to Kaldor´s growth laws 1983), based on Kaldor 1967, argues that differences in growth rates are largely accounted for by differences in productivity growth.

2. Theoretical background

2.1 Kaldor´s first law of economic growth "manufacturing an engine of growth"

There is a conceptual contribution presented by Nicholas Kaldor in 1960 where he established the benefits of manufacturing, as a sector that has direct and spillover effects over the rest of the economy and has unique characteristics to encourage economic growth. In 1966, during his inaugural lecture on "Causes of the UK´s slow growth rate" in Cambridge, he discussed a series of laws to explain growth rate differences between developed or industrialized countries; later he elaborated more on these laws that were presented in a lecture about "Strategic Factors in Economic Development" at Cornell University in 1967. These laws emphasize the role of manufacturing on economic growth and constitute the basis to explain differences in growth rates among countries. The laws can be summarized by the following statements:

- The faster the growth rate of Manufacturing Value Added (MVA) output[2], the faster the growth rate of Gross Domestic Product (GDP). This law can be summed up in "manufacturing sector an engine of growth".

- The faster the growth rate of Manufacturing Value Added (MVA) output, the faster the growth rate of labor productivity in manufacturing due to increasing returns to scale, both static and dynamic[3] (also known as the Verdoorn´s Law).

- The faster the growth rate of Manufacturing Value Added (MVA) output, the faster the growth rate of non-manufacturing labor productivity due to reallocation of labor from sectors with diminishing returns (usually land-based activities and petty services) to sectors with increasing returns.

The research question of the thesis specifically deals with Kaldor´s first law "manufacturing sector an engine of growth". In this regard, Kaldor was the first to test and present empirical results that supports the growth hypothesis where he found a strong correlation between the growth of manufacturing output and the growth of GDP, based on a cross section analysis of twelve developed countries[4] over the period 1953-1954 to 1963-1964. The results were obtained by using a pooled OLS econometric model and are presented below:

Regression model $$gGDP_{it} = \alpha + \beta(gMVA_{it}) + \mu_{it}$$

Regression results $$gGDP_{it} = 1.153 + \underset{(0.040)^5}{0.614}(gMVA_{it})$$ $R^2 = 0.959$

[2] Annex I presents all the activities considered part of manufacturing according to the International Standard Industrial Classification (ISIC) Rev 3.
[3] According to Thirlwall (2002) "Static returns relate to the size and scale of production units and are a characteristic largely of manufacturing, (…). Dynamic economies refer to increasing returns brought about by ´induced´ technical progress, learning by doing, external economies in production and so on".
[4] Japan, Italy, West Germany, Austria, France, Denmark, The Netherlands, Belgium, Norway, Canada, United Kingdom, and United States.
[5] Standard error of residuals as a proportion of mean value of Y=0.0825

Where gGDP is the GDP growth rate, gMVA is Manufacturing Value Added growth rate and α is the constant of the model. The most important coefficient in the model is β since indicates the strength and size of the impact (elasticity) of manufacturing sector´s growth on the economic growth of the country when the former increases in 1%. This coefficient was viewed by Kaldor as the main indicator of the engine of growth hypothesis. He also used the coefficient of determination R^2 as evidence in favour of his law.

The academic also showed that the positive and high correlation between the two variables is not simply the result of manufacturing output being a large proportion of total output (according to Kaldor 25 to 40% of total GDP), because is also due to the positive association between the overall economic growth rate and the excess of manufacturing output growth rate over the non-manufacturing (NMVA) output growth rate (gMVA - gNMVA). In fact, Kaldor illustrated that countries which exhibit GDP growth rates over 3% a year, present a manufacturing growth rate output higher than the growth rate of non-manufacturing sectors. Expressing this in terms of a regression equation and using the same sample as before, he showed the following statistically significant results at 99% level:

Regression model $$gGDP_{it} = \alpha + \beta(gMVA_{it} - gNMVA_{it}) + \mu_{it}$$

Regression results $$gGDP_{it} = \underset{(0.267)^6}{3.351 + 0.954(gMVA_{it} - gNMVA_{it})} \qquad R^2 = 0.562$$

Similarly, gGDP is the GDP growth rate, gMVA - gNMVA is the excess of manufacturing output growth rate over the non-manufacturing output growth rate, and α is the constant of the model. The coefficient β represents the variation of GDP growth rate when the excess of manufacturing growth over the non-manufacturing growth varies in 1%.The coefficient of determination R^2 shows how well the model fits the data.

The idea that the high correlation between GDP growth and MVA growth does not depend on manufacturing being a large part of total output is also supported by the positive relation between manufacturing output growth and non manufacturing output growth, considering the backward and forward linkages that manufacturing generates with the other sectors of the economy. Based on the same sample, Kaldor found an almost identical relation between these two variables that is also statistically significant at 99% level.

Regression model $$gNMVA_{it} = \alpha + \beta(gMVA_{it}) + \mu_{it}$$

Regression results $$gNMVA_{it} = \underset{(0.080)^7}{1.142 + 0.550(gMVA_{it})} \qquad R^2 = 0.824$$

Correspondingly, gNMVA is the non-manufacturing output growth rate, gMVA is the manufacturing output growth, and α is the constant of the model. The coefficient β shows that when manufacturing grows 1%, the non manufacturing sectors grow in β. The coefficient of determination R^2 shows this almost identical relation between the dependent and independent variable.

[6] Standard error of residuals
[7] Standard error of residuals

To provide additional support to the growth hypothesis Kaldor also examined the relation between GDP growth and the rate of growth of agricultural production, mining and services output[8] for the same sample. He found no correlation between GDP growth and either agriculture production and mining growth, in contrast of the highly significant relationship (at 99%) encountered with services growth.

Regression model $gGDP_{it} = \alpha + \beta(gSVA_{it}) + \mu_{it}$

Regression results $gGDP = -0.188 + 1.060(gSVA)$ $R^2 = 0.930$
(0.092)[9]

In this case, gGDP is the GDP growth rate, gSVA is Sevices Value Added growth rate and α is the constant of the model. The coefficient β captures the strength and size of the influence of services growth on the economic growth of the country when the former increases in 1%.

Surprisingly, his conclusion was that as the elasticity of services is near to unity (1.060) and the constant is negligible, the results suggest that the causal relationship goes in the other way around - i.e. that is that GDP growth determines services growth (Kaldor 1967)

Despite the popularity of Kaldor´s first law, the results he obtained were highly criticized due to the endogeneity bias they may present caused by the reciprocal causality between the independent and the explained variable. Other limitation that can be discussed in his results is related to the conclusion he derives from the relation between services and economic growth. First, the interpretation about the constant and the value of the coefficient is not convincing and second, to provide such conclusion about the causal relation between two variables would it be necessary to conduct a proper causality analysis. Otherwise, this could imply that even 50 years ago there was some empirical proof in favour of services as a source of growth, at least for developed economies and was misinterpreted or not paid sufficient attention.

2.2 Transmission mechanisms between manufacturing and economic growth

This subsection discusses important theoretical arguments that Kaldor and other authors present to support the statement of “manufacturing an engine of growth”. The first argument was discussed for the first time by Adam Smith, who back in those days already pointed out that manufacturing has increasing returns to scale; while in agriculture and mining there is only scope for diminishing returns, as for instance, land is a fixed factor of production. This vision remained dormant until the American Economist, Allyn Young revived it in 1928 through his paper “Increasing Returns and Economic Progress”, where he established that there are two necessary conditions in order to achieve self-sustained growth: returns must increase and the demand for commodities must be elastic. He provides an example of this statement using the steel and textile industries.

[8] Annex II presents all the activities considered part of services output according to the International Standard Industrial Classification (ISIC) Rev 3.
[9] Standard error of residuals.

"As the supply of steel increases, its relative price falls. If demand is elastic textile producers demand proportionately more steel. Textile production increases and its relative price then falls. If demand is elastic steel producers demand proportionately more textiles, and so on" (Thirlwall 2002). "Under certain circumstances there are no limits to the process of expansion except the limits beyond which demand is not elastic and returns do not increase" (Young 1928).

He also stated that the aggregate growth has to be related to the rate of expansion of the sector with the most favorable growth characteristics. Based on these ideas, Kaldor (1967) argued that the level of productivity in manufacturing activities is higher than in the rest of the economy. Therefore, a faster expansion of the high-productivity manufacturing sector provokes a labor transfer from the low-productivity ones (like agriculture), phenomenon known as *structural change bonus* that will increase in overall productivity and income per capita. In the same direction technological progress, measured by productivity growth rates, is higher in manufacturing than in the other sectors, so a higher concentration of labor in manufacturing creates a higher average productivity growth rates. These facts provoke that manufacturing exhibits increasing returns, both static and dynamic, while the other sectors are subject to diminishing returns. (Static returns relate the level of productivity to the scale of manufacturing output, whereas dynamic returns relate the change of productivity, derived by learning by doing and technological change, to the manufacturing output.

In addition, Kaldor discussed that the income elasticity of demand is higher for manufactured than for agricultural products as countries increase its real income. The idea behind is that as the industrial sector expands and economies grow, real income per capita increase, and the rise in real income itself stimulates the demand for manufactured products. This happens considering there is a familiar relation between the level of real income and the structure of consumer demand; at low levels of income, a high proportion of income is devoted to food, while in an intermediate level of real income per capita, the income elasticity of demand for manufactured goods is high. However, "at still higher levels of real income per capita, the income elasticity of demand for manufactures tails off both absolutely and relative to demand for services" (Kaldor 1967, 29).

Moreover, Cornwall (1977) established that manufacturing is a sector that offers special opportunities to drive technological progress in the economy, diffuse this technological advance to other sectors due to the strong backward and forward linkages it generates[10] (for instance, technological improvements in software and ICT services cannot happen without advances in ICT hardware) (Lavopa and Szirmai 2012), and encourage the specialization in activities with higher value added and technological content.

Another argument exposed by Cornwall (1977) is that manufacturing sector offers special opportunities for economies of scale due to the nature of technologies since can be applied more productively in large scale production. Also, the expansion of production raise the scope for learning by doing, increase productivity and lower marginal costs. Therefore, the growth rate of productivity in manufacturing will depend positively on the growth rate of

[10] Backward linkages can be created if the final demand for manufacturing output increases and the demand in many sectors further down the line increment as well (could be agricultural or mining products, services). This implies that the increase of manufacturing output due to the increment of final demand, leads not only to a raise of manufacturing productivity (Kaldor-Verdoorn law), but also to an increase on output, and perhaps, productivity in the sectors further down the line. Similarly, the manufacturing sector also creates forward linkages considering that the sector is the supplier of capital goods and these are the main carriers of new technology (Cornwall 1977).

manufacturing output growth (Kaldor-Verdoorn law). Despite of this, is necessary to recognize that "due to the rise of new ICT technologies, economies of scale are no longer limited to manufacturing. In certain ICT based service sectors, scale economies have become very important as the marginal costs of additional units of service approach zero" (Szirmai, Is manufacturing still the main engine of growth in developing countries? 2009).

Furthermore, has been argued that manufacturing has particular conditions for capital accumulation which is one of the main factors for development and growth. Capital intensity is high in mining, manufacturing, utilities and transport, but is much lower in agriculture and services. This happens because "capital accumulation can be more easily realized in spatially concentrated manufacturing than in spatially dispersed agriculture" (Szirmai 2009, 13). Nevertheless, Szirmai also warns that the relative capital intensity of manufacturing has declined over the time since by 1990 was about the same as in the total economy.

3. Literature review[11]

Since the results presented by Kaldor in 1967 about "manufacturing an engine of growth", the economic growth literature had tested and confirmed its validity either at country level or at regional level and had used different econometric techniques (pooled regressions, panel data or times series) to explain the growth relation. For example, at a country level with international comparison there are Parikh (1978), McCombie (1983), Thirwall (1983), and Necmi (1999). Others have done it at a country level but individually like Stoneman (1979) for UK, Whiteman (1987) for Australia, Drakopoulos and Theodossiou (1991) for Greece, and Bairam (1991) for Turkey. The researchers that conducted the law at regional level are Cripps and Tarling (1973) that studied the case for advanced capitalist economies; McCombie and de Ridder (1983), and Bernat (1996) that analyzed the case of US; Casetti and Tanaka (1992) who assessed the validity with regards to Japan. Hansen and Zhang (1996) that performed the analysis respect to several regions in China, and Wells and Thirlwall (2003) that evaluated the growth law across African countries.

More recently, Lavopa and Szirmai (2012) with a sample of 92 countries for the period 1960-2010 and using an instrumental variable/two-stage least squares method, find strong evidence for the engine of growth hypothesis for manufacturing. Libanio and Moro (2013) provides estimations that support Kaldor´s views on the importance of manufacturing industry for economic growth by using a panel data (applying fixed effect and random effect models) for eleven largest economies in Latin America during the period 1980-2006. Pacheco-Lopez and Thirlwall (2013) find a new interpretation of Kaldor´s first law and using also an instrumental variable/two-stage least squares approach, show that for 89 open developing economies for the period 1990-2011, trade is the most important transmission channel from manufacturing growth to economic growth.

Furthermore, there is a short empirical analysis that tests Kaldor´s approach to other sectors of the economy to evaluate if manufacturing is the only engine of growth. Acevedo, et al. (2009) carries out the econometric analysis on a panel of 18 Latin American countries over

[11] The literature review has been guided by (Libanio and Moro 2013), (Cantore, et al. 2013), (Guo, Dall'erba and Le Gallo 2013), and (Ener and Arica 2011).

the period 1951-2006 and using a fixed effects model identifies a strong relation between manufacturing and economic growth, but find the same relation for services. They can not confirm that manufacturing is the most important engine of growth over services. In the same direction, Felipe, et al. (2007), by using a fully modified ordinary least squares, confirm Kaldor´s first law; however, finds that agriculture and services have higher engine of growth elasticities compared to manufacturing for South East Asian economies.

From the literature review is possible to observe that the there is a strong confirmation on the validity of Kaldor´s first law of economic growth at a country and regional level. All the papers have used for the analysis the same econometric technique utilized by Kaldor (pooled regression) or have tried to improve it by using more sophisticated techniques like panel data (fixed or random effects), instrumental variable/two-stage least squares method or the fully modified OLS to overcome the endogeneity bias found in Kaldor´s theory.

Despite of this, the literature has two main limitations. First lacks current evidence of "manufacturing an engine of growth" law for a world panel and presents little evidence of Kaldor´s approach on other sectors of the economy, especially for the services sector that, as will be discussed, shows great potential to be an important source of growth. Second, the econometric techniques used in some papers try to improve the pooled OLS used by Kaldor but still have important limitations. For example some papers use fixed or random effects considering they allow for heterogeneity across countries. Nevertheless, this technique does not solve the problem of endogeneity.[12] In addition, the 2SLS instrumental variable method[13] used in few papers is meant to treat endogeneity bias (see Lavopa and Szirmai 2012, Fagerberg and Verspagen 2001), yet is extremely complicated to find suitable exogenous instruments that are correlated with the endogenous variable but do not affect the dependant variable Y. In fact, the instrumental variables used in these papers need to be analyzed carefully since the economic intuition suggests that are correlated with the dependent variable and the error term and they do not present results for exogeneity and overidentification tests.

Considering the limitations of these methods, the econometric literature presents an alternative model than can be used to test and improve the results about the growth hypothesis proposed by Kaldor "manufacturing an engine of growth" and extend it to the services sector. This model is the system Generalized Methods of Moments (GMM) that will be explained in a following section.

[12] The main assumption of the fixed and random effect formulation is that the error term is split into two different components as follows: $\varepsilon_{i,t} = \mu_{i,t} + f_i$. Where the first term represents the traditional idiosyncratic random error and the second represents specific effects. In the fixed effects model the fi is correlated with the regressors, while in the random effects model fi does not depend on the regressor, therefore is a random variable. Despite of this, by construction the random effects model assumes a country specific error term fi not correlated with the regressors, however, endogeneity may arise as regressors could be correlated with the error component $\mu_{i,t}$

[13] The idea of the 2SLS technique is on a first step identify exogenous instruments Z that are correlated with the endogenous variable X but do not affect the dependent variable Y. On a first stage the method regress the endogenous variable X on the selected instruments Z. At the second stage, the fitted values from the previous regression are used to estimate Y=f(X).

4. Modern view towards services as a growth escalator

To complement the theoretical discussion on the way to generate economic growth and explain the differences between countries is necessary to argument why the development of the services sector has become important in the economic debate over the time. There is a new modern economic thinkers, referred in the literature as the "prophets of post-industrial economy", who argue that countries should focus on services to accomplish economic growth. In fact, sometimes the debate suggests that developing countries (late-comers to development) should skip industrialization and move directly into services economy as the world is living in a post-industrial era, well-known as "the information age" (Blinder 2006).

This new trend discusses the fact that in the past, economic growth was only associated with growth of the manufacturing sector. The services sector was recognized to have low productivity level, low-skilled labor force, low innovation possibilities, low rate of employment generation, and in general few opportunities to trigger economic growth. Nevertheless, today there is evidence which shows that the services sector contributes more to GDP growth than industry, not just on rich countries but also in many developing countries, like the South Asian economies (Ghani and Kharas 2010). Also the sector is suitable for technology improvement and high labor productivity since ICT technologies have a strong presence in the services sector and contribute greatly to productivity growth (Szirmai 2009). ("In fact, there are empirics that show that labor productivity levels in services in South Asia are above those in industry, and that productivity growth in South Asia's services sector matches labor productivity growth in manufacturing of successful East Asian countries") (Ghani 2009).

As part of the service growth revolution is important to differentiate between two broad categories within the services sector since not all provides the same opportunities to achieve growth, "traditional personal services" and "modern impersonal services". In 1984, Baumol called the former "stagnant personal services" and the latter "progressive impersonal services". The traditional services, like beauty and barbershops, meal preparations, nursing, housecleaning, often require face to face interaction and a limited use of ICT, however they also include "stagnant impersonal services" such as public administration services. These services can benefit less from ICT and technological changes, even when there is room for productivity improvement by using new technologies (Ghani 2009).

In contrast, the modern services such as communication, computing, insurance and banking services can take greater advantage from ICT, globalization, economies of scale and exhibit higher productivity growth rates compared to traditional services. One important aspect about these services is that they have become more impersonalized over the time, which implies that nowadays banking services can be done through the internet and that in the near future students will be able to access high quality education via virtual classrooms. The fact that modern services are highly characterized by the 3T´s, growing tradeability, increasing technological sophistication and lower transports costs, allows them to be more dynamic and to show greater potential to be "the next growth escalator" as suggested by Ghani from the World Bank.

The first T "technology" is responsible for the transformation of services from personal to impersonal services since it allows to be delivered electronically over long distances and keeping the quality almost intact. Technology has also reduced the trading cost, as services

can be more easily measured, exchange and outsource. The second T “transport” has contributed to services growth since the cost of transporting services has decrease and the way they are traded is much easier than goods since are delivered using the internet, satellites, telecom networks. Finally, the last T “tradability”, implies that modern services are more widely traded due to the liberal trade regime in services compared to the one of goods. Services can be moved from one country to another without facing borders, customs or tariffs imposed by governments (Ghani 2009).

More general, the 3 T´s has contributed to the development of the service sector tremendously. In fact, services have become the fastest growing sector in world trade, but for countries really matters the type of services they develop. Modern impersonal services can make the difference in this growing era of technology. Besides, this type of services are characterized by strong productivity growth (which has been widely recognized as one of the main sources of economic growth), that are even comparable with some of the high-growth industries within manufacturing. “High productivity growth rates in services are attributed to trade, increasing returns to scale, strong uptake of information and communication technology equipment, and competitive pressures” (Ghani 2009, 56).

What is also interesting is that developing countries are focusing more on the production of services that can be traded, which is shown by the faster increase in the share of services exports in total services value added than developed economies. Also the services exports of developing countries grow more rapidly than those from developed countries. This suggests that not just rich countries consider the expansion of the service sector as part of their development agenda to achieve economic growth.

Despite this fact, is essential to ask whether a strategy for low income countries is to jump directly into the expansion of the service sector, skipping industrialization. Eichengreen and Gupta (2009) claim that there are two different waves of service sector growth. The first one takes place when the economy at low levels of growth increases the share of services in total GDP, but at a decelerating rate as growth continues; the type of services developed during this period are the traditional ones that exhibit low productivity. While the second wave takes place when the economy has reached higher income levels and develops modern or high productivity services.

If this is true, the question is what happens between these two waves of service sector growth that generates countries go from a low income category to a higher one? Could be the industrialization process suggested by the pioneers of the literature on structural change, Fisher (1939) and Clark (1940), considering that the source of demand for those high-productivity or modern services are manufacturing firms. However, answer this question is not the purpose of this thesis, but is something important to have in mind for future research.

5. Why manufacturing and services matter for economic growth through empirical evidence

In addition to the theoretical discussion presented before, this section pretends to highlight through empirical evidence, important facts about why manufacturing and services development matter for economic growth.

5.1 The role of manufacturing

Important empirical evidence suggests that the manufacturing sector has played a major role in the economic transformation of countries by promoting the shift from activities based on natural resources with low productivity and value addition to more productive activities that generate higher profits and are suitable for innovation, technological change and human capital formation. The benefits that the manufacturing sector exhibits today are a consequence of the rapid technological change, increasing open markets and the fragmentation and internationalization of production. (Albaladejo 2012).

As Ha-Joon Chang (2010) claims, "*history has repeatedly shown that the single most important thing that distinguishes rich countries from poor ones is basically their higher capabilities in manufacturing, where productivity is generally higher, and, most importantly, where productivity tends to (although does not always) grow faster than in agriculture and services"* (Chang 2010, 213).

Based on international experience is possible to highlight some facts about the benefits of strengthening the manufacturing sector.

- Fast growing economies are associated with highest growth of manufacturing over non-manufacturing sectors. Table 1 shows at a regional level that most of the countries with the highest GDP growth rate (typed in bold) exhibit a positive excess of manufacturing growth over the non-manufacturing growth. All blue countries from all regions fulfill this relation except the ones from Latin America, due to the general trend of the region towards des-industrialization over the period of analysis. In the case of Ireland and India, that almost have an equal growth between manufacturing and non-manufacturing, is because services is the fastest growing sector in their economies.

Table 1. Regional growth trends, 1990-2011

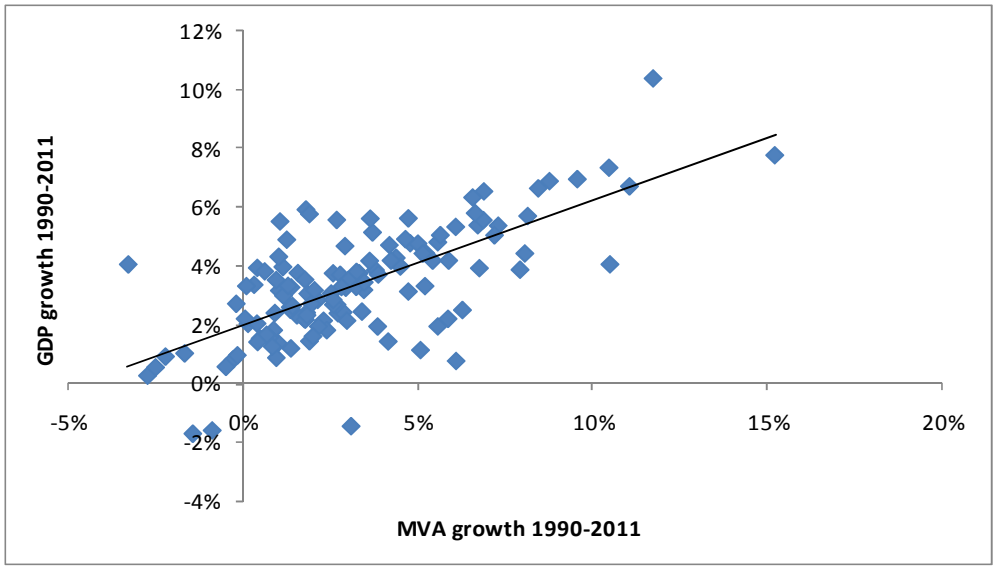
Region	Country	Average growth rate 1990-2011			Excess manufacturing growth over non-manufacturing growth
		GDP	Manufacturing	Non-manufacturing	
East Asia and Pacific	**China**	**9.9%**	**11.7%**	**9.9%**	**1.9%**
	Cambodia	**7.7%**	**15.2%**	**6.9%**	**8.3%**
	Vietnam	**7.2%**	**10.5%**	**6.7%**	**3.8%**
	Mongolia	3.8%	0.6%	4.1%	-3.5%
	Philippines	3.8%	3.2%	4.0%	-0.7%
	Japan	0.9%	0.9%	0.9%	0.1%
European Union	**Estonia**	**5.4%**	**6.7%**	**5.2%**	**1.5%**
	Ireland	**4.8%**	**5.0%**	**4.7%**	**0.3%**

	Poland	**3.9%**	**7.9%**	**3.2%**	**4.7%**
	Italy	1.0%	-0.2%	1.2%	0.2%
	Lithuania	0.8%	6.1%	0.1%	-2.0%
	Latvia	0.5%	-2.5%	1.1%	-2.6%
Latin America	**Chile**	**5.1%**	**3.7%**	**5.4%**	**-1.7%**
	Peru	**4.9%**	**4.6%**	**5.0%**	**-0.3%**
	Bolivia	**3.9%**	**3.8%**	**3.9%**	**-0.1%**
	Brazil	3.2%	1.8%	3.3%	-1.4%
	Paraguay	3.2%	1.1%	3.2%	-2.1%
	Venezuela	2.6%	2.6%	2.7%	-0.1%
Middle East and North Africa	**Jordan**	**5.6%**	**6.9%**	**5.4%**	**1.5%**
	Egypt	**4.4%**	**5.2%**	**4.3%**	**0.9%**
	Iran	**4.4%**	**8.1%**	**4.0%**	**4.0%**
	Turkey	4.0%	4.5%	3.9%	0.6%
	Morocco	3.7%	2.8%	3.9%	-1.1%
	Algeria	2.7%	-0.2%	2.9%	-3.1%
South Asia	**Bhutan**	**6.9%**	**8.8%**	**6.7%**	**2.0%**
	India	**6.5%**	**6.9%**	**6.5%**	**0.4%**
	Bangladesh	**5.4%**	**7.3%**	**5.0%**	**2.2%**
	Sri Lanka	5.3%	6.1%	5.2%	0.9%
	Nepal	4.4%	5.1%	4.4%	0.8%
	Pakistan	4.2%	5.4%	4.0%	1.5%
Sub-Saharian Africa	**Uganda**	**7.0%**	**9.6%**	**6.8%**	**2.7%**
	Mozambique	**6.6%**	**8.4%**	**6.5%**	**2.0%**
	Angola	**5.7%**	**8.1%**	**5.6%**	**2.6%**
	Cote d'Ivoire	1.4%	1.0%	1.5%	-0.5%
	Central African Rep.	1.2%	1.4%	1.2%	0.2%
	Burundi	0.8%	-0.3%	1.0%	-1.3%
North America	**United States**	**2.4%**	**3.4%**	**2.3%**	**1.1%**
	Canada	2.4%	0.9%	2.6%	-1.7%

Source: World Development Indicators, United Nations Statistics Division.

- There is an undeniable link between manufacturing growth and GDP growth (Figure 1). More importantly, manufacturing can transform the economic structure of agrarian societies. Preliminary results show the experience of 129 countries that exhibit a positive relation between manufacturing growth and GDP growth for the period 1990-2011. However, this relation will be tested in a following section for its significance and magnitude.

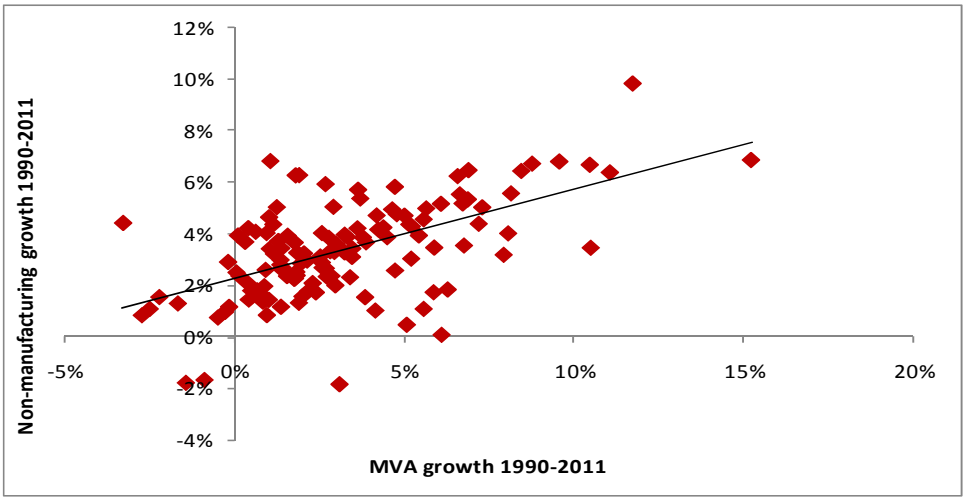
Figure 1. Manufacturing Value Added growth and Gross Domestic Product growth, 1990-2011



Source: World Development Indicators, United Nations Statistics Division, Swiss Statistics

- The manufacturing sector growth has a positive relation with the growth rate of non-manufacturing activities. This is supported by the theoretical statement that manufacturing spread positive externalities over the rest of the economy due to the strong backward and forward linkages it generates. Figure 2 shows the positive relation for a sample of 129 countries between 1990 and 2011.

Figure 2. Manufacturing growth and Non-manufacturing growth, 1990-2011

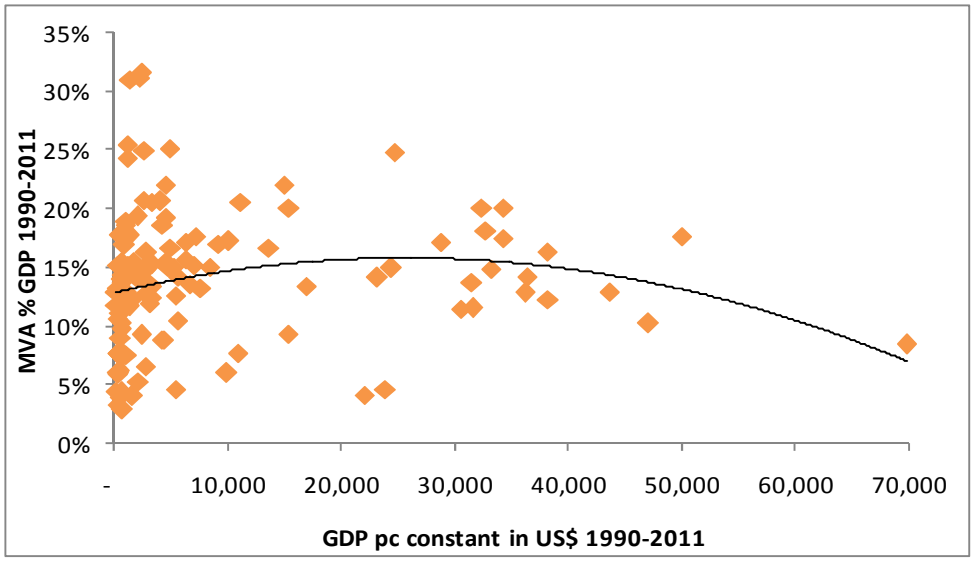


Source: World Development Indicators, United Nations Statistics Division, Swiss Statistics

- There is a curvilinear relation between the income level of economies and the importance of manufacturing in total output, especially in developing countries (Rodrik 2009). As GDP per capita increases from low levels, the share of manufacturing also rises until it reaches a peak (Figure 3). After this point the share of manufacturing

declines as the service sector becomes more important in the economy. This means that low income countries have a limited dependence on manufacturing (9% in average between 1990 and 2011), while for upper-middle income manufacturing is usually the engine of growth (15% in average during the same period).

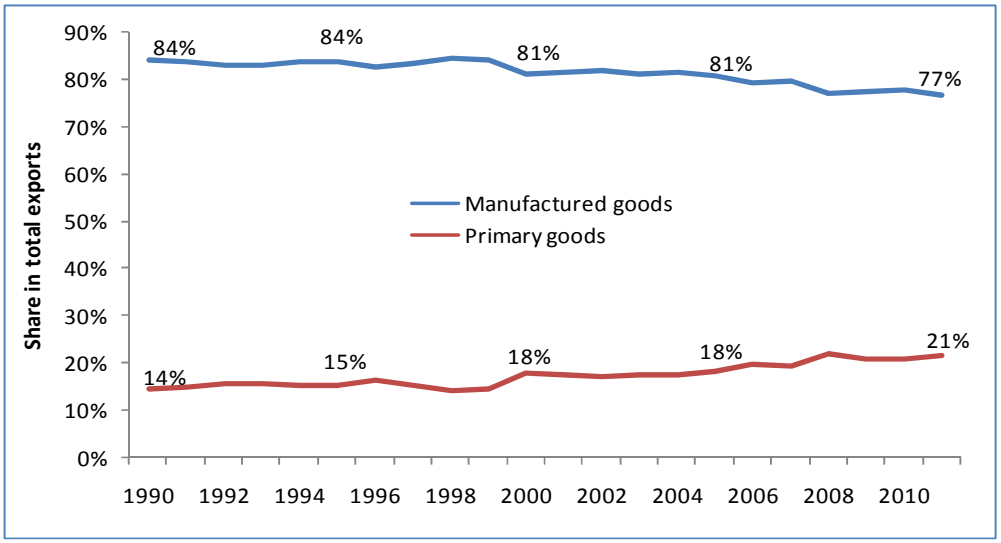
Figure 3. Income level (GDP per capita) and the importance of Manufacturing (MVA % GDP), 1990-2011



Source: World Development Indicators, United Nations Statistics Division, Swiss Statistics

- The world demand of manufactured products drives goods exports (Figure 4). The share of manufactured over total goods exports accounted for 77% in 2011 (7% less than the share registered in 1990). The share decrease between the two decades can be explained by the boom in commodity prices, due to the volatility of these products.

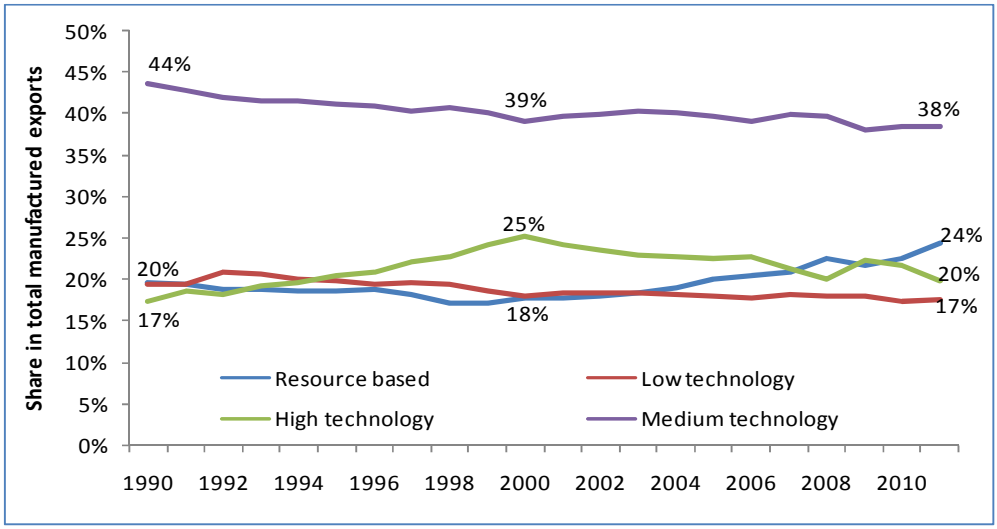
Figure 4. Share of manufactured and primary goods in total export products, 1990-2011



Source: UN-COMTRADE

- World manufactured exports are represented by four technological categories, resource based, low tech, medium tech and high tech manufactures.[14] The technology intensive products that incorporate high value addition constitute the bulk of total manufactured exports. The share of medium and high technology goods in 2011 reached together 58% of total manufactures (Figure 5). This shows that the world is demanding more sophisticated products and therefore it encourages technological change, innovation (based on research and development), and specialized human capital formation.

Figure 5. Share of manufactured products by technological category in total manufactured exports, 1990-2011



Source: UN-COMTRADE

- The manufacturing sector is more stable than the primary sector as is less expose to external shocks like price changes, natural disasters, unfair competition. For instance, countries with an important agricultural sector suffer from the last issue since industrialized economies usually impose subsidies to their primary products and therefore the international competition is uneven.

[14] The technological classification has been developed by UNIDO in the *Industrial Development Report 2002/2003.* It uses the Standard International Trade Classification (SITC), 3 digit, revision 3. The resource-based products include goods such as processed food, beverages, simple wood products, refined petroleum products, precious stones and organic chemicals. Their competitiveness depend on the abundance of natural resources and require simple technologies. The low technology products have low requirements in terms of innovation and technological capabilities, but are labor-intensive such as clothing and textiles, footwear, furniture, toys, simple metal and plastic products. The medium technology products usually require technologies that are intensive in scale and capacity. These include basic intermediate goods and durable and capital goods, therefore, they are considered the core of the industrial activity and exports. Examples are automotive products, industrial chemicals, standard machinery and simple electric and electronic products. Moreover, the high technology goods are based on research and development such as, computers, semiconductors, pharmaceutical products, advanced electronic goods, complex electrical machinery, and precision instruments.

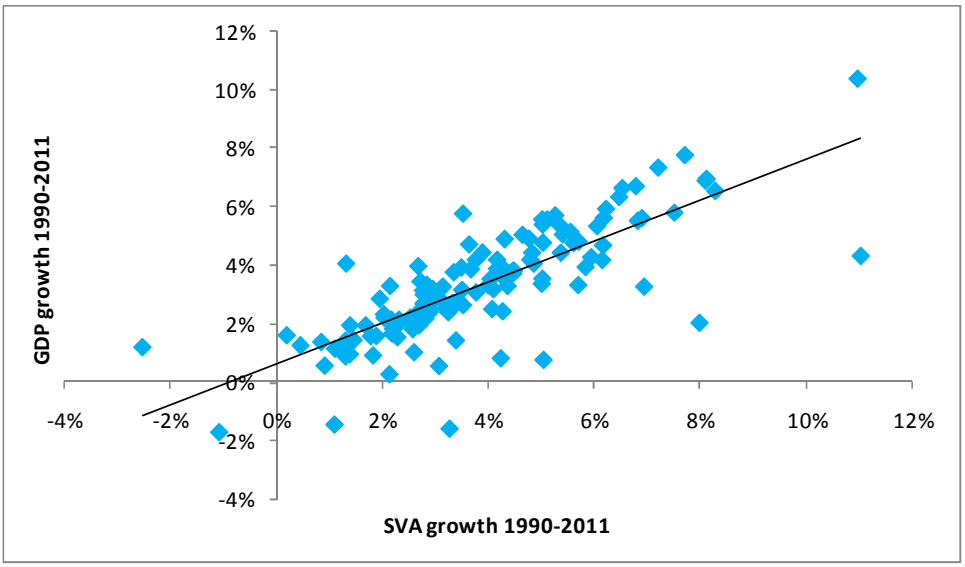
5.2 The role of services

In the last two decades, the service revolution has taken an important place in the economic growth debate of academics and practitioners. The principle idea is that late-comers to development do not have to take necessarily the boat of industrialization and wait until the catch-up process takes place. The globalization of services offers new alternatives that developing countries can exploit to specialize, scale up and achieve high economic growth, as several highly industrialized economies do.

Based on empirical evidence, there are several arguments about the benefits of boosting the services sector. They are discussed below.

- The service sector growth has a positive association with economic growth. Figure 6 illustrates this relation for a sample of 129 countries for the period 1990-2011. Nevertheless in a following section this relation will be tested for significance and magnitude. Empirical evidence shows many cases of service-led growth, probably India is the most famous case, yet there are more examples such as Armenia, Bangladesh, Kyrgyz Republic, Moldova, Mozambique, Pakistan, Philippines, Romania, Rwanda, and Sri Lanka (Ghani, Goswami and Kharas, Can services be the next growth escalator? 2011).

Figure 6. Services Value Added growth and Gross Domestic Product growth, 1990-2011



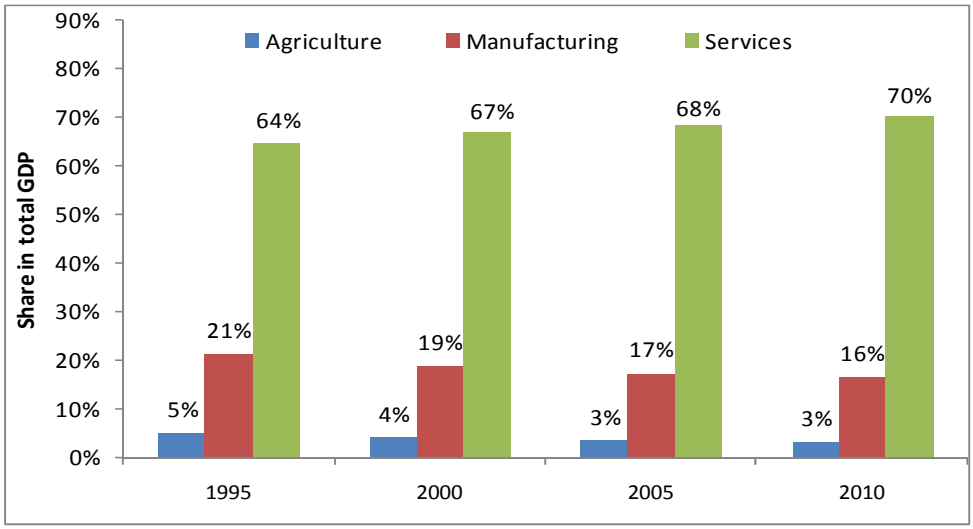
Source: World Development Indicators, United Nations Statistics Division, Swiss Statistics

- The service sector is the main contributor to the Gross Domestic Product of the world. Between 1995 and 2010 the share of service has increased from 64% to 70% in detriment of agriculture and specially manufacturing (Figure 7). Over the same period, considering the World Bank income classification, in low income and lower-middle income countries the service sector represented around 49% followed by agriculture (25%) and manufacturing (14%) in 2010. For upper middle income and high income economies, services accounted for 54% and 74% respectively, while manufacturing

constituted the second main contributor but with lower shares (23% and 15% respectively).

These numbers generate a clear message: the sectoral composition of an economy matters a great deal. Is it a coincidence that countries with the highest shares of services and manufacturing are the richest ones? The answer is obvious. At a first glance both sectors are good for economic growth, but within each sector there are activities that provide higher positive externalities than others. In manufacturing the medium and high technology industries provide more benefits, while in services are modern impersonal services that can pull up the economy. An important question that arises is how feasible and realistic is to think that low and low-middle income countries can develop modern services and medium and high technology industries? The point of discussion should be in which sector these countries can catch-up faster the technology required to produce this type of services and goods. The answer seems to be in services, as ICT can be developed faster in this "information age".

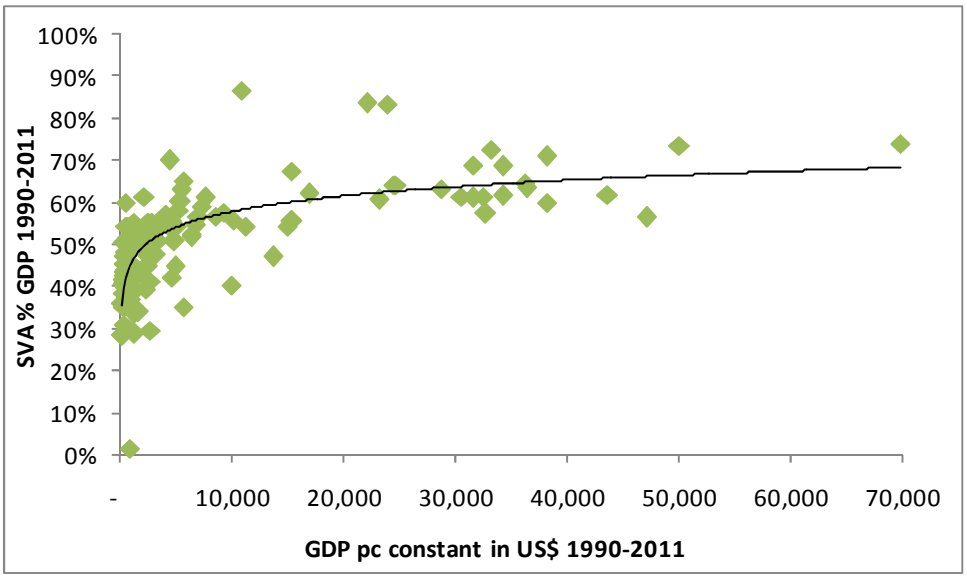
Figure 7. Sectoral contribution in total GDP, 1995-2010



Source: World Development Indicators, United Nations Statistics Division, Swiss Statistics

- There is a positive relation between income per capita and the share of services in total GDP. In the literature there is a well-known stylized fact that shows that as a country develops the importance of the services sector in total GDP increases. Could be that on a first phase traditional services are developed but on a second phase must be modern services as they are the ones that drives economic growth of countries. Figure 8 shows this relation for 129 countries for the period 1990 to 2011. The share of services in GDP of low income countries is in average 43%, for low-middle income 44%, for upper-middle income 52% and for high income 61%.

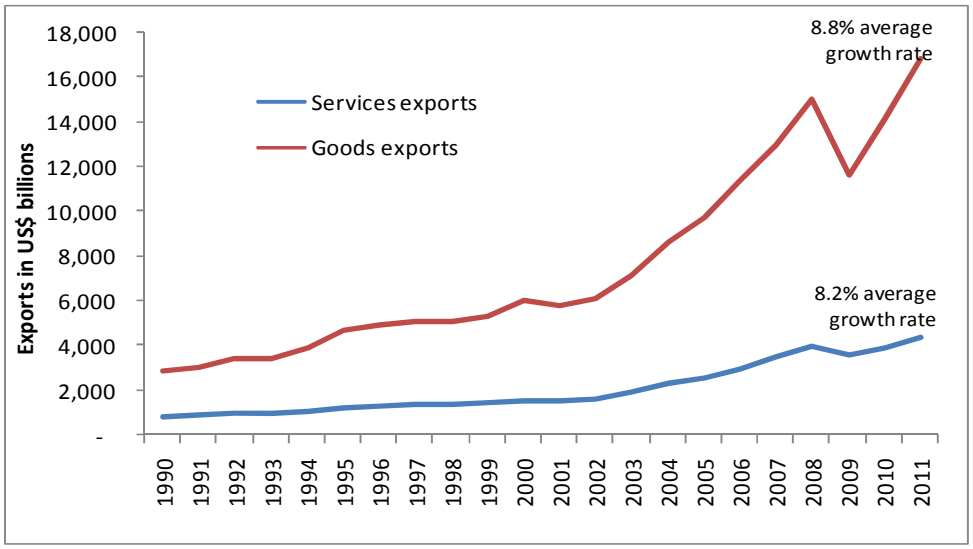
Figure 8. Income level (GDP per capita) and the importance of Services (SVA % GDP), 1990-2011



Source: World Development Indicators, United Nations Statistics Division, Swiss Statistics

- In the era of the third industrial revolution services trade has been growing tremendously. Despite the fact that in 2011 goods exports still accounted for 80% of total trade, the dynamism of the service sector (8.2%) during 1990-2011 has almost equal the growth rate of goods exports (8.8%) (Figure 9). Indeed taking only the period between 2000 and 2011, the former grew faster than the latter. Part of the explanation is that some types of services are characterized by growing tradeability, increasing technological sophistication and lower transport costs. Some of them can even be transported electronically over the world through satellite and telecom networks and are constantly expanding in number.

Figure 9. Share of services and goods exports in total trade, 1990-2011



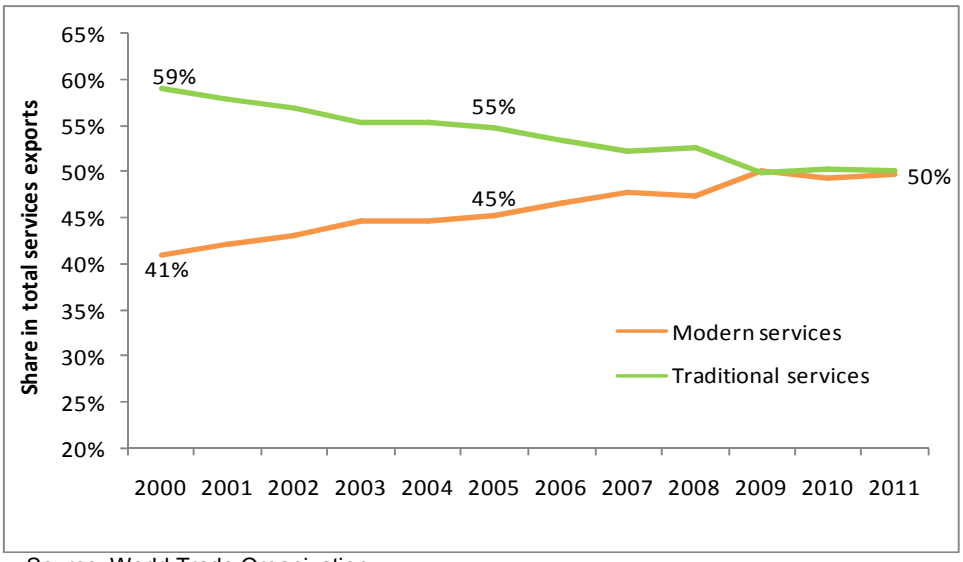
Source: World Development Indicators and World Trade Organization

- Modern services have rapidly increased their share in total services exports from 41% to 50% between 2000 and 2011, in contrast to the behavior observed in traditional services (Figure 10). [15] By looking at trends is possible to note that modern services trade is more dynamic than traditional services exports considering the former grew at 11.9% compared to 8.3% of the latter for the same period.

  These trends suggest that the world is consuming more sophisticated services and consequently it promotes innovation, technological development and specialized human capital formation. Nowadays the empirical debate even suggests that technological change in the services sector is larger than in the goods sectors.

  An article developed by the World Bank discusses that the rapid development of modern services over the world, the high international demand for them and the rise on catch-up opportunities between countries (like the broadband penetration that have improve in speed and quality in developing countries) are giving low income and low-middle income countries greater possibilities to develop and export modern services and trigger economic growth.

Figure 10. Share of modern and traditional services in total services exports, 2000-2011



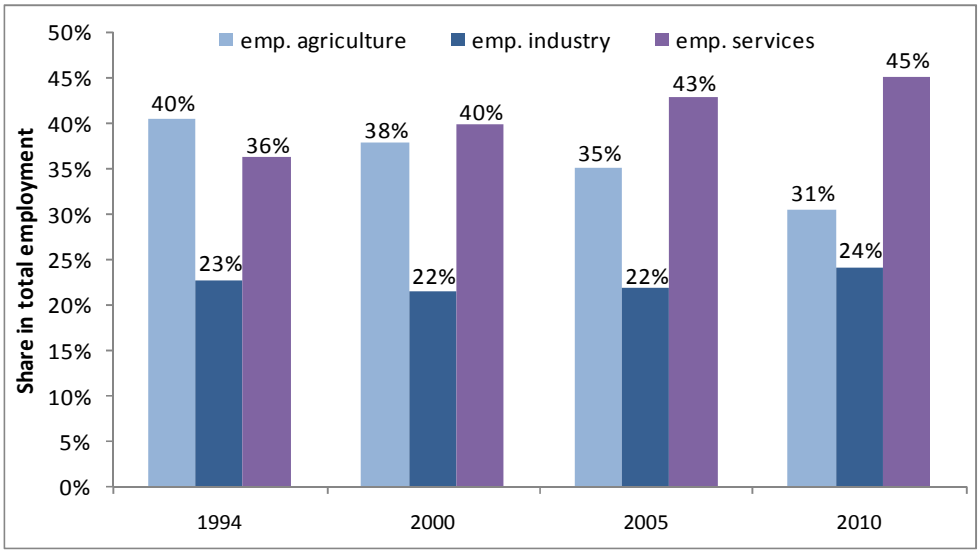
Source: World Trade Organization

- Evidence of sectoral contribution to employment generation shows that services is the sector that concentrates the highest share. Indeed, between 1994 and 2010 the share has increased from 36% to 45% with labor force been dragged from agriculture mainly. Not surprising because as predicted by Kuznets as a country develops, high-productivity activities (manufacturing and services) will grow and a transfer of labor force from low-productivity activities will take place.

[15] According to the classification of services exports used by the World Bank in the report "The Service Revolution in South Asia 2009", modern services include banking; insurance; financial; communication services; and royalties and license fees. Traditional services are considered transportation; travel; personal, cultural and recreational services; construction; and government services.

Although industry (as a proxy of manufacturing) concentrates around 24% (11% less than services) of total employment, conventional wisdom has suggested that labour-intense manufacturing creates more jobs than services, especially in developing countries. However, late research has shown that employment grows faster in the service sector (Ghani, Goswami and Kharas, Can services be the next growth escalator? 2011).

Figure 11. Sectoral contribution to employment generation, 1994-2010



Source: World Development Indicators

6. Data description

To test the current validity of Kaldor´s first law of economic growth "manufacturing as the engine of growth" and extend it to the services sector, was necessary to obtain the following variables in constant terms of 2005: Gross Domestic Product (GDP), Manufacturing Value Added (MVA), Services Value Added (SVA)for the period from 1990 to 2011.

These variables where used to calculate their own 3 years average growth rates considering that MVA growth and SVA growth cannot have a real effect on GDP growth within one single year. It is more reasonable to use the hypothesis suggested in empirical studies of 3 to 5 years to test both relations (Lavopa and Szirmai 2012 and Cantore, et al. 2013). The variables were obtained from the following sources:

- World Development Indicators
- United Nations Statistics Divisions
- National Accounts of countries

In the case of GDP almost all data was obtained from World Development Indicators (WDI), however in the case of MVA the data was completed with the United Nations Statistics Divisions (UNSD) and the national accounts of few countries. This procedure was done for

18 countries. To extend the database for the services sector was necessary to use the share of the services sector in total GDP (obtained from the WDI) and then apply it to the GDP in constant value 2005. The process was done for 8 countries. As for the countries with incomplete time series of GDP, MVA or SVA, growth rates were calculated for the initial period (between the initial value and 2000) and for the last period (between 2000 and the last value) to project the missing values.

Using these data, additional variables were calculated to provide additional support to Kaldor´s first law such as the sectoral share in total GDP, for manufacturing and services. Moreover, MVA per capita was calculated to determine the level of industrialization of countries.[16]

The initial database contained 184 countries that reported data of GDP, 157 of MVA and 163 of SVA, however crossing the three variables for all countries, left the sample with 129 nations for the period 1990-2011 with regional and income level representation.[17] The world sample of 129 countries was reduced to 119 since the remaining countries where found important outliers that distort the results considerably (Annex III presents all countries included in the analysis classified according their income level). The countries eliminated were Albania, Armenia, Georgia, Ghana, Lesotho, Lithuania, Mauritania, Rwanda, Sierra Leona and Trinidad and Tobago.

The technique used to identify the outliers was the *Control Chart Technique* discussed by Bakar, et al. (2006). It considers three measures: the mean of the sample, the Upper Control Limit (UCL) and the Lower Control Limit (LCL), both define the constraints. Then the data is plotted on a dispersion chart to identify which values are outside the limits and then those countries are recognized as outliers. The technique was applied for the panel data of manufacturing and economic growth and for services and economic growth. The results of the *Control Chart Technique* are specified in Table 2.

Table 2. Results for the Control Chart Technique for outliers' identification

Measures	Panel data 1990-2011 (3 average growth rates)	
	Manufacturing growth sample	Services growth sample
Mean value	3.31%	3.97%
Upper Control Limit	30.31%	21.97%
Lower Control Limit	-23.69%	-14.03%

Source: World Development Indicators, United Nations Statistics Division, Swiss Statistics

The sample of countries was chosen based on data availability and the period of coverage (21 years) was selected to maximize comparability among countries by income levels since

[16] Countries above the world average of MVA per capita for the period 1990-2011 were consider high industrialized, while economies below the average were identified as low industrialized.

[17] By region there are 13 countries from East Asia & Pacific, 25 from the European Union, 23 from Latin America, 9 from Middle East and North Africa, 2 from North America, 6 from South Asia, 26 from Sub-saharian Africa, and 15 other category. By income level, according to the classification developed by the World Bank, the sample contains 20 low-income countries, 60 middle-income, and 39 high-income.

the intention of the thesis is to present results for the world panel, but also for low, middle and high income countries that will ensure more meaningful findings in terms of policy implications.[18] The sample also ensures that the model has an adequate number of observations, considering the analysis uses 3 years average growth rates which leave 7 observations by country, but also guarantees that the time period is small and fulfill the required size to use the system Generalized Methods of Moments (GMM) as an econometric model.

7. Methodology and the econometric model

This section introduces the econometric technique that will be used to test the current validity of "manufacturing as the engine of growth" and extend it to the services sector. As mentioned in a previous section, Kaldor results for the first law of economic growth suffer from endogeneity bias which can arises for many reasons such that the independent variable (MVA) is correlated with the error term, omitted variables in the regression, simultaneity bias. In the growth relations between 1) GDP growth and manufacturing growth and 2) GDP growth and services growth, the dependant and independent variable could be reciprocally correlated. Ordinary Least Squares (OLS), which is the econometric model used by Kaldor, has the strong assumption that causality goes in one direction, this is from MVA growth or SVA growth to total GDP growth. The problem is that in case of reciprocal causality, is well known that OLS technique produce biased estimates.

In fact, the biased results presented by Kaldor due to endogeneity, is the main reason why the theory has been widely criticized. In order to treat this limitation and that literature that have tested Kaldor´s first law was not successful to present reliable results that avoid endogeneity issues, an exogenous instrumental variable technique in a fixed effect model was tested. However, was not feasible to find exogenous instruments that are correlated with the independent endogenous variable but not with the error term. Many variables[19] where used as instruments but the model did not pass the overindentification and the exogeneity tests.

For this reason an alternative econometric model also useful to treat endogeneity and efficient in dynamic panels (which is the case of the regressions in this thesis) was successfully employed to test the engine of growth hypothesis for both sectors. The technique is the System Generalized Methods of Moments (GMM) suggested by Cantore, et al. (2013) to also test Kaldor´s approach. This author even argues that the GMM has proved to be more efficient[20] than the exogenous instrumental variable technique (2SLS) in case of overidentification. (Details about the GMM approach are presented in the following subsection). However, is important to mention that even when GMM treats endogeneity, the

[18] The trade-off between expanding the time period and reducing the number of countries is in detriment of an acceptable representation of low income countries.

[19] The variables used as instruments where the logarithm of GDP per capita, population, GINI coefficient, industrialization level, openness index, development level. To be able to use education, investment and technology level would it be necessary to narrow the sample of countries, which is not desirable for the purpose of the thesis. These variables were suggested as instruments in a couple of papers, but not even these papers presented results for overindentification and exogeneity tests. Besides, the variables used in the papers are intuitively correlated with GDP growth.

[20] An estimator is efficient within a class if it has a lower variance than the rest of the estimators in the class.

direction of causality between the independent and explained variable cannot be conclusive one hundred percent. Further analysis would be required to provide additional support about the causal relation.

The model is based on the equations proposed by Kaldor but will also include the past values of the dependant variable to account for some persistency in GDP growth (this is to capture some possible autocorrelations). Also incorporates time period dummy variables to analyze if the effect of manufacturing growth or services growth on GDP growth have change during 1990-1999, 1999-2005, 2005-2011 and dummies for high and low level of industrialization and development level of countries (developed, developing and in transition).

The two dynamic panel models that will be estimated using the system GMM technique are specified below. Annex IV, V, VI and VII specify the data used in the models.

$$gGDP_{it} = \alpha 1 + \delta 1 gGDP_{it-1} + \beta 1(gMVA_{it}) + Z1_t + W1_i + \varepsilon 1_{it} \quad (1)$$

$$gGDP_{it} = \alpha 2 + \delta 2 gGDP_{it-1} + \beta 2(gSVA_{it}) + Z2_t + W2_i + \varepsilon 2_{it} \quad (2)$$

Dependant variable	
$gGDP_{it}$	Gross Domestic Product growth
Independant variables	
$gGDP_{it-1}$	Lagged Gross Domestic Product growth
$gMVA_{it}$	Manufacturing Value Added growth
$gSVA_{it}$	Services Value Added growth
α1 and α2	Constant
β1 and β2	Elasticity of MVA or SVA growth respect to GDP growth
$\delta 1$ and $\delta 2$	Elasticity of lagged GDP growth respect to GDP growth
$Z1_t$ and $Z2_t$	Time period dummies. 1990-1999, 1999-2005, 2005-2011
$W1_i$ and $W2_i$	Industrialization level (high or low) or development level (developed, developing, transition) dummies
$\varepsilon 1_{it}$ and $\varepsilon 2_{it}$	Error term that contains μ_{it} (traditional idiosyncratic random error) + f_{it} (represents country specific effects)

where β1 and β2 are the most important coefficients since they capture the **whole** effect of manufacturing growth on GDP growth and of services growth on GDP growth. In other words β1 and β2 indicate the strength and size of the correlation (elasticity) of the sectoral growth on the economic growth of the country when the former increases in 1%.

It is important to explain the reason of having two regressions instead of one that includes manufacturing growth and services growth as two independent variables. The first motive is that if a regression includes already two sectors to analyze their relation with economic growth, it would be expected that the regression includes the rest of the sectors such as agriculture, mining and the category “other sectors”. But there are no reasons to consider

these sectors since there is no theoretical or empirical evidence that suggests that they can trigger economic growth. Also, in econometric terms it would be a mistake to regress an identity.

The second reason is that services already accounts for a high share in total GDP (around 50-60%). By adding the manufacturing sector to the same regression it would end up representing almost 80% of the total GDP. A regression like this would imply that GDP growth is almost just affected by changes in the growth rates of these two sectors (which is not the case). Finally, the literature also supports the idea of having different regressions. For instance Acevedo, et al. (2009) not only uses separate regressions to analyze the correlation between manufacturing and services growth with economic growth, the authors even split services in several subsectors to ensure it does not have such a high representation in GDP.

It is also necessary to clarify why relation (1) and (2) omit other variables that surely influence economic growth. The first point is that the purpose of the thesis is not to explain which variable determines economic growth; it is only to find a relation between the growth of two sectors of the economy and GDP growth. The second is that the objective of the thesis is to use Kaldor approach which is entirely supported by the estimations performed in the literature that uses the same theoretical framework. The third is that it is not possible to combine output and input indicators (such as education, investment, technology) in the same regression and also it is not feasible (as explained before) to include additional output indicators, such as other sector´s growth due to the problem of estimating an identity.

On the other hand, the hypothesis of “manufacturing as the engine of growth” and “services as the engine of growth” will be tested not just by looking at the elasticities of both sectors, but also by following the criteria suggested by Fagerberg and Verspagen (1999). This is if the coefficient $\beta 1$ is positive and significantly higher than the share of manufacturing in GDP ($\lambda 1$), then accounts as a support for the engine of growth hypothesis. Once $\beta 1$ is calculated a one-side Wald test (under the null hypothesis that $\beta 1 \leq \lambda 1$) will be used to determine if the coefficient is significantly higher than the share of manufacturing in GDP. The same procedure is also true for services.

The idea behind this criterion is that the growth contributions of each sector in the economy are not totally independent from each other. In fact, as discussed in a previous section, there are reasons to believe that manufacturing creates backward and forward linkages with the other sectors, acting as an engine of growth. Therefore, it would be expected that the whole contribution of manufacturing to the aggregate growth rate will be higher than its direct effect that is captured by its share in GDP. This logic applies for services although there is no clarity of how strong are the spillover effects it generates with the rest of the economy.

It has to be clear that even if results fulfill both conditions (that β is positive and significantly higher than the share of the respective sector in GDP), the statement in favour the engine for growth hypothesis is not definitive because the causality between variables requires more confirmation; this is between MVA growth respect to GDP growth and SVA growth respect to GDD growth.

Also is important to state that this thesis is based on the assumption that "manufacturing as engine of growth" and "services as source of growth" can be complementary not just substitutes, this means that the results could show that both sectors are engines of growth. This belief is based on empirical evidence of countries that have achieved certain economic growth by following a structural transformation of the economy, which fosters manufacturing at some point and services at some other.

7.1 Understanding the Generalized Method of Moments (GMM)

The Generalized Methods of Moments is an econometric model that dates back several decades ago. Hansen (1982) in his seminal work about generalized method of moments estimator showed that every instrumental variable estimator in linear or non linear models, with cross-section, time series or panel data, can be performed as a GMM estimator (Wooldridge 2001). In the following years, several academics developed different approaches and applications for the GMM and in the nineties Arellano and Bond (1991) and Arellano and Bover (1995)/Blundell and Bond (1998) presented augmented versions.

The GMM has been designed for situations with few time periods (small T) and many individuals (large N), with independent variables that are not strictly exogenous, with fixed effects, with heteroskedasticity and autocorrelation between individuals (Roodman 2006). Therefore, it is useful to treat the endogeneity bias that equation (1) and (2) suffer by construction. Also it is well-known that when a dynamic model like (1) or (2) is regressed by using either OLS or fixed effects technique, the coefficient of the lagged dependant variable $gGDP_{it-1}$ can be biased upwards or downwards respectively. In this case the use of GMM can also help to correct the bias.

There are different alternatives to perform the GMM technique, however the basic intuition of the model is that it uses past values of the endogenous variables as internal instruments to minimize the weighted distance between the theoretical and actual values. Evidently these instruments will have to pass certain test in order to prove their validity and that the model specification is correct.

One of the options proposed by Arellano and Bond is "*the difference GMM estimator"* that transforms the regressors, usually by differencing them, to remove country specific fixed effects, which are the source of endogeneity. Then the first difference of the dependant variable is instrumented with lagged values of the regressor in levels (Arellano and Bond 1991). Nevertheless, may occur that the past values in levels are poor instruments for first differences (Blundell and bond 1998).

For this reason, Arellano and Bover (1995)/Blundell and Bond (1998) proposed "*the system GMM estimator"* that builds a system using the original equation with the dependant variable in first difference and the transformed equation. In this technique, the transformed equation has a dependent variable in levels that is instrumented with suitable lags of their own first differences, which is based in the assumption that first differences of instrument variables

are uncorrelated with country fixed effects.[21] "This allows the introduction of more instruments, and can dramatically improve efficiency" (Roodman 2006, 1).

The GMM estimator reports the standard errors according to one-step or two-step variants. Although in the two-step estimation, the standard covariance matrix is more efficient and robust to whatever patterns of heteroskedasticity, it typically yields standard errors that are downward bias. To overcome this issue, Windmeijer (2005) devises a finite-sample correction for the two–step standard errors in order to induce much more reliable confidence intervals.

An important consideration of the GMM estimate is that the model has been developed for short, wide panels, and to fit linear models with one dynamic dependent variable, additional controls, and fixed effects. Therefore, when the time dimension of the panel sample and the number of past values are too high, an instrument proliferation issue may arise. Numerous instruments can overfit endogenous variables.

There are two techniques to reduce the number of internal instruments and overcome instrument proliferation. The first is known as *lags truncation*, which "uses only certain lags instead of all available lags for instruments. Separate instruments are still generated for each period, but the number per period is capped" (Roodman 2009). The second technique is called *collapse* and it "creates one instrument for each variable and lag distance, rather than one for each time period, variable, and lag distance" (Cantore, et al. 2013). However, analysts that use these techniques to reduce instruments need to have clear that it may involve a loss in the efficiency of estimates, especially if the sample is small.

The literature does not discussed which technique (lags truncation or collapse) is superior and there is no consensus on how many instruments to use to avoid overfitting the GMM estimates, but a simple rule of thumb is that the number of instruments must be lower than the number of countries (Roodman 2009). In any case as Bontempi and Mammi (2012) and Cantore, et al. (2013) mention, the use of those techniques is at a certain degree arbitrarily depending of which fits the model better or of trust in the restrictions implicitly imposed on the instrument matrix.

Moreover, to judge for the goodness of a system GMM estimate is useful to look at the coefficient of the lagged dependant variable (δ1 and δ2 from equation 1 and 2). The first important consideration is that it cannot be a unit root (equal to 1). Second, it is well-known from the literature that and OLS regression with a lagged dependant variable will generate an estimate biased upwards in the presence of individual-specific effects, while a Within Groups (fixed effect) will produce an estimate biased downwards. Therefore it would be ideal that the coefficient from the GMM lies between the OLS and Fixed Effects coefficients (Bond, Hoeffler and Temple 2001). However, according to Roodman (2009) could be also acceptable if the coefficient of the dependant variable from GMM lies a bit higher or lower the OLS/Fixed Effects coefficients, as long as the number still in the range of the lower bound of the confidence interval of fixed effects and the upper bound of the confidence

[21] The main difference between the "difference GMM" and "system GMM" is the way that the individual effects are included in the model. The Arellano and Bond approach uses differencing, while the Arellano and Bover uses orthogonal deviations.

interval of the OLS. If any of these situations is violated, then would be a sign of a bias in the GMM estimates.

There are also statistical tests useful to judge the robustness of two-step system GMM estimates which provide support on the correct specification of the model. In particular these are the *autocorrelation tests, the over identification Sargen/Hansen tests and the difference-in-Hansen tests.*

For the *autocorrelation tests,* Roodman (2006) discusses that in GMM estimates in first difference, autocorrelation of order 1 (AR(1)) should be expected by construction,[22] but not for AR(2) meaning that the error term should not be correlated so that the estimates are not biased.

The *overidentification Sargen* tests is a test to verify the joint validity of the full instrument set but this test is not robust for autocorrelation and requires homoskedastic errors for consistency, since in the presence of robust standard errors the Sargen statistics asymptotic distribution is not known. For this reason is preferred to use the *Hansen test* that is robust to autocorrelation and heteroskedasticity and tests the correct model specification and/or validity of overidentifying restrictions; however, could be weak in case of instruments proliferation. Roodman (2009) warns about the danger to assess p-values of the Sargen/Hansen under the conventional significance levels of 0.05 or 0.10 with complacency. Those thresholds are acceptable to assess the significance of a coefficient estimate, but not to check the correlation between instruments and the error term. He suggests that a lower limit of the p-value around 0.20 or 0.25 can be reliable to not reject the null hypothesis.

Related to the Hansen test is the d*ifference-in-Hansen* test that checks the validity of a subset of instruments, in other words, tests the exogeneity of GMM instruments for levels and the validity of the exogenous regressors (time periods, industrialization level or development level dummies from equation (1) and (2)) in a system GMM.

8. Findings: manufacturing and services on economic growth

Based on Kaldor´s first law of economic growth, this section presents the main findings about the research question: Manufacturing continues to be an engine of growth? More importantly, is the only growth escalator?

The econometric model used to derive conclusions is the *system GMM* treated for heteroskedasticity and standard errors downward bias. Techniques to control instrument proliferation were applied and are specified in the results tables.

Findings of equations (1) and (2) are shown in Table 3 and Table 4, where the outcome of OLS model and Fixed Effects are presented as reference since is expected that the

[22] The reasoning behind is that In difference GMM taking first difference of the model $y_{it} = \alpha y_{it-1} + \beta x_{it} + \varepsilon_{it}$ yields to: $y_{it} - y_{it-1} = \alpha(y_{it-1} - y_{it-2}) + \beta(x_{it} - x_{it-1}) + (\varepsilon_{it} - \varepsilon_{it-1})$. That is $\Delta y_{it} = \alpha \Delta y_{it} + \beta \Delta x_{it} + \Delta \varepsilon_{it}$. Since $\Delta \varepsilon_{it} = (\varepsilon_{it} - \varepsilon_{t-1})$ is mathematically related to $\Delta \varepsilon_{it-1} = (\varepsilon_{it-1} - \varepsilon_{it-2})$ via the shared ε_{it-1}, a first-order serial correlation is expected in differences.

coefficient of MVA growth (B1) and SVA growth (B2) under the system GMM estimation will be higher than the one obtained with the two first models. The upper and lower bound of the confidence interval at 95% for the lagged dependant variable are specified in brackets for robustness check, also the number of instruments, the autocorrelation tests, the over identification Hansen test and the difference-in-Hansen tests of GMM instruments for levels and exogenous regressors.

Table 3 presents findings for equation (1) for a world panel for the period 1990-2011 that only included dummies for the industrialization level of countries, as time periods dummies were not useful to specify the system GMM estimations. This may happened because the relation between manufacturing growth and economic growth has remain quite stable during 1990-2011, which is not the case if compared with the first decades after 1950 were the role of manufacturing was strongest to explain economic growth. (Szirmai, Is manufacturing still the main engine of growth in developing countries? 2009).

The regression tests the current validity of Kaldor´s first law for a world panel and finds strong support for it. The coefficient β1 is positive and significant and shows that when manufacturing growth increases in 1% the growth of GDP rises in 0.56%. The higher value of β1 under the GMM estimation compared to OLS and Fixed Effects implies that traditional techniques downwards the coefficient of manufacturing growth when the issue of endogeneity is not well treated.

The constant of the model and the coefficient of the dummy variable regarding the industrialization level of countries (represented by the MVA per capita) are positive and significant. This implies that when manufacturing growth does not change the economic growth rate varies within the range captured by the constant (1.41%). The dummy variable for high industrialized countries shows a significant and negative correlation with economic growth. This means that these countries grow less than lower industrialized countries as expected.

Table 3. Estimates of the relation between manufacturing and economic growth for a world panel

Estimation methods **World Panel 1990-2011** **Dependent variable: GDP growth (t)**	**System GMM (1)**	**Pooled OLS (2)**	**Fixed effects (3)**
Independent variables			
Constant	0.0141301***	0.0185348***	0.0188712***
	(0.0034)	(0.0021)	(0.0023)
GDP growth (t-1)	0.1210488*	0.22184427***	0.1518719***
	(0.0709)	(0.0417)	(0.0542)
		[0.3037]	[0.0446]
MVA growth (t)	**0.5586928*** **	0.3558412***	0.3669788***
	(0.0578)	(0.0243)	(0.0402)
High industrialized	-0.0049166**	-0.0067998***	
	(0.0023)	(0.0016)	
R^2		0.5512	0.5352

Autocorrelation (1). 5% significance Pr > z	0.000		
Autocorrelation (2). 5% significance Pr > z	0.407		
Hansen test of overidentifying restrictions Prob > chi2	0.669		
Difference-in-Hansen tests of exogeneity of GMM instruments for levels Prob > chi2	0.753		
Difference-in-Hansen tests of validity of exogenous regresors Prob > chi2	0.574		
Number of instruments	14		
Observations	714	714	714
Countries	119	119	119

Notes: The system GMM estimation used the collapse technique for instrument proliferation. Robust standard errors are reported in parenthesis. The pooled OLS and Fixed Effect models register in brackets the upper and lower bound respectively of the confidence interval of the lagged dependant variable. To calculate the difference-in-Hansen test of exogeneity of GMM instruments for levels, the STATA used the Hansen excluding group Prob> chi2 = 0.534. To calculate the difference-in-Hansen test of validity of exogenous regressors, the STATA used the Hansen excluding group Prob> chi2 = 0.609.

*** significant at 1%
** significant at 5%
* significant at 10%

The results of equation (2) are shown in Table 4. The intention of this regression is to extend Kaldor´s first law to the services sector for a world panel for the period 1990-2011 and assess whether services can also be considered a growth escalator. The equation includes exogenous regressors such as time periods dummies and the level of development among countries.

The empirical evidence shows a positive and significant relation between services growth and economic growth, which is partially in line with the findings obtained by Kaldor in 1967 for a sample of 12 developed countries for the period 1953-1954 to 1963-1964, but who did not recognize or misinterpret the role of services in the growth process. The coefficient β2 suggests that when services growth changes in 1% the total economic growth raises in 0.88%. As expected it is much higher than the coefficient generated by the OLS or Fixed Effect models.

The constant of the model, the time periods and development level dummies are significant. Different from previous findings, the value of the constant implies that when services growth does not change, GDP growth varies in (-0.9%). Furthermore, it is interesting to note that the period 1990-1999 and 1999 to 2005 are positive and significant, which means that the role of services in the growth process was even stronger when the services revolution started to play a leading role on the economic development of some economies (caused by the explosion of ICT technologies and the growing importance of modern impersonal services).

Moreover, the system GMM estimates from Table 3 and Table 4 pass the good specification tests of the model. The coefficient of the lagged dependant variable falls inside the confidence interval delimited by OLS and Fixed Effects. The number of instruments is lower than the number of countries and autocorrelation of order 1 is detected in contrast of AR(2). P-values for overidentification Hansen test and the difference-in-Hansen tests of GMM instruments for levels and exogenous regressors suggest that there is no reason to reject

the null hypothesis of validity of full set of instruments and also of subsets of instruments (endogenous and exogenous).

Table 4. Estimates of the relation between services and economic growth for a world panel

Estimation methods **World Panel 1990-2011** **Dependent variable: GDP growth (t)**	**System GMM (1)**	**Pooled OLS (2)**	**Fixed effects (3)**
Independent variables			
Constant	-0.0087905**	0.0066455*	0.0121169***
	(0.0037)	(0.0039)	(0.0029)
GDP growth (t-1)	0.0401348	0.1587047***	0.0986189*
	(0.0509)	(0.0426)	(0.0498)
		[0.2424]	[-0.0001]
SVA growth (t)	**0.8809935*** **	0.5917066***	0.5848154***
	(0.0657)	(0.0379)	(0.0592)
Developed	0.0050061*	0.0006692	
	(0.0028)	(0.0035)	
Developing	0.0056722**	0.0044795	
	(0.0028)	(0.0033)	
Period 1990-1999	0.0066248***	- 0.0005907	- 0.0012506
	(0.0016)	(0.0017)	(0.0017)
Period 1999-2005	0.0040893***	omitted	omitted
	(0.0015)		
Period 2005-2011		-0.0058923***	- 0.0050276***
		(0.0016)	(0.0015)
R^2		0.6380	0.6295
Autocorrelation (1). 5% significance Pr > z	0.003		
Autocorrelation (2). 5% significance Pr > z	0.589		
Hansen test of overidentifying restrictions Prob > chi2	0.220		
Difference-in-Hansen tests of exogeneity of GMM instruments for levels Prob > chi2	0.334		
Difference-in-Hansen tests of validity of exogenous regresors Prob > chi2	0.411		
Number of instruments	33		
Observations	714	714	714
Countries	119	119	119

Notes: The system GMM estimation used the lag truncation technique for instrument proliferation (only second lag). The pooled OLS and Fixed Effect models register in brackets the upper and lower bound respectively of the confidence interval of the lagged dependant variable. To calculate the difference-in-Hansen test of exogeneity of GMM instruments for levels, the STATA used the Hansen excluding group Prob> chi2 = 0.224. To calculate the difference-in-Hansen test of validity of exogenous regressors, the STATA used the Hansen excluding group Prob> chi2 = 0.202.

*** significant at 1%
** significant at 5%
* significant at 10%

Table 5 shows results for the approach proposed by Fagerberg and Verspagen (1999) to provide additional support to the hypothesis “manufacturing an engine of growth” and

"services a source of growth". In the case of both sectors, the coefficients obtained from the regressions (β1 and β2) are significantly higher than the sectoral share in total GDP (for manufacturing 13.75% and for services 51.25% for the world sample on average between 1990 and 2011). These results were tested by using a one-sided Wald test - under the null hypothesis of $\beta 1 \leq \lambda 1$ and $\beta 2 \leq \lambda 2$, which shows significant p-values suggesting that there is no reason to accept the null hypothesis.

It is interesting to observe that by looking only at the coefficient of gMVA and gSVA it would be possible to say that services growth exhibits a strongest relation with GDP growth compared with manufacturing growth. However, considering that the difference between the elasticity (β1 and β2) and the sectoral share (λ1 and λ2) is higher for manufacturing, could be evidence that manufacturing creates strongest effects with the rest of the sectors. Therefore, is not possible to determine which sector is more engine of growth.

Table 5. Results to support the manufacturing and services engines of growth hypothesis for a world panel

Sector	Coefficient (β)	Specification tests	Sectoral share in GDP (λ)	One-sided Wald test p-value	Difference between β -λ
Manufacturing	**0.5587*** **	Ok	13.75%	1.51E-13	0.42
Services	**0.8810*** **	Ok	51.25%	9.94E-09	0.37

The results presented so far confirm that manufacturing still matters for economic growth, but that is not the only way to achieve it since services also contribute to the growth process of countries. In addition to this, in terms of policy implications it is useful to derive results about the role of manufacturing and services, but according to the income level of countries (low, middle and high income). It would help to understand the economic growth pattern that is behind each group of countries for future discussions.

The regressions estimated for countries income levels were based on equation (1) and (2), however they did not include dummy variables for time period, level of industrialization or development since these variables were not useful for the specification of the model.

8.1 Results for low income countries

Table 6 and Table 7 show results for the two growth hypothesis for low income countries. This means countries that according to the World Bank have a Gross National Income (GNI) per capita up to US$1,035. Findings show that Kaldor´s first law is true for manufacturing growth but for services growth is not clear. The coefficient of the former (β1) is positive and significant meaning that when manufacturing growth rises in 1%, GDP growth increases in 0.21%. In the case of services growth, the coefficient (β2=0.36) is only significant at 10%, reason why cannot be conclusive to ensure that the extension of Kaldor´s first law to the services sector is useful to understand the relation between the sector and the economic growth in low income countries.

Also, what is unexpected is that the coefficient (β1 and β2) generated with the System GMM technique is lower than the one obtained with OLS or Fixed Effect. But apart from this, the regression of manufacturing growth passes all robustness test previously analyzed for the other models.[23] In the case of the regression of services growth, the model does not find autocorrelation of order 1 (AR(1)) as was expected, but as suggested in the literature what really matters is not to find autocorrelation of order 2 (Cervellati, et al. 2014).

Table 6. Estimates of the relation between manufacturing and economic growth for low income countries panel

Estimation methods **Low income countries panel 1990-2011** **Dependant variable: GDP growth (t)**	**System GMM (1)**	**Pooled OLS (2)**	**Fixed effects (3)**
Independent variables			
Constant	0.0238249***	0.0209893***	0.0276663***
	(0.0077)	(0.0026)	(0.0038)
GDP growth (t-1)	0.2774127*	0.2983381***	0.1481422*
	(0.1500)	(0.0511)	(0.0776)
		[0.3995]	[-0.0142]
MVA growth (t)	**0.2066908*** **	0.24722***	0.2295796***
	(0.0551)	(0.0374)	(0.0457)
R^2		0.5651	0.5490
Autocorrelation (1). 5% significance Pr > z	0.021		
Autocorrelation (2). 5% significance Pr > z	0.108		
Hansen test of overidentifying restrictions Prob > chi2	0.515		
Difference-in-Hansen tests of exogeneity of GMM instruments for levels Prob > chi2	0.676		
Number of instruments	19		
Observations	120	120	120
Countries	20	20	20

Notes: The system GMM estimation used the lag truncation technique for instrument proliferation (only second and third lag). The pooled OLS and Fixed Effect models register in brackets the upper and lower bound respectively of the confidence interval of the lagged dependant variable. To calculate the difference-in-Hansen test of exogeneity of GMM instruments for levels, the STATA used the Hansen excluding group Prob> chi2 = 0.344.

*** significant at 1%
** significant at 5%
* significant at 10%

The constant of the models is significant and positive for both regressions, meaning that when gMVA or gSVA do not change, gGDP increases in α magnitude. In the regression that explains the relation between manufacturing and economic growth, persistency in GDP

[23] This is that the coefficient of the lagged dependant variable falls inside the confidence interval delimited by OLS and Fixed Effects reported in brackets. The number of instruments is lower than the number of countries and autocorrelation of order 1 is detected in contrast of AR(2). P-values for overidentification Hansen test and the difference-in-Hansen tests of GMM instruments for levels and exogenous regressors suggest that there is no reason to reject the null hypothesis of validity of full set of instruments and also of subsets of instruments (endogenous and exogenous).

growth was found, in contrast with the regression that tests "services an engine of growth" hypothesis, where there was no correlation between GDP growth and its past value.

These results mean that there is empirical evidence that suggests that only the manufacturing sector could be a source of growth for low income countries. If this is the case, a point of future discussion is which type of manufacturing can boost a faster and sustained economic growth for low income countries? Either resource based and low technology activities or medium and high technology industries?

Table 7. Estimates of the relation between services and economic growth for low income countries panel

Estimation methods **Low income countries panel 1990-2011** **Dependent variable: GDP growth (t)**	**System GMM (1)**	**Pooled OLS (2)**	**Fixed effects (3)**
Independent variables			
Constant	0.0240834**	0.0149396***	0.0228978***
	(0.0037)	(0.0036)	(0.0034)
GDP growth (t-1)	0.1173758	0.2457096***	0.0350303
	(0.0509)	(0.0771)	(0.0492)
		[0.3984]	[-0.0680]
SVA growth (t)	**0.355833***	0.4109089***	0.4184122***
	(0.0657)	(0.0777)	(0.0883)
R^2		0.6018	0.5567
Autocorrelation (1). 5% significance Pr > z	0.076		
Autocorrelation (2). 5% significance Pr > z	0.816		
Hansen test of overidentifying restrictions Prob > chi2	0.338		
Difference-in-Hansen tests of exogeneity of GMM instruments for levels Prob > chi2	0.492		
Number of instruments	13		
Observations	120	120	120
Countries	20	20	20

Notes: The system GMM estimation used the lag truncation technique for instrument proliferation (only third lag). The pooled OLS and Fixed Effect models register in brackets the upper and lower bound respectively of the confidence interval of the lagged dependant variable. To calculate the difference-in-Hansen test of exogeneity of GMM instruments for levels, the STATA used the Hansen excluding group Prob> chi2 = 0.211.

*** significant at 1%
** significant at 5%
* significant at 10%

To provide additional proof for the growth hypothesis suggested by Kaldor, Table 8 presents results for Fagerberg and Verspagen (1999) approach. By using a one-sided Wald test is possible to support the conclusion about manufacturing as the only engine of growth for low income countries. This is demonstrated by the p-values that show that β1 is significantly higher than the share of MVA in total GDP (8.72% for the low income sample on average between 1990 and 2011); while β2 is much lower than the share of SVA in total GDP of

these economies (42.99% on average for the same period). This means that for the last relation was not possible to reject the null hypothesis of $\beta 2 \leq \lambda 2$.

Table 8. Results to support the manufacturing and services engines of growth hypothesis for low income countries panel

Sector	Coefficient (β)	Specification tests	Sectoral share in GDP (λ)	One-sided Wald test p-value	Difference between β -λ
Manufacturing	**0.2066908*** **	Ok	8.71%	1.50E-02	0.12
Services	**0.355833***	Ok	42.99%	3.65E-01	-0.07

8.2 Results for middle income countries

Economies categorized by the World Bank as middle income countries register a GNI per capita between US$1,036 and US$12,615. For these countries, Kaldor´s first law of economic growth is consistent for manufacturing and also when the law is extended to the services sector. Findings from Table 9 and Table 10 show that the relation between economic growth and the growth of these two sectors is positive and significant. When manufacturing growth of middle income countries increases in 1%, GDP growth rises in 0.81% (β1). Similar to this, if services growth changes in 1%, GDP growth increases in 0.88% (β2).

In both regressions the constant and the lagged dependant variable are not significant showing that for middle income countries if manufacturing or services growth does not change, then the increase of GDP growth will not significantly differ from zero. This means that both sectors are fundamental to generate growth in this group of countries. As for the past value of GDP growth there is not a persistency effect.

Table 9. Estimates of the relation between manufacturing and economic growth for middle income countries panel

Estimation methods **Middle income countries panel 1990-2011** **Dependant variable: GDP growth (t)**	**System GMM (1)**	**Pooled OLS (2)**	**Fixed effects (3)**
Independent variables			
Constant	0.0037239	0.01648993***	0.018191***
	(0.0070)	(0.0030)	(0.0038)
GDP growth (t-1)	0.1097837	0.2117708***	0.1559853*
	(0.1207)	(0.0594)	(0.0795)
		[0.3286]	[-0.0030]
MVA growth (t)	**0.8118138*** **	0.4035168***	0.4141196***
	(0.1160)	(0.0391)	(0.0038)
R^2		0.5490	0.5455
Autocorrelation (1). 5% significance Pr > z	0.031		
Autocorrelation (2). 5% significance Pr > z	0.237		
Hansen test of overidentifying restrictions Prob > chi2	0.803		

Difference-in-Hansen tests of exogeneity of GMM instruments for levels Prob > chi2	0.719		
Number of instruments	13		
Observations	360	360	360
Countries	60	60	60

Note: The system GMM estimation used the lag truncation technique for instrument proliferation (only third lag). The pooled OLS and Fixed Effect models register in brackets the upper and lower bound respectively of the confidence interval of the lagged dependant variable. To calculate the difference-in-Hansen test of exogeneity of GMM instruments for levels, the STATA used the Hansen excluding group Prob> chi2 = 0.651.

*** significant at 1%
** significant at 5%
* significant at 10%

The robustness tests for the number of instruments, lagged dependant variable, autocorrelation of order 1 and 2, Hansen of overidentifying restrictions and difference-in-Hansen tests of exogeneity of GMM instruments for levels and exogenous regressors are satisfied, which implies that both models are correctly specified and therefore results are reliable. Also, as expected, both coefficients (β1 and β2) obtained from the System GMM regression are much higher than the ones found with OLS and Fixed Effects.

Table 10. Estimates of the relation between services and economic growth for middle income countries panel

Estimation methods **Middle income countries panel 1990-2011** **Dependant variable: GDP growth (t)**	**System GMM (1)**	**Pooled OLS (2)**	**Fixed effects (3)**
Independent variables			
Constant	0.001902	0.0060323**	0.0082318*
	(0.0051)	(0.0030)	(0.0046)
GDP growth (t-1)	-0.0056906	0.1564837**	0.1093303
	(0.0530)	(0.0633)	(0.0705)
		[0.2809]	[-0.0318]
SVA growth (t)	**0.8782148*** **	0.6394105***	0.630419***
	(0.0916)	(0.0471)	(0.0827)
R^2		0.6518	0.6497
Autocorrelation (1) Pr > z	0.037		
Autocorrelation (2) Pr > z	0.532		
Hansen test of overidentifying restrictions Prob > chi2	0.350		
Difference-in-Hansen tests of exogeneity of GMM instruments for levels Prob > chi2	0.282		
Number of instruments	17		
Observations	360	360	360
Countries	60	60	60

Note: The system GMM estimation used the lag truncation technique for instrument proliferation (only second lag). The pooled OLS and Fixed Effect models register in brackets the upper and lower bound respectively of the confidence interval of the lagged dependant variable. To calculate the difference-in-Hansen test of exogeneity of GMM instruments for levels, the STATA used the Hansen excluding group Prob> chi2 = 0.463.

*** significant at 1%
** significant at 5%
* significant at 10%

The Fagerberg and Verspagen (1999) approach confirms that for middle income countries "manufacturing and services are engines of growth" (Table 11). Results from the one-sided Wald tests show that the coefficient β1 is significantly higher than the share of MVA in total GDP (14.68% for the middle income sample on average between 1990 and 2011) and the same is true for β2 compared with the share of SVA in total GDP of these countries (47.81% on average for the same period).

It is clear that the economic growth process of middle income countries is related to the growth of the manufacturing and services sectors; however, is difficult to suggest which sector has a greater influence on economic growth. By looking at the coefficients of the explanatory variable (β2 and β1) is possible to argue that services growth has a stronger relation with GDP growth compared to manufacturing growth. Nevertheless, checking at the difference between β1 and the share of MVA in total GDP (0.67) and β2 and the share of SVA in total GDP (0.40), is obvious that the contribution of manufacturing to the aggregate growth rate is much higher.

This ambiguity could be explained by the fact that in several middle income countries both sectors have been strategic to encourage economic growth, which means that the two growth hypotheses are complementary rather than substitutes. The other thing is that empirical evidence from Ghani (2009) shows that some middle income countries such as East Asian economies have a manufacturing-led growth, while South Asian countries exhibit a services-led growth and most of these countries belong to this income group.

Table 11. Results to support the manufacturing and services engines of growth hypothesis for middle income countries panel

Sector	Coefficient (β)	Specification tests	Sectoral share in GDP (λ)	One-sided Wald test p-value	Difference between β -λ
Manufacturing	**0.8118138*** **	Ok	14.68%	4.94E-09	0.67
Services	**0.8782148*** **	Ok	47.81%	6.24E-06	0.40

8.3 Results for high income countries

High income economies are countries that register a GNI above US$ 12,616 according to 2012 World Bank classification. Results for high income countries relative to Kaldor´s first law reject the hypothesis about manufacturing is an engine of growth for these economies (Table 12). Even when the coefficient of the independent variable (β1) is significant the model does not pass all robusteness tests, specifically the Hansen test of overidentifying restrictions and the difference-in-Hansen test excluding group used to calculate the difference-in-Hansen test of exogeneity of GMM instruments for levels. This simply means that the internal instrumental variables are not valid to construct the model, therefore results are not reliable.

Table 12. Estimates of the relation between manufacturing and economic growth for high income countries panel

Estimation methods **High income countries panel 1990-2011** **Dependant variable: GDP growth (t)**	**System GMM (1)**	**Pooled OLS (2)**	**Fixed effects (3)**
Independent variables			
Constant	0.0052116	0.013605***	0.0146039***
	(0.0097)	(0.0026)	(0.0029)
GDP growth (t-1)	0.346826	0.2033666***	0.1245535*
	(0.3416)	(0.0676)	(0.0708)
		[0.3365179]	[-0.0188]
MVA growth (t)	**0.4761443*** **	0.3746581***	0.4290628***
	(0.0879)	(0.0345)	(0.0571)
R^2		0.5059	0.4943
Autocorrelation (1). 5% significance Pr > z	0.029		
Autocorrelation (2). 5% significance Pr > z	0.319		
Hansen test of overidentifying restrictions Prob > chi2	0.140		
Difference-in-Hansen tests of exogeneity of GMM instruments for levels Prob > chi2	0.300		
Number of instruments	13		
Observations	234	234	234
Countries	39	39	39

Note: The system GMM estimation used the lag truncation technique for instrument proliferation (only third lag). The pooled OLS and Fixed Effect models register in brackets the upper and lower bound respectively of the confidence interval of the lagged dependant variable. To calculate the difference-in-Hansen test of exogeneity of GMM instruments for levels, the STATA used the Hansen excluding group Prob> chi2 = 0.109.

*** significant at 1%
** significant at 5%
* significant at 10%

In contrast, when Kaldor´s first law is extended to the services sector for high income countries, findings from Table 13 show that the services sector is an engine of growth for these countries. The coefficient for services growth (β2) is positive and significant, which suggest that in high income countries GDP growth increases in 0.94% when SVA growth rises in 1%. Also the coefficient obtained by the system GMM estimation is much higher than the ones obtained with OLS and Fixed Effect technique.

The constant and the lagged dependant variable of the regression are not significant which means that for high income countries if services growth does not change, the increase of GDP growth will not significantly differ from zero. This means that the development of the services sector is crucial to generate growth in this group of countries. In case of the past value of GDP growth do not show a persistency effect in the variable.

The regression satisfies all robustness tests for the number of instruments, lagged dependant variable, autocorrelation of order 2, Hansen of overidentifying restrictions and difference-in-Hansen tests of exogeneity of GMM instruments for levels and exogenous regressors. The only specification test that the model does not pass is the existence of

autocorrelation of order 1. However, as mentioned before, Cervellati et al. (2014) suggests that what really matters in the aurocorrelation tests is not to find an AR(2) process related to the error term.

Table 13. Estimates of the relation between services and economic growth for high income countries panel

Estimation methods **High income countries panel 1990-2011** **Dependant variable: GDP growth (t)**	**System GMM (1)**	**Pooled OLS (2)**	**Fixed effects (3)**
Independent variables			
Constant	-0.0009947	0.0059306**	0.0078859*
	(0.0038)	(0.0026)	(0.0043)
GDP growth (t-1)	-0.0040034	0.0615652**	0.0167809
	(0.0816)	(0.0489)	(0.0508)
		[0.1579]	[-0.0861]
SVA growth (t)	**0.9417059*** **	0.670991***	0.6528022***
	(0.1276)	(0.0817)	(0.1352)
R^2		0.5882	0.5858
Autocorrelation (1) Pr > z	0.090		
Autocorrelation (2) Pr > z	0.289		
Hansen test of overidentifying restrictions Prob > chi2	0.313		
Difference-in-Hansen tests of exogeneity of GMM instruments for levels Prob > chi2	0.410		
Number of instruments	17		
Observations	234	234	234
Countries	39	39	39

Note: The system GMM estimation used the lag truncation technique for instrument proliferation (only second lag). The pooled OLS and Fixed Effect models register in brackets the upper and lower bound respectively of the confidence interval of the lagged dependant variable. To calculate the difference-in-Hansen test of exogeneity of GMM instruments for levels, the STATA used the Hansen excluding group Prob> chi2 = 0.257.

*** significant at 1%
** significant at 5%
* significant at 10%

Table 14 present results for Fagerberg and Verspagen (1999) approach to provide additional support to Kaldor´s first law. In this case it makes sense to analyze the approach only on the coefficient obtained for the services sector in high income countries since the elasticity of manufacturing growth is not reliable considering that the model did not pass the specification tests.

The one-sided Wald test verifies that β2 is significantly higher than the share of SVA in total GDP of high income countries (60.83% on average between 1990 and 2011) since the p-value suggests that there is no reason to accept the null hypothesis (β2 ≤ λ2). Therefore, there is confirmation for services sector as an engine of growth for high income countries, in contrast with findings obtained for manufacturing.

Table 14. Results to support the manufacturing and services engines of growth hypothesis for high income countries panel

Sector	Coefficient (β)	Specification tests	Sectoral share in GDP (λ)	One-sided Wald test p-value	Difference between β -λ
Manufacturing	**0.4761443*** **	NO	14.57%		
Services	**0.9417059*** **	OK	60.83%	4.50E-03	0.33

9. Conclusions and policy implications

The results obtained in the present thesis stimulate the debate about which sector is suitable to trigger economic growth. For several decades Kaldor´s first law represented the theoretical foundation that suggested that manufacturing is the only way to encourage economic growth due to the special characteristics it exhibits compared to other sectors of the economy (increasing returns to scale, high productivity, high income elasticity of demand, good for capital accumulation, economies of scale, innovation, technological change and diffusion due to the strong backward and forward linkages it generates). This even mean that if in a first stage manufacturing was not competitive, national efforts would have to go to strength the sectoral capabilities so later manufacturing could spread the positive externalities on the rest of the economy.

This view opposes to the neoclassical approach based on the idea that a country should focus on sectors that have comparative advantages and also to a new growing literature that claims that services also exhibit important characteristics to be consider a growth escalator and that late-comers to development could even skip industrialization and move directly to the provision of modern services.

On the other hand, empirical evidence presented in academic papers shows confirmation for Kaldor´s first law of economic growth for different regions or group of countries according their income level, yet they fail to demonstrate that the econometric techniques utilized to treat the endogeneity bias – also present in Kaldor´s results- have been handled successfully.

In addition, there is limited literature that extended the growth hypothesis suggested by Kaldor to the services sector and found that it also play a major role in the economic growth process. This last statement differs significantly with Kaldor´s interpretation since he argued that overall growth determines services growth and not the other way around. However, his conclusion was not based on a proper causality analysis so results may have been misinterpreted. This could means that even back in the sixties there was empirical evidence that suggested that services were also an engine of growth, at least for developed countries.

Considering these limitations, the contribution of the thesis to the existing literature about Kaldor´s first law was to test whether manufacturing continues to be an engine of growth for a panel with world representation by using an econometric technique suitable to treat the endogeneity bias that Kaldor´s approach has by construction. Also to extend the law to the

services sector to asses if manufacturing is the only engine of growth or services can also be consider a growth escalator.

The results obtained suggest that when Kaldor´s first law is applied to a world panel (119 countries) for the period 1990-2011, there is confirmation that manufacturing continues to be an engine of growth, but that is not the only way to trigger it considering services is also a source of growth. Therefore, even when the world is living in an era of services revolution, the benefits that manufacturing can spread in the rest of the sectors is undeniable and its development should continue to be part of the national initiatives to foster growth.

When the analysis is performed in low, middle and high income countries separately, results are more meaningful for policy debate because they show that for low income countries the development of the manufacturing sector could be the only way to boost growth. This is important for policy makers, specially from countries that have an economic development model based on extensive agriculture and oil/mineral production that need to consider that structural change towards higher value added and sophisticated manufacturing activities can lower the vulnerability of the economy and get the positive externalities that the sector is likely to generate in the rest of the economy.

A point of discussion for these countries is which type of manufacturing activities must be triggered to create economic growth, resource based and low technology or medium and high technology sectors? Evidence shows that manufacturing activities with higher technology component generate more space for technological progress, human capital development and productivity increase, which at the end contribute positively to a faster growth. However, is not possible for countries with limited capabilities to initiate an advanced industrialization process, the strategy could start by developing basic and labor intensive industries – that are also suitable to encourage growth and are necessary to support the development of other sectors - and then swap in a future stage to medium and high technology sectors. This is different for services because if low income countries engage in the development of traditional services on a first stage is difficult to expect that they will trigger growth to later move into modern impersonal services.

For the case of middle income countries manufacturing and services turn to be an engine of growth. This means that for these countries manufacturing is not the only route to achieve economic growth as was suggested in the past and that late-comers to development have not missed the boat and can also benefit from the globalization of services, improvement of ICT technologies, and the impressive increase of modern impersonal services. Therefore, the debate for middle income countries about which sector to develop must depend on their national capabilities, priorities and goals.

For instance, some East Asian countries like China have pursued a manufacturing-led growth, while several South Asian economies such as India exhibit a service-led growth. The difference between them lies in various factors, first East Asia was an early integrator into the world economy when the possibilities to enter in the manufacturing business were higher and easier than today. In contrast, South Asia as a late-comer to development had better opportunities to capture the benefits from the services revolution era. Second and more importantly, these countries consider their strengths and weaknesses to engage on a development policy. For the case of South Asia, Ghani (2009) shows that India tried to take

advantage of its higher market integration in services compared to goods trade, high availability of skilled labor force in IT, better institutions that impacted day-to-day running of services, and improved quality and availability of infrastructure to support services growth. This is simply to say that the debate should not advocate for manufacturing or services straightforward, in a process of productive transformation it will depend on external and internal factors. Besides the development of both sectors are more complementary rather than substitutes.

Finally, findings for high income countries show that manufacturing growth cannot explain anymore the growth process of these economies for the period 1990-2011, as only the services sector turns to be the engine of growth. These results are opposed to what Kaldor found back in the sixties for 12 developed countries. Yet, are in line with later empirical evidence that shows that once countries have achieved certain level of development, the role of manufacturing in the growth process decelerates and the services sector plays a major role in economic growth. This happens as these nations tend to send the mass production activities to developing countries where the competitive advantage is based on low labor costs, while they retain only high productive activities that leave space for innovation, technological change and market power and also get involved in the provision of modern impersonal services that are a strong source of growth. So for high income countries, the debate is not which sector to encourage, it moves around how to make high growth sustainable over the time considering it has been difficult for them to reach high GDP growth rates.

Bibliography

Acevedo, A, A Mold, and E Perez Caldentey. "The analysis of leading sectors: A long term view of 18 Latin American economies." Paper No. 15017, Munich Personal RePEC Archive (MPRA), 2009.

Albaladejo, M. "Indicators of industry and trade competitiveness." Training manual prepared for an institutional capacity building program, United Nations Industrial Development Organization, 2012.

Arellano, M, and O Bover. "Another look at the instrumental-variable estimation of error-components models." *Journal of Econometrics* 68 (1995): 29-52.

Arellano, M, and S Bond. "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations." *The Review of Economic Studies* (Oxford University Press) 58 No. 2 (April 1991): 277-297.

Bairam, E. "Economic growth and Kaldor's law: The case of Turkey 1925-1978." *Applied Economics* 23 (1991): 277-280.

Bakar, Z, R Mohemad, A Ahmad, and M Deris. "A comparative study for outlier detection. Techniques in data mining." Working Paper, CIS, 2006.

Bernat, A. "Does manufacturing matter? A spatial econometric view of Kaldor's laws." *Journal of Regional Science* 36 (1996): 463-477.

Blinder, A. "The next industrial revolution." 2006.

Blundell, R, and S Bond. "GMM estimation with persistent panel data: An application to production functions." Working Paper No.W99/4, The Institution for Fiscal Studies, 1998.

Bond, S, A Hoeffler, and J Temple. "GMM estimation of empirical growth models." Working Paper, University of Oxford and University of Bristol, 2001.

Bontempi, M, and I Mammi. *A strategy to reduce the count the count of moment conditions in pannel data GMM.* Working Paper No. 40720, MPRA, 2012.

Cantore, N, M Clara, A Lapova, and C Soare. "Manufacturing as an engine of growth. Which is the best fuel?" Working paper, Research and Policy Advice, UNIDO, UNO-MERIT, 2013.

Casetti, E, and K Tanaka. "The spatial dynamics of Japanese manufacturing productivity: An empirical analysis by expanded Verdoorn equations." *Papers in Regional Science* 71 (1992): 1-13.

Cervellati, M, F Jung, U Sunde, and T Vischer. "Income and democracy: Comment." *American Economic Review* 104(2) (2014): 707-719.

Chang, H. *Bad samaritans: The myth of free trade and the secret history of capitalism.* New York: Bloomsbury Press, 2010.

Clark, C. *The conditions of economic progress.* London: Macmillan, 1940.

Cornwall, J. "Modern capitalism. Its growth and transformation." New York: St. Martin´s Press, 1977.

Cripps, T.F., and R.J. Tarling. *Growth in advanced capitalist economies 1950-1970.* Cambridge: Cambridge Univeristy Press, 1973.

Drakopoulos, S.A., and I Theodossiou. "Kaldor's approach to Greek economic growth." *Applied Economics* 23 (1991): 1683-1689.

Eichengreen, B, and P Gupta. *The two waves of service sector growth.* Working Paper 14968, Cambridge: National Bureau of Economic Research, 2009.

Ener, M, and F Arica. "Is the Kaldor's growth law valid for high income economies. A panel study." *Research Journal of Economics, Business and ICT* 1 (March 2011): 60-64.

Fagerberg, J, and B Verspagen. "'Modern Capitalism' in the 1970s and 1980s." Working Paper No.1999002, Centre for Technology, Innovation and Culture, University of Oslo, 1999.

Fagerberg, J, and B Verspagen. "Technology-gaps, innovation-diffusion and transformation: an evolutioanry interpretation." *Research Policy, Elsevier*, 2002: 1291-1304.

Felipe, J, M León-Ledesma, M Lanzafame, and G Estrada. "Sectoral engines of growth in Developing Asia: Stylized facts and implications." Working paper No. 107, Asian Development Bank, 2007.

Fisher, A.G.B. "Primary, secondary and tertiary production." *Economic Record* 15 (1939): 24-38.

Ghani, E. *The service revolution in South Asia.* Poverty reduction and economic managment unit, World Bank, World Bank, 2009.

—. *The service revolution in South Asia.* Oxford University Press, 2010.

Ghani, E, A Goswami, and H Kharas. "Can services be the next growth escalator?" *VOX. Research-based policy analysis and comentary from leading economists.* December 12, 2011. http://www.voxeu.org/article/can-services-be-next-growth-escalator (accessed January 27, 2014).

—. "Service with a smile: A new growth engine for poor countries." *VOX. Research-based policy analysis and comentary from leading economists.* World Bank. May 4, 2011. http://www.voxeu.org/article/service-smile-new-growth-engine-poor-countries (accessed January 27, 2014).

Ghani, E, and H Kharas. "The service revolution." Economic Premise, No 14, World Bank, 2010.

Guo, D, S Dall'erba, and J Le Gallo. "The leading role of manufacturing in China's regional economic growth. A spatial econometric approach of Kaldor's laws." *International Regional Science Review* 36 No. 2 (April 2013): 139-166.

Hansen, J.D., and J Zhang. "A Kaldorian approach to regional economic growth in China." *Applied Economics* 28 (1996): 679-685.

Kaldor, N. *Causes of the slow rate of economic growth in the United Kingdom.* Cambridge: Cambridge University Press, 1996.

—. *Strategic Factors in Economic Development.* Ithaca, New York: Cornell University Press, 1967.

Lavopa, A, and A Szirmai. "Manufacturing growth, manufacturing exports and economic development, 1960-2010." Maastricht: United Nations University-MERIT, 2012.

Libanio, G, and S Moro. "Manufacturing industry and economic growth in Latin America: A Kaldorian approach." Minas Gerais: Federal University of Minas Gerais, 2013.

McCombie, J. "Kaldor´s law in retrospect." *Jornal of Post-Keynesian Economics* 5 (1983): 414-429.

McCombie, J.S.L., and J.S. de Ridder. "Increasing returns, productivity, and output growth: The case of the United States." *Jornal of Post Keynesian Economics* 5 (1983): 373-387.

Necmi, S. "Kaldor´s growth analysis revisited." *Applied Economics* 31 (1999): 653-660.

Pacheco-López, P, and A.P. Thirlwall. "A new interpretation of Kaldor´s first growth law for open developing economies." University of Kent, 2013.

Parikh, A. "Differences in growth rates and Kaldor´s laws." *Economica* 45 (1978): 83-91.

Park, D, and K Shin. "The service sector in Asia: Is it an engine of growth?" Working paper, serie 322, Asian Development Bank, 2012.

Pons-Novell, J, and E Viladecans-Marsal. "Kaldor´s laws and spatial dependence: Evidence for the European regions." *Regional studies* 33: 47-65.

Rodrik, D. "Growth after the crisis." Harvard Kennedy, School, Cambridge, MA. 02138, May 2009.

Roodman, D. "How to do xtabond2: An Introduction to “Difference” and “System” GMM in Stata." Working Paper No. 103, Center for Global Development, 2006.

Stoneman, P. "Kaldor´s law and British economic growth." *Applied Economics* 11 (1979): 309-319.

Szirmai, A. "Industrialization as an engine of growth in developing countries, 1950-2005." Working paper, United Nations University-Maastricht Economic and social Research and training centre on Innovation and Technology, Maastricht, 2009.

—. "Is manufacturing still the main engine of growth in developing countries?" *UNU-WIDER.* May 2009. http://www.wider.unu.edu/publications/newsletter/articles/en_GB/05-09-Szirmai/ (accessed February 05, 2014).

Thirlwall, A.P. "A plain man´s guide to Kaldor´s growth laws." *Journal of Post Keynesian Economics.* (M.E. Sharpe, Inc.) 5 (1983): 345-358.

—. *The nature of economic growth: An alternative framework for understanding the perfomrnace of nations.* Canterbury: Edward Elgar Publishing, 2002.

Wells, H, and A.P. Thirlwall. "Testing Kaldor's Growth Laws across the countries of Africa." *African Development Review* 15 (2003): 89-105.

Whiteman, J.L. "Productivity and growth in Australian manufacturing industry." *Journal of Post Keynesian Economics* 9 (1987): 576-592.

Windmeijer, F. "A finite sample correction for the variance of linear efficient two-step GMM estimators." *J ECONOMETRICS* 126 (1) (May 2005): 25-51.

Wooldridge, J M. "Aplications of Generalized Method of Moments Estimation." *Journal of Economics Perspectives* 15 No.4 (2001): 87-100.

Young, A. "Increasing returns and economic progress." *Economic Journal*, December 1928: 534.

Annex I. International Standard Industrial Classification (ISIC) Rev 3 for manufacturing

ISIC Code	Manufacturing Activities (D)
15	Manufacture of food products and beverages
16	Manufacture of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel; dressing and dyeing of fur
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21	Manufacture of paper and paper products
22	Publishing, printing and reproduction of recorded media
23	Manufacture of coke, refined petroleum products and nuclear fuel
24	Manufacture of chemicals and chemical products
25	Manufacture of rubber and plastics products
26	Manufacture of other non-metallic mineral products
27	Manufacture of basic metals
28	Manufacture of fabricated metal products, except machinery and equipment
29	Manufacture of machinery and equipment n.e.c.
30	Manufacture of office, accounting and computing machinery
31	Manufacture of electrical machinery and apparatus n.e.c.
32	Manufacture of radio, television and communication equipment and apparatus
33	Manufacture of medical, precision and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers and semi-trailers
35	Manufacture of other transport equipment
36	Manufacture of furniture; manufacturing n.e.c.
37	Recycling

Annex II. International Standard Industrial Classification (ISIC) Rev 3 for services

ISIC Code	Services Activities
G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
H	Hotels and restaurants
I	Transport, storage and communications
J	Financial intermediation
K	Real estate, renting and business activities
L	Public administration and defense; compulsory social security
M	Education
N	Health and social work
O	Other community, social and personal service activities
P	Private households with employed persons
Q	Extra-territorial organizations and bodies

Annex III. Countries used to run econometric estimates

Low income (20)	Middle income (60)		High income (39)	
Bangladesh	Algeria	Malaysia	Australia	Singapore
Benin	Angola	Mauritius	Austria	Slovak Republic
Burkina Faso	Argentina	Mexico	Bahamas, The	Slovenia
Burundi	Belarus	Moldova	Belgium	Spain
Cambodia	Bhutan	Mongolia	Canada	Sweden
Central African Rep.	Bolivia	Morocco	Chile	Switzerland
Comoros	Brazil	Nicaragua	Croatia	United Kingdom
Ethiopia	Bulgaria	Nigeria	Cyprus	United States
Gambia, The	Cameroon	Pakistan	Czech Republic	Uruguay
Guinea	China	Panama	Denmark	
Kenya	Colombia	Paraguay	Estonia	
Kyrgyz Republic	Costa Rica	Peru	Finland	
Madagascar	Cote d'Ivoire	Philippines	France	
Malawi	Dominican Republic	Romania	Germany	
Mali	Ecuador	Senegal	Hong Kong	
Mozambique	Egypt, Arab Rep.	Seychelles	Iceland	
Nepal	El Salvador	South Africa	Ireland	
Niger	Fiji	Sri Lanka	Italy	
Tanzania	Guatemala	St. Lucia	Japan	
Uganda	Honduras	Suriname	Korea, Rep.	
	Hungary	Swaziland	Latvia	
	India	Thailand	Luxembourg	
	Indonesia	Tunisia	Malta	
	Iran, Islamic Rep.	Turkey	Netherlands	
	Jamaica	Ukraine	New Zealand	
	Jordan	Uzbekistan	Norway	
	Kazakhstan	Venezuela, RB	Poland	
	Lao PDR	Vietnam	Portugal	
	Lebanon	Yemen, Rep.	Puerto Rico	
	Macedonia, FYR	Zambia	Russian Federation	

Annex IV. Gross Domestic Product growth rates used for the estimations

Country	1990-1993	1993-1996	1996-1999	1999-2002	2002-2005	2005-2008	2008-2011
Algeria	-0.5%	2.3%	3.1%	3.2%	5.7%	2.5%	2.8%
Angola	-11.5%	8.3%	6.0%	6.7%	10.7%	19.0%	3.2%
Argentina	10.1%	2.8%	2.7%	-5.5%	9.0%	4.8%	3.0%
Australia	1.4%	4.0%	4.5%	3.2%	3.5%	3.5%	2.1%
Austria	2.0%	2.5%	3.2%	2.1%	1.9%	2.9%	0.3%
Bahamas, The	-2.6%	3.9%	4.6%	3.2%	1.0%	0.5%	-0.5%
Bangladesh	4.3%	4.5%	5.2%	5.2%	5.8%	6.4%	6.2%
Belarus	-6.2%	-6.7%	7.7%	5.2%	9.3%	9.6%	4.4%
Belgium	0.8%	2.3%	3.1%	1.9%	1.9%	2.2%	0.5%
Benin	4.3%	4.1%	5.0%	5.2%	3.3%	4.5%	2.9%
Bhutan	2.0%	5.9%	6.4%	8.6%	6.9%	9.7%	9.0%
Bolivia	3.7%	4.6%	3.4%	2.2%	3.8%	5.2%	4.2%
Brazil	1.9%	4.0%	1.2%	2.8%	3.3%	5.1%	3.3%
Bulgaria	-5.8%	-1.6%	1.7%	4.9%	6.2%	6.4%	-1.1%
Burkina Faso	4.2%	5.9%	7.0%	4.5%	7.0%	5.4%	5.0%
Burundi	-0.2%	-6.6%	0.7%	1.9%	1.5%	5.1%	3.8%
Cambodia	8.0%	7.0%	7.5%	7.8%	10.7%	9.2%	4.3%
Cameroon	-3.4%	1.9%	4.8%	4.2%	3.3%	3.1%	3.1%
Canada	0.4%	3.1%	4.6%	3.3%	2.7%	1.9%	1.0%
Central Afr. Rep.	-2.3%	2.6%	4.5%	-0.8%	-1.3%	3.2%	2.7%
Chile	9.1%	7.9%	3.0%	3.3%	5.2%	4.3%	3.4%
China	12.4%	11.3%	8.2%	8.6%	10.5%	12.2%	9.6%
Colombia	3.2%	4.4%	-0.1%	2.9%	4.7%	5.7%	4.1%
Comoros	1.9%	-1.1%	2.4%	3.0%	2.1%	0.9%	2.0%
Costa Rica	6.3%	3.2%	7.4%	1.9%	5.5%	6.4%	2.8%
Cote d'Ivoire	-0.1%	5.2%	4.0%	-1.7%	0.5%	1.6%	0.4%
Croatia	3.5%	4.3%	2.4%	4.1%	4.6%	4.0%	-2.8%
Cyprus	3.5%	4.6%	4.1%	3.7%	3.4%	4.3%	0.0%
Czech Republic	-4.2%	4.5%	0.2%	3.1%	5.1%	5.3%	-0.1%
Denmark	1.1%	3.8%	2.6%	1.6%	1.7%	1.4%	-1.1%
Dominican Republic	6.2%	5.0%	7.2%	4.4%	3.4%	8.1%	5.2%
Ecuador	2.8%	2.7%	0.9%	3.1%	5.4%	4.3%	3.7%
Egypt, Arab Rep.	2.8%	4.5%	5.2%	3.8%	3.9%	7.0%	3.9%
El Salvador	6.1%	4.7%	3.8%	2.1%	2.6%	3.0%	0.1%
Estonia	7.2%	6.7%	6.0%	7.5%	7.6%	4.3%	-1.3%
Ethiopia	-1.4%	7.2%	1.5%	5.3%	7.5%	11.0%	8.7%
Fiji	1.8%	4.1%	2.5%	1.1%	2.3%	0.7%	0.2%
Finland	-3.5%	3.7%	5.0%	3.1%	3.0%	3.3%	-1.0%
France	0.6%	1.8%	2.9%	2.1%	1.8%	1.6%	0.2%
Gambia, The	3.2%	1.1%	4.9%	2.6%	4.3%	3.5%	2.8%
Germany	2.0%	1.6%	1.8%	1.5%	0.5%	2.7%	0.6%

Guatemala	4.1%	4.0%	4.4%	3.3%	3.0%	5.0%	2.5%
Guinea	3.6%	4.3%	4.2%	3.8%	2.2%	3.1%	1.8%
Honduras	5.0%	2.1%	2.0%	4.1%	5.6%	5.7%	1.7%
Hong Kong	6.0%	4.2%	0.5%	3.2%	6.4%	5.2%	3.0%
Hungary	-5.3%	1.5%	3.5%	4.1%	4.2%	1.6%	-1.3%
Iceland	-0.8%	2.8%	5.1%	2.8%	5.8%	3.9%	-2.7%
India	3.7%	7.3%	6.2%	4.3%	8.4%	7.6%	8.4%
Indonesia	7.8%	7.9%	-2.9%	4.4%	5.2%	6.0%	5.8%
Iran, Islamic Rep.	4.9%	3.1%	2.7%	5.4%	5.6%	5.3%	4.0%
Ireland	2.5%	8.4%	10.4%	7.0%	4.7%	2.7%	-1.8%
Italy	0.5%	2.1%	1.6%	2.0%	0.9%	0.9%	-1.2%
Jamaica	4.3%	0.7%	-0.4%	0.9%	2.0%	1.2%	-1.4%
Japan	1.4%	1.8%	-0.2%	1.0%	1.8%	0.9%	-0.6%
Jordan	8.1%	4.4%	3.2%	5.1%	6.9%	7.8%	3.4%
Kazakhstan	-8.5%	-6.9%	0.8%	11.0%	9.5%	7.6%	5.3%
Kenya	0.3%	3.7%	2.0%	1.6%	4.6%	4.9%	4.3%
Korea, Rep.	7.1%	8.2%	2.2%	6.5%	3.8%	4.2%	3.4%
Kyrgyz Republic	-12.5%	-6.8%	5.2%	3.5%	4.6%	6.7%	2.8%
Lao PDR	5.3%	7.4%	6.0%	5.8%	6.5%	8.0%	8.0%
Latvia	-17.4%	1.7%	5.9%	7.1%	8.8%	5.7%	-5.2%
Lebanon	15.6%	6.6%	0.3%	2.9%	3.9%	5.7%	6.1%
Luxembourg	4.9%	2.3%	6.9%	5.0%	3.8%	3.5%	0.1%
Macedonia, FYR	-6.7%	-0.6%	3.0%	0.2%	3.9%	5.4%	1.6%
Madagascar	-1.1%	1.3%	4.1%	-1.0%	6.5%	6.1%	-0.6%
Malawi	3.4%	4.0%	3.6%	-0.6%	4.4%	6.6%	6.6%
Malaysia	9.4%	9.7%	1.8%	4.9%	6.0%	5.6%	3.5%
Mali	2.5%	3.4%	6.5%	6.4%	5.2%	5.9%	4.3%
Malta	5.1%	5.3%	5.0%	2.6%	1.1%	3.6%	0.6%
Mauritius	5.3%	4.7%	4.8%	4.5%	3.5%	5.1%	4.8%
Mexico	3.3%	1.0%	5.2%	2.4%	2.9%	3.2%	0.9%
Moldova	-16.2%	-13.6%	-2.8%	5.3%	7.2%	5.2%	6.9%
Mongolia	-7.1%	3.6%	3.4%	2.9%	8.3%	9.2%	7.3%
Morocco	0.5%	5.0%	1.9%	4.1%	4.7%	5.3%	4.5%
Mozambique	2.6%	5.6%	9.7%	7.2%	7.8%	6.8%	6.9%
Nepal	4.8%	5.7%	4.2%	3.7%	4.0%	4.3%	4.4%
Netherlands	1.8%	3.2%	4.3%	2.0%	1.5%	3.0%	-0.4%
New Zealand	2.1%	4.1%	3.0%	3.6%	3.5%	1.1%	0.8%
Nicaragua	-0.1%	5.2%	4.9%	2.6%	4.0%	4.4%	2.2%
Niger	-0.9%	3.3%	4.1%	2.8%	3.3%	6.1%	-2.3%
Nigeria	3.3%	2.3%	1.9%	3.3%	8.7%	6.2%	7.4%
Norway	3.1%	4.8%	3.4%	2.2%	2.5%	1.7%	0.0%
Pakistan	4.8%	4.5%	2.4%	3.2%	6.6%	4.5%	3.4%
Panama	7.7%	2.5%	5.9%	1.8%	6.3%	10.2%	7.3%
Paraguay	3.4%	4.5%	1.0%	-1.1%	3.5%	5.5%	4.3%
Peru	2.1%	7.9%	2.3%	2.7%	5.3%	8.8%	5.4%
Philippines	0.6%	5.0%	2.5%	3.6%	5.5%	5.3%	4.1%

Poland	-0.4%	6.2%	5.5%	2.3%	4.3%	6.0%	3.4%
Portugal	1.1%	3.0%	4.5%	2.2%	0.5%	1.3%	-0.9%
Puerto Rico	3.8%	3.7%	4.5%	3.3%	0.8%	-1.5%	-0.9%
Romania	-6.9%	5.0%	-4.1%	4.3%	5.9%	7.3%	-1.8%
Russian Federation	-9.5%	-6.9%	0.7%	6.6%	6.9%	7.3%	0.2%
Senegal	1.7%	2.4%	5.1%	2.8%	6.1%	3.7%	2.9%
Seychelles	5.4%	1.1%	7.3%	1.0%	-0.1%	5.7%	3.9%
Singapore	8.3%	8.5%	4.1%	3.9%	7.0%	6.4%	6.2%
Slovak Republic	-8.4%	6.3%	2.9%	3.1%	5.5%	8.2%	0.8%
Slovenia	-4.0%	4.2%	4.6%	3.7%	3.8%	5.4%	-2.1%
South Africa	-0.7%	3.6%	1.8%	3.5%	4.3%	4.9%	1.6%
Spain	0.8%	2.5%	4.4%	3.8%	3.3%	2.8%	-1.2%
Sri Lanka	5.3%	5.0%	5.1%	2.8%	5.9%	6.8%	6.6%
St. Lucia	4.1%	3.4%	3.0%	-1.2%	3.6%	5.1%	0.7%
Suriname	-1.6%	1.9%	2.1%	2.9%	6.6%	4.4%	3.9%
Swaziland	2.7%	3.7%	2.9%	1.6%	2.5%	3.1%	1.1%
Sweden	-1.5%	3.2%	3.9%	2.7%	3.2%	2.3%	1.6%
Switzerland	-0.4%	0.7%	2.1%	1.7%	1.7%	3.3%	1.0%
Tanzania	1.3%	3.2%	4.0%	6.0%	7.4%	7.1%	6.5%
Thailand	8.3%	8.0%	-2.7%	4.1%	6.0%	4.2%	1.8%
Tunisia	4.6%	4.2%	5.4%	3.8%	5.2%	5.4%	1.3%
Turkey	4.4%	3.4%	2.1%	2.2%	7.7%	4.0%	4.2%
Uganda	5.7%	9.0%	6.0%	5.7%	6.5%	9.3%	6.6%
Ukraine	-10.8%	-15.2%	-1.7%	6.8%	8.0%	5.8%	-2.3%
United Kingdom	0.7%	3.6%	3.5%	3.2%	3.2%	1.7%	-0.4%
United States	2.0%	3.5%	4.6%	2.4%	3.0%	1.4%	0.3%
Uruguay	4.7%	3.7%	3.6%	-4.5%	4.4%	5.9%	5.9%
Uzbekistan	-4.8%	-1.5%	4.6%	4.0%	6.3%	8.6%	8.3%
Venezuela, RB	5.3%	0.4%	0.1%	-0.8%	6.4%	8.0%	-0.2%
Vietnam	7.6%	9.2%	6.2%	6.9%	7.9%	7.7%	6.0%
Yemen, Rep.	6.2%	5.7%	5.0%	4.6%	4.4%	3.4%	0.0%
Zambia	1.6%	-1.7%	1.2%	3.9%	5.3%	6.2%	6.8%

Annex V. Manufacturing Value Added growth rates used for the estimations

Country	1990-1993	1993-1996	1996-1999	1999-2002	2002-2005	2005-2008	2008-2011
Algeria	-2.6%	-4.9%	1.9%	2.0%	2.2%	2.8%	-2.7%
Angola	-10.5%	0.0%	7.1%	9.6%	16.7%	28.7%	9.6%
Argentina	8.8%	1.1%	0.8%	-7.4%	11.7%	5.5%	3.8%
Australia	-1.0%	2.9%	2.1%	1.7%	1.3%	1.8%	-1.6%
Austria	-0.2%	3.4%	3.4%	2.5%	2.5%	6.8%	-2.3%
Bahamas, The	-5.6%	6.2%	0.6%	-4.4%	10.0%	-3.5%	0.5%
Bangladesh	7.5%	8.3%	5.6%	5.6%	7.3%	9.2%	7.5%
Belarus	-6.0%	-7.8%	12.2%	6.6%	14.5%	11.1%	4.6%
Belgium	-1.4%	2.8%	3.2%	1.4%	1.2%	1.3%	-2.5%
Benin	5.3%	8.3%	3.0%	8.1%	1.3%	0.7%	3.2%
Bhutan	0.9%	18.3%	4.0%	5.6%	6.1%	14.8%	12.9%
Bolivia	3.0%	5.7%	2.5%	1.6%	4.1%	5.9%	3.7%
Brazil	0.0%	4.3%	-1.4%	2.9%	3.8%	3.2%	0.2%
Bulgaria	2.6%	2.6%	-0.3%	6.3%	6.3%	8.4%	3.2%
Burkina Faso	3.1%	-1.4%	18.4%	-11.2%	10.4%	-2.9%	5.0%
Burundi	0.7%	-10.9%	3.3%	-6.5%	4.1%	5.9%	2.5%
Cambodia	22.9%	13.0%	20.7%	19.7%	13.2%	9.7%	8.3%
Cameroon	-2.7%	-1.2%	7.3%	5.0%	2.3%	1.1%	1.3%
Canada	-0.5%	4.4%	6.4%	2.1%	0.9%	-3.4%	-3.3%
Central Afr. Rep.	-3.6%	1.5%	1.2%	2.0%	-0.4%	6.3%	2.8%
Chile	8.0%	4.9%	0.6%	-7.5%	16.7%	2.8%	1.9%
China	16.8%	13.7%	8.9%	9.8%	11.1%	13.0%	9.2%
Colombia	2.3%	-6.6%	-2.9%	2.8%	5.8%	4.8%	0.8%
Comoros	4.2%	-1.0%	-0.7%	5.1%	2.1%	1.6%	2.9%
Costa Rica	6.8%	2.8%	14.3%	-3.0%	7.7%	4.5%	1.1%
Cote d'Ivoire	1.0%	6.8%	6.0%	-1.3%	-1.2%	-1.8%	-2.2%
Croatia	3.3%	2.2%	3.3%	3.9%	3.6%	3.8%	-5.0%
Cyprus	-0.9%	1.0%	0.5%	0.3%	0.8%	0.0%	0.3%
Czech Republic	5.7%	6.8%	2.7%	4.8%	7.9%	10.5%	0.9%
Denmark	-1.6%	3.5%	3.2%	0.2%	-0.2%	3.8%	-3.5%
Dominican Republic	6.1%	6.2%	8.8%	2.2%	3.2%	2.8%	4.0%
Ecuador	3.3%	1.8%	-0.7%	4.2%	4.1%	6.0%	1.9%
Egypt, Arab Rep.	3.4%	6.4%	8.6%	5.2%	3.0%	7.2%	2.8%
El Salvador	4.6%	5.3%	6.1%	3.7%	1.7%	2.3%	0.5%
Estonia	8.7%	5.4%	7.4%	13.4%	10.7%	3.8%	-1.7%
Ethiopia	-13.4%	8.2%	3.4%	4.1%	6.6%	8.7%	9.8%
Fiji	4.6%	4.0%	6.9%	2.3%	-1.9%	-0.5%	1.5%
Finland	-2.6%	7.4%	9.0%	7.2%	3.9%	7.5%	-4.7%
France	-1.0%	3.2%	4.0%	1.9%	1.7%	-0.2%	-4.2%
Gambia, The	0.9%	1.4%	1.5%	2.8%	8.1%	-0.3%	0.0%
Germany	-2.3%	0.0%	2.2%	2.1%	2.1%	2.2%	-2.8%

Guatemala	2.8%	2.7%	3.0%	1.4%	3.3%	2.9%	1.8%
Guinea	4.6%	2.8%	4.9%	6.1%	0.8%	1.1%	2.4%
Honduras	4.7%	2.7%	4.0%	5.7%	5.8%	4.3%	-0.1%
Hong Kong	-3.3%	-3.3%	-3.3%	-7.3%	-2.5%	-2.0%	-1.5%
Hungary	5.1%	6.8%	10.5%	4.2%	5.7%	4.4%	-0.8%
Iceland	2.6%	2.6%	2.2%	2.2%	0.7%	7.6%	1.1%
India	3.0%	11.9%	2.8%	5.5%	7.9%	9.6%	7.8%
Indonesia	9.9%	11.6%	-1.1%	4.9%	5.4%	4.3%	4.4%
Iran, Islamic Rep.	4.5%	6.9%	5.0%	11.3%	9.7%	9.2%	10.0%
Ireland	3.6%	12.0%	12.9%	9.5%	2.6%	-1.1%	-3.4%
Italy	-1.0%	3.6%	0.7%	0.9%	-0.7%	0.2%	-4.8%
Jamaica	-2.2%	-2.2%	-1.6%	-2.3%	-0.8%	-0.4%	-2.3%
Japan	-0.1%	2.2%	-1.1%	-0.7%	4.0%	3.8%	-1.4%
Jordan	4.6%	3.1%	9.1%	11.4%	9.0%	8.5%	2.7%
Kazakhstan	-0.9%	-9.2%	1.6%	11.7%	8.4%	4.0%	5.7%
Kenya	2.3%	3.2%	-1.5%	0.4%	5.0%	5.4%	3.1%
Korea, Rep.	6.1%	9.8%	5.6%	9.2%	7.2%	6.0%	6.6%
Kyrgyz Republic	-17.1%	-20.4%	17.5%	0.4%	0.1%	3.4%	2.0%
Lao PDR	15.2%	14.4%	8.4%	10.7%	10.3%	12.1%	6.6%
Latvia	-29.2%	-0.8%	4.7%	8.6%	6.2%	-0.1%	-1.4%
Lebanon	2.0%	4.1%	0.6%	2.3%	4.0%	-2.2%	2.4%
Luxembourg	5.2%	3.2%	5.9%	2.2%	1.9%	-2.6%	-4.6%
Macedonia, FYR	-15.1%	-3.8%	-1.1%	1.9%	4.8%	4.0%	-4.9%
Madagascar	-1.8%	1.8%	4.6%	-3.3%	9.9%	11.5%	-1.0%
Malawi	-1.7%	2.6%	1.4%	-16.5%	7.9%	14.7%	2.3%
Malaysia	11.8%	13.6%	2.1%	5.7%	8.0%	3.7%	2.2%
Mali	5.2%	1.9%	-10.1%	1.1%	4.9%	3.0%	3.6%
Malta	1.3%	4.0%	3.2%	-1.2%	-3.6%	3.4%	-6.1%
Mauritius	4.9%	5.4%	4.7%	3.2%	-1.7%	3.1%	0.8%
Mexico	2.3%	3.1%	7.1%	0.7%	2.0%	2.3%	1.3%
Moldova	-4.7%	-3.7%	-12.0%	11.9%	7.4%	-3.3%	0.0%
Mongolia	-6.8%	-9.8%	-5.6%	18.1%	-3.6%	13.7%	1.5%
Morocco	1.6%	3.5%	2.5%	4.1%	2.6%	3.2%	1.9%
Mozambique	-1.7%	6.4%	20.0%	19.0%	10.6%	3.6%	3.0%
Nepal	18.2%	7.7%	5.2%	1.7%	1.6%	1.2%	1.4%
Netherlands	0.4%	3.5%	2.8%	2.2%	1.4%	2.4%	-0.4%
New Zealand	2.8%	2.9%	0.6%	4.0%	2.1%	-3.1%	0.2%
Nicaragua	5.7%	6.8%	4.5%	4.1%	5.7%	5.3%	4.4%
Niger	-2.6%	4.5%	0.3%	-0.2%	2.8%	2.2%	3.9%
Nigeria	0.2%	-1.9%	-1.1%	6.8%	9.0%	9.3%	7.6%
Norway	0.1%	2.4%	1.1%	-0.6%	4.5%	3.0%	-0.8%
Pakistan	5.1%	3.6%	3.6%	5.0%	12.1%	7.2%	1.6%
Panama	8.6%	1.0%	2.2%	-5.4%	0.9%	4.5%	1.1%
Paraguay	3.3%	1.6%	0.1%	-1.4%	2.2%	1.1%	1.3%
Peru	1.8%	7.7%	0.3%	4.1%	6.1%	9.2%	3.6%
Philippines	-0.5%	5.8%	1.6%	3.7%	4.7%	4.0%	3.5%

Poland	8.8%	8.9%	8.2%	2.3%	9.0%	12.5%	6.0%
Portugal	-3.6%	6.1%	3.2%	1.2%	-0.6%	0.9%	-2.3%
Puerto Rico	5.5%	2.3%	4.1%	4.4%	1.4%	-2.5%	0.0%
Romania	-11.7%	5.4%	-5.3%	7.3%	6.0%	5.7%	-0.1%
Russian Federation	-17.4%	-2.9%	2.1%	6.8%	7.1%	3.9%	-0.8%
Senegal	3.0%	3.4%	2.6%	4.6%	1.6%	-0.2%	6.1%
Seychelles	5.6%	7.4%	6.2%	10.5%	-3.3%	-2.2%	0.7%
Singapore	5.8%	8.4%	5.4%	3.3%	8.7%	4.3%	10.2%
Slovak Republic	4.5%	4.5%	7.0%	4.2%	15.6%	13.9%	-4.6%
Slovenia	-9.4%	5.1%	4.2%	6.3%	4.8%	5.0%	-2.6%
South Africa	-2.7%	3.5%	1.0%	4.7%	3.1%	4.8%	-0.6%
Spain	5.1%	4.2%	5.9%	2.3%	0.9%	0.0%	-5.3%
Sri Lanka	8.7%	8.3%	6.6%	2.2%	5.1%	5.6%	6.2%
St. Lucia	1.2%	-2.6%	0.7%	0.1%	5.7%	3.3%	1.6%
Suriname	-11.1%	1.6%	-2.3%	20.1%	8.8%	2.8%	0.6%
Swaziland	1.7%	3.6%	2.8%	1.5%	1.2%	1.9%	-3.2%
Sweden	10.5%	10.7%	8.8%	4.5%	6.5%	1.6%	-1.0%
Switzerland	0.3%	1.2%	0.8%	3.0%	1.3%	5.4%	1.4%
Tanzania	-0.6%	2.1%	6.3%	5.7%	9.3%	9.0%	7.9%
Thailand	13.1%	9.3%	0.4%	4.8%	8.0%	5.3%	0.8%
Tunisia	5.1%	5.2%	6.8%	4.7%	1.2%	4.6%	3.0%
Turkey	5.8%	4.1%	2.3%	0.5%	9.5%	4.6%	4.9%
Uganda	10.0%	17.9%	14.0%	5.3%	6.7%	6.7%	6.9%
Ukraine	-15.1%	-18.9%	0.8%	11.1%	11.7%	5.4%	-0.6%
United Kingdom	-1.2%	2.5%	1.0%	-0.6%	0.3%	-0.1%	-1.6%
United States	5.9%	5.9%	6.3%	0.9%	5.2%	0.2%	-0.4%
Uruguay	-2.8%	1.7%	-0.4%	-5.4%	8.8%	7.1%	0.7%
Uzbekistan	0.6%	0.3%	1.4%	1.4%	1.7%	3.0%	4.0%
Venezuela, RB	4.5%	-0.7%	9.1%	-3.2%	6.7%	3.9%	-1.7%
Vietnam	9.6%	12.1%	10.3%	11.5%	11.8%	11.8%	6.2%
Yemen, Rep.	6.9%	-0.9%	0.7%	3.8%	6.2%	5.1%	3.7%
Zambia	1.0%	-1.3%	3.2%	4.5%	5.0%	3.5%	3.8%

Annex VI. Services Value Added growth rates used for the estimations

Country	1990-1993	1993-1996	1996-1999	1999-2002	2002-2005	2005-2008	2008-2011
Algeria	-0.3%	2.4%	2.7%	3.5%	5.3%	6.3%	3.4%
Angola	-10.6%	2.3%	1.3%	3.1%	5.2%	29.2%	10.1%
Argentina	8.6%	3.2%	3.5%	-4.3%	6.4%	4.1%	2.2%
Australia	1.6%	4.1%	5.1%	3.7%	3.9%	3.8%	2.2%
Austria	2.5%	2.3%	3.7%	2.4%	2.0%	2.4%	0.8%
Bahamas, The	-2.4%	3.3%	-1.1%	3.7%	0.3%	6.0%	-0.4%
Bangladesh	3.9%	4.4%	4.9%	5.5%	5.8%	6.6%	6.3%
Belarus	-8.9%	-3.5%	10.4%	5.3%	6.7%	5.5%	5.3%
Belgium	2.7%	2.3%	3.7%	2.7%	2.8%	2.7%	1.1%
Benin	3.1%	3.1%	5.4%	4.9%	4.1%	5.1%	3.4%
Bhutan	2.4%	6.9%	9.7%	8.4%	11.6%	6.3%	11.5%
Bolivia	3.8%	4.1%	5.1%	2.0%	2.3%	3.6%	4.7%
Brazil	2.6%	2.2%	1.9%	2.9%	3.0%	4.8%	3.1%
Bulgaria	1.9%	1.9%	0.2%	6.2%	6.3%	6.5%	0.9%
Burkina Faso	0.7%	5.2%	3.5%	6.9%	6.4%	7.6%	5.5%
Burundi	-0.6%	-6.7%	0.5%	11.8%	9.0%	13.5%	3.6%
Cambodia	7.5%	6.0%	7.4%	9.2%	10.7%	9.8%	3.5%
Cameroon	-6.4%	5.2%	-0.6%	3.2%	8.9%	4.7%	5.8%
Canada	1.0%	3.0%	4.6%	3.9%	2.9%	3.0%	1.8%
Central Afr. Rep.	-8.3%	1.7%	5.8%	-10.6%	-2.2%	-0.8%	-2.3%
Chile	9.7%	7.8%	3.5%	-3.8%	10.9%	6.9%	4.5%
China	12.6%	11.2%	9.4%	10.2%	10.6%	13.4%	9.4%
Colombia	4.9%	4.2%	1.6%	4.9%	4.6%	5.8%	4.1%
Comoros	-0.1%	-3.3%	1.2%	-0.8%	1.9%	2.3%	0.2%
Costa Rica	5.7%	3.1%	5.4%	4.3%	5.6%	6.6%	4.4%
Cote d'Ivoire	-1.1%	4.2%	3.6%	-3.7%	-0.7%	2.8%	1.0%
Croatia	3.4%	4.6%	2.6%	3.8%	4.4%	4.2%	-1.4%
Cyprus	4.8%	8.6%	5.2%	4.2%	3.7%	4.6%	3.9%
Czech Republic	1.1%	2.0%	2.1%	4.2%	4.1%	4.5%	0.8%
Denmark	2.1%	3.1%	2.3%	2.5%	1.5%	1.9%	-0.3%
Dominican Republic	5.9%	5.1%	6.4%	6.2%	5.2%	9.4%	4.9%
Ecuador	2.4%	2.8%	-0.3%	3.4%	4.5%	5.0%	4.1%
Egypt, Arab Rep.	0.0%	4.5%	5.3%	4.5%	5.0%	7.0%	1.1%
El Salvador	4.4%	4.5%	3.2%	2.1%	3.2%	3.1%	0.0%
Estonia	7.1%	7.3%	6.2%	6.0%	7.2%	4.4%	-2.8%
Ethiopia	-4.7%	8.6%	5.0%	6.5%	8.2%	14.4%	11.3%
Fiji	1.2%	4.1%	3.4%	1.7%	3.3%	1.2%	0.4%
Finland	-2.7%	4.4%	4.4%	2.6%	2.1%	2.2%	-1.0%
France	1.3%	1.9%	3.1%	2.0%	1.9%	2.0%	0.3%
Gambia, The	5.7%	2.3%	3.0%	3.5%	3.2%	4.6%	6.3%
Germany	3.7%	2.6%	2.2%	2.4%	0.6%	3.6%	0.9%

Guatemala	4.7%	4.6%	4.8%	3.8%	3.3%	6.4%	3.3%
Guinea	2.5%	3.3%	2.6%	2.1%	1.3%	1.4%	1.8%
Honduras	4.9%	2.2%	3.5%	4.7%	6.8%	6.9%	2.3%
Hong Kong	5.0%	5.0%	5.0%	3.0%	7.4%	5.5%	3.2%
Hungary	-3.3%	1.0%	1.5%	4.5%	3.8%	0.9%	-0.5%
Iceland	-0.5%	3.4%	6.1%	3.2%	6.2%	3.9%	0.6%
India	5.9%	7.8%	9.2%	6.4%	9.0%	10.1%	9.5%
Indonesia	9.6%	7.1%	-4.4%	5.1%	7.1%	8.3%	7.6%
Iran, Islamic Rep.	5.0%	4.0%	3.7%	4.6%	4.9%	6.0%	5.5%
Ireland	3.1%	7.9%	8.3%	8.5%	8.9%	4.6%	-1.7%
Italy	1.2%	2.0%	1.6%	2.4%	1.3%	1.2%	0.0%
Jamaica	11.7%	2.0%	-0.2%	2.0%	2.2%	1.9%	-0.9%
Japan	2.5%	2.5%	0.0%	2.0%	1.8%	0.4%	0.0%
Jordan	4.9%	6.0%	3.7%	4.1%	6.6%	6.5%	3.3%
Kazakhstan	-6.1%	3.7%	0.0%	9.6%	9.7%	7.9%	6.0%
Kenya	2.9%	4.6%	2.0%	1.5%	4.1%	5.8%	5.5%
Korea, Rep.	7.5%	7.3%	2.5%	6.1%	2.6%	4.1%	2.6%
Kyrgyz Republic	-12.2%	-7.5%	2.6%	3.0%	11.5%	17.2%	3.3%
Lao PDR	5.0%	7.9%	6.7%	5.7%	7.5%	8.0%	6.6%
Latvia	-6.3%	3.4%	6.3%	7.2%	9.4%	6.7%	-4.2%
Lebanon	2.1%	4.3%	-0.9%	2.8%	3.6%	6.4%	6.5%
Luxembourg	5.6%	3.0%	6.8%	5.2%	3.9%	4.6%	0.1%
Macedonia, FYR	-2.0%	0.9%	2.0%	0.7%	3.2%	4.8%	3.3%
Madagascar	-1.3%	1.4%	5.0%	-2.2%	7.5%	6.4%	-1.3%
Malawi	1.5%	1.2%	2.1%	-1.9%	2.8%	6.9%	6.2%
Malaysia	14.1%	9.0%	2.6%	6.2%	6.4%	8.8%	5.7%
Mali	1.9%	2.6%	4.1%	3.6%	7.9%	6.2%	3.9%
Malta	10.5%	6.0%	6.3%	3.0%	4.9%	5.5%	3.7%
Mauritius	6.3%	6.0%	6.0%	6.4%	5.8%	6.1%	6.4%
Mexico	3.7%	0.5%	4.9%	3.2%	3.3%	3.5%	1.2%
Moldova	-7.1%	-1.2%	3.2%	1.0%	12.2%	10.8%	5.3%
Mongolia	-6.9%	-0.5%	1.8%	10.2%	7.2%	12.0%	8.9%
Morocco	4.5%	1.1%	4.5%	4.5%	5.7%	5.2%	4.9%
Mozambique	4.0%	3.4%	6.9%	8.0%	8.1%	8.1%	7.2%
Nepal	7.8%	6.0%	5.5%	3.1%	4.3%	5.4%	5.3%
Netherlands	2.2%	3.2%	5.0%	2.1%	2.0%	3.3%	0.2%
New Zealand	2.4%	4.0%	4.1%	3.8%	3.7%	2.1%	3.0%
Nicaragua	5.4%	5.1%	5.8%	3.3%	4.3%	2.5%	1.5%
Niger	-4.4%	3.1%	3.2%	3.9%	15.0%	-5.3%	0.0%
Nigeria	0.2%	0.4%	15.0%	-5.6%	8.5%	7.1%	1.0%
Norway	2.5%	3.3%	5.6%	2.4%	3.5%	3.6%	1.4%
Pakistan	5.5%	4.7%	3.4%	4.0%	6.5%	6.5%	2.9%
Panama	6.5%	2.4%	5.9%	3.3%	6.8%	10.4%	8.4%
Paraguay	2.3%	3.2%	0.6%	-1.1%	3.6%	5.3%	5.6%
Peru	1.6%	7.0%	2.0%	2.0%	5.1%	9.2%	6.6%
Philippines	1.2%	4.8%	3.9%	3.9%	6.5%	5.9%	5.1%

Poland	4.4%	5.7%	5.2%	3.4%	3.1%	5.0%	2.3%
Portugal	2.1%	1.3%	4.4%	2.9%	1.4%	2.0%	1.1%
Puerto Rico	2.7%	4.6%	4.6%	1.8%	1.4%	-1.5%	-3.7%
Romania	-5.4%	5.1%	-4.5%	4.6%	0.6%	10.6%	-6.8%
Russian Federation	-10.4%	-4.5%	0.1%	5.4%	6.9%	10.0%	0.4%
Senegal	0.7%	2.3%	5.7%	4.0%	6.2%	7.7%	1.7%
Seychelles	5.5%	-2.5%	6.8%	-0.8%	-0.6%	6.4%	4.6%
Singapore	9.1%	8.1%	3.9%	5.1%	7.2%	7.2%	4.7%
Slovak Republic	4.0%	3.9%	5.2%	2.1%	2.1%	6.4%	4.8%
Slovenia	-1.5%	3.6%	4.5%	3.9%	3.8%	5.1%	0.3%
South Africa	0.0%	4.1%	2.9%	5.6%	6.0%	2.9%	2.4%
Spain	2.0%	2.5%	3.6%	3.8%	3.6%	3.8%	0.6%
Sri Lanka	6.5%	5.9%	5.4%	4.1%	6.9%	6.8%	6.6%
St. Lucia	3.8%	6.3%	3.4%	1.2%	4.1%	4.2%	1.6%
Suriname	0.9%	3.1%	5.0%	1.2%	1.2%	-3.8%	6.2%
Swaziland	6.2%	3.9%	1.7%	-3.9%	3.7%	4.8%	4.0%
Sweden	-1.0%	2.6%	3.3%	2.5%	2.7%	2.9%	1.4%
Switzerland	2.9%	2.1%	3.6%	1.2%	-3.7%	3.1%	1.1%
Tanzania	1.7%	2.2%	4.0%	6.6%	7.8%	8.1%	7.7%
Thailand	7.6%	7.7%	-3.7%	3.6%	5.2%	3.6%	2.7%
Tunisia	4.6%	5.2%	6.1%	6.4%	6.7%	6.9%	5.7%
Turkey	4.9%	2.7%	2.8%	3.5%	7.5%	4.5%	3.7%
Uganda	7.4%	9.8%	7.1%	7.6%	7.1%	9.9%	7.8%
Ukraine	-3.8%	-14.3%	-3.5%	5.7%	7.0%	7.2%	-4.1%
United Kingdom	1.0%	-1.1%	13.5%	-5.0%	7.6%	4.4%	-1.7%
United States	2.6%	3.1%	4.5%	3.0%	3.1%	2.0%	0.6%
Uruguay	6.9%	4.0%	-3.7%	-3.0%	3.1%	6.3%	6.9%
Uzbekistan	-4.6%	0.3%	5.2%	4.6%	6.2%	12.6%	11.6%
Venezuela, RB	3.7%	-1.1%	-1.7%	0.8%	7.6%	9.7%	0.9%
Vietnam	7.9%	9.4%	4.8%	6.0%	7.4%	8.2%	6.7%
Yemen, Rep.	7.3%	5.9%	6.1%	6.2%	7.3%	5.0%	5.1%
Zambia	2.6%	0.1%	4.8%	4.4%	4.9%	7.7%	6.1%

Annex VII. Sectoral share in Gross Domestic Product

	Average 1990-2011	
Countries	**MVA share in total GDP**	**SVA share in total GDP**
Algeria	6.5%	29.6%
Angola	4.1%	34.0%
Argentina	22.0%	42.3%
Australia	11.5%	61.2%
Austria	17.5%	61.6%
Bahamas, The	4.2%	83.6%
Bangladesh	15.2%	50.6%
Belarus	25.0%	41.2%
Belgium	14.9%	72.7%
Benin	7.6%	54.3%
Bhutan	7.6%	33.5%
Bolivia	11.8%	44.3%
Brazil	15.5%	55.8%
Bulgaria	13.6%	50.6%
Burkina Faso	11.8%	40.8%
Burundi	12.9%	28.4%
Cambodia	13.3%	38.4%
Cameroon	16.9%	48.3%
Canada	13.7%	61.2%
Central Afr. Rep.	6.1%	35.2%
Chile	13.6%	54.6%
China	31.0%	39.4%
Colombia	15.3%	51.1%
Comoros	4.4%	42.1%
Costa Rica	18.6%	55.5%
Cote d'Ivoire	18.6%	54.9%
Croatia	15.1%	56.8%
Cyprus	9.4%	67.5%
Czech Republic	20.6%	54.4%
Denmark	13.0%	61.9%
Dominican Republic	20.6%	53.6%
Ecuador	12.8%	55.2%
Egypt, Arab Rep.	15.2%	44.9%
El Salvador	20.8%	55.2%
Estonia	13.3%	61.1%
Ethiopia	4.5%	36.0%
Fiji	12.4%	55.2%
Finland	18.2%	57.4%
France	11.6%	68.9%
Gambia, The	6.2%	60.1%
Germany	20.1%	61.5%
Guatemala	19.4%	52.5%
Guinea	6.0%	40.4%
Honduras	17.8%	50.7%
Hong Kong SAR, China	4.6%	83.5%
Hungary	17.0%	57.7%
Iceland	10.3%	56.5%
India	14.3%	45.8%
Indonesia	25.5%	40.0%
Iran, Islamic Rep.	9.3%	44.9%

Ireland	16.4%	60.0%
Italy	17.2%	63.3%
Jamaica	8.9%	57.0%
Japan	20.1%	68.6%
Jordan	14.1%	61.3%
Kazakhstan	11.9%	47.7%
Kenya	11.1%	48.3%
Korea, Rep.	22.1%	54.3%
Kyrgyz Republic	15.0%	40.7%
Lao PDR	7.9%	35.8%
Latvia	12.6%	63.0%
Lebanon	10.5%	65.1%
Luxembourg	8.4%	73.9%
Macedonia, FYR	15.2%	50.4%
Madagascar	12.8%	50.4%
Malawi	11.8%	50.6%
Malaysia	25.2%	44.7%
Mali	3.9%	36.9%
Malta	16.7%	47.0%
Mauritius	19.3%	53.6%
Mexico	17.6%	59.1%
Moldova	11.7%	48.2%
Mongolia	7.5%	36.9%
Morocco	14.9%	49.3%
Mozambique	10.6%	47.3%
Nepal	7.6%	42.4%
Netherlands	12.9%	64.5%
New Zealand	15.0%	64.3%
Nicaragua	12.9%	51.0%
Niger	6.0%	45.4%
Nigeria	2.9%	1.4%
Norway	9.2%	48.9%
Pakistan	15.5%	47.7%
Panama	8.8%	69.9%
Paraguay	12.2%	43.0%
Peru	14.8%	54.8%
Philippines	24.3%	51.9%
Poland	15.2%	56.7%
Portugal	13.4%	62.1%
Puerto Rico	44.3%	53.7%
Romania	20.7%	57.0%
Russian Federation	15.0%	50.9%
Senegal	14.0%	51.7%
Seychelles	7.7%	86.6%
Singapore	24.8%	64.2%
Slovak Republic	17.3%	55.6%
Slovenia	20.1%	55.5%
South Africa	16.7%	54.1%
Spain	14.2%	60.6%
Sri Lanka	19.0%	55.2%
St. Lucia	4.7%	60.2%
Suriname	13.4%	53.6%
Swaziland	31.2%	39.4%
Sweden	14.3%	63.5%
Switzerland	17.7%	73.4%
Tanzania	7.8%	41.7%
Thailand	31.7%	47.5%
Tunisia	16.3%	52.0%

Turkey	17.1%	51.7%
Uganda	6.1%	43.3%
Ukraine	15.5%	52.4%
United Kingdom	12.5%	24.0%
United States	12.3%	71.0%
Uruguay	15.0%	58.0%
Uzbekistan	9.0%	44.0%
Venezuela, RB	14.2%	35.2%
Vietnam	17.7%	39.6%
Yemen, Rep.	7.7%	37.8%
Zambia	10.3%	42.0%

Annex VIII. Abstract

The economic development and growth literature continues to discuss the way to encourage economic growth in developing countries. For many decades structuralist have argued that manufacturing is the only engine of growth, however the role of manufacturing has been questioned lately due to failures of industrialization in several African and Latin American countries, empirical evidence that shows that some South Asian economies have a service-led growth and increasing literature that claims that countries should focus on the development of the services sector as the world is living in a post-industrial era well-known as the information age. This thesis contributes to the existing literature that deals with Kaldor´s first law of economic growth in three ways. First, provides current evidence for the manufacturing an engine of growth hypothesis by using an econometric technique (system GMM) that treats endogeneity bias for a sample of 119 countries over the period 1990-2011. Second, by extending the same approach to the services sector, the thesis analyses if it can also be consider a growth escalator and finds strong confirmation for this. Finally, derives results for countries by income levels and shows that manufacturing is the only engine of growth for low income economies, while for middle income countries both sectors can be consider a source of growth. In the case of high income nations manufacturing does not explain overall growth anymore, but services play the major role.

Die Literatur über ökonomische Entwicklung und Wachstum beschäftigt sich weiterhin mit Möglichkeiten, ökonomisches Wachstum in Entwicklungsländern anzuregen. Für mehrere Jahrzehnte haben Anhäger eines strukturalistischen Blickwinkels den Standpunkt vertreten, dass der Produktionssektor die einzige treibende Kraft des Wachstums sei. Jedoch wird die Rolle dieses Sektors in letzter Zeit hinterfragt bedingt durch gescheiterte Industrialisierungen in afrikanischen und lateinamerikanischen Ländern, empirische Nachweise, dass südasiatische Volkswirtschaften durch ihre Dienstleistungssektoren wachsen und zunehmende Forschung, die darauf hinweist, dass sich Länder auf die Entwicklung ihrer Dienstleistungssektoren fokussieren sollten, da sich die Welt in einer post-industrialisierten Ära, bekannt als das Informationszeitalter, befindet. Diese Arbeit trägt in drei Punkten zu der existierenden Literatur zu Kaldors erstem Gesetz des ökonomischen Wachstums bei. Erstens wird die Hypothese des Produktionssektors als treibende Kraft des Wachstum durch aktuelle Zahlen für eine Stichprobe von 119 Länder in der Periode von 1990 bis 2011 belegt unter Verwendung eines ökonometrischen Verfahrens (System GMM) zur Behandlung eines systematischen Fehlers. Zweitens wird die gleiche Methode verwendet, um zu analysieren, ob der Dienstleistungssektor ebenfalls als Wachstumsgenerator fungiert, wodurch ein starker Nachweis für diese These gefunden wird. Drittens werden Ergebnisse für Länder nach Einkommensniveau erarbeitet und geschlossen, dass der Produktionssektor für Länder mit einem niedrigen Einkommen die einzige treibende Kraft des Wachstums ist, während für Länder mit mittlerem Einkommen beide Sektoren als Wachstumsgeneratoren gesehen werden können. Für Staaten mit hohem Einkommen lässt der Produktionssektor keinen Rückschluss auf das Wachstum zu, aber dem Dienstleistungssektor fällt eine tragende Rolle zu.

Annex IX. Resumé

María Elena Ayala

Profile

Master in Economics with particular interest on international trade, inclusive growth, agriculture, industrial and sustainable development, and public policy. Strengths in research, statistics, econometrics, economic analysis, policy design, project implementation and monitoring. Work experience at national and international level. As Director of Research and Industrial Studies at the Ministry of Industry and Productivity, participated on the Industrial Policy design and implementation of Ecuador for two years, which built my skills to develop public policy, manage inter-institutional coordination mechanisms, and generate public-private dialogue. Later on, as an international consultant from United Nations Industrial Development Organization worked on the National Capacity Building Program for Industrial Policy Development in Africa, Middle East, Asia and Latin America, that have strengthened my technical capabilities to develop technical cooperation, my inter-personal skills to deal with multicultural environments and the ability to deal with highly ranked public-officers.

Current Position

International Consultant on Industrial Development - United Nations Industrial Development Organization (UNIDO).

Education

October 2011-April 2014: Master in Economics, University of Vienna (UNIVIE)
October 2000- July 2005: Bachelor's in Economics, Pontifical Catholic University of Ecuador (PUCE)
September 1999 - June 2000: International Baccalaureate – Prairie Valley High School – IOWA-USA
October 1991 - July 1999: Isaac Newton Experimental High School – High School Diploma with a specialization in Physics and Mathematics

Skills

Languages: Italian (basic), English (fluent), Spanish (native language)

Computer skills: Microsoft Office (Excel, Word, Power Point), Web browsing (Internet Explorer), E-views and STATA (Econometric softwares), SPSS (Statistical package), and national and international databases management.

Work Experience

June 2010 – Present: United Nations Industrial Development Organization (UNIDO) Headquarters – International Consultant on Industrial Development

- International Consultant for the "Policy Development, Statistics and Strategic Research Branch" for:
  - Project design and implementation on an Institutional Capacity Building Program for Industrial Policy Development in Africa (Cape Verde, The Gambia, Rwanda), Middle East (Palestine), Asia (Viet Nam) and Latin America (Colombia)
  - Train public, private and academic representatives of developing countries on "Indicators of Industry and Trade Competitiveness for Country Diagnosis"
  - Train public, private and academic representatives of developing countries on "Sectoral and Value Chains analysis".

- International Consultant for " Trade Capacity Building Branch" to:
  - Develop sectoral studies to identify the export competitiveness of aquaculture, cosmetics, fruits and vegetables in Colombia to strength the National Quality System of the country.

October 2008 – May 2010: Department of Research and Industrial Studies, Office of the Undersecretary of Industrial Productivity, Ministry of Industry and Productivity – Director of Research and Industrial Studies

- Technical advisory for the design and implementation of the Industrial Policy 2008-2012 (member of the institutional work team)
- Implementation, follow-up and monitoring of Industrial Policy projects, like the Intelligence System for Industrial Competitiveness (SICI), the Industrial Reactivation Project, the Industrial Survey, among others.
- Preparation of technical advisory reports for the Ministry and the Presidency of the Republic on industrial matters.
- Management of inter-institutional agreements to exchange statistical information related to industry
- Management of public-private dialogue to gather main issues, limitations and requirements of the private sector
- Coordination, development and update of Information Systems
    - The Industrial Competitiveness Intelligence System (SICI)
    - The Investor Information System, jointly developed with the Ministry of Production, Employment and Competitiveness (MCPEC)
    - The Import Monitoring System (update)

- Coordination and development of studies and publications
    - Industrial Competitiveness Report of Ecuador 2009
    - Industrial Policy of Ecuador 2008-2012
    - Sugar cane value chain
    - Outlook of the Ecuadorian Industry
    - Industrial Perspective Report on current issues faced by the industrial sector

- MIPRO representative for industrial statistics and research matters
- MIPRO representative for the implementation of the Unique System of Regional Compensation (SUCRE) within the Bolivarian Alliance for the People of our America (ALBA).
- MIPRO representative for the creation of a GREAT NATIONAL trade company among ALBA countries (ALBAEXIM)
- Definition of strategic sectors for the country as part of the Well Being National Plan of Ecuador 2009-2013, together with the Ministry of Production, Employment and Competitiveness (MCPEC) and the National Planning Secretariat (SENPLADES)
- Prioritization of potential products at the sector level on which to apply public policies, together with the Ministry of Production, Employment and Competitiveness (MCPEC) and the National Planning Secretariat (SENPLADES).
- Identification of attractive markets for different products at the sector level as part of the Trade Policy of Ecuador design, together with the Ministry of Production, Employment and Competitiveness (MCPEC) and the National Planning Secretariat (SENPLADES).

August 2008-September 2008: HEXAGON-Consultores – Independent Consultant

- Project design for a Control and Monitoring System for the Ecuadorian Social Security Institute (IESS)

January 2008 – July 2008: Department of Research and Industrial Studies, Office of the Undersecretary of Industrial Productivity, Ministry of Industry and Competitiveness (MIC) [24] - Researcher

- MIC representative for the preparation of the National Strategic Plan for Statistical Development (PENDES) under INEC (National Institute for Statistics) coordination.
- Design of Ecuador-Industrial website (first version).
- Preparation of the Industrial Assessment of Ecuador used in the Industrial Policy document
- Technical advisory to the Undersecretary of Industrial Productivity and Minister office.
- Research for the Industrial Outlook Bulletins published periodically.

April 2005- December 2007: Technical Unit for Industrial Studies (UTEPI), Joint Program between the Ministry of Industry and Competitiveness (MIC) and United Nations Industrial Development Organization (UNIDO) – National Consultant hired by UNIDO to work in the Ministry

[24] The Technical Unit for Industrial Studies has become the Department of Research and Industrial Studies of the Undersecretary of Competitiveness of the Ministry of Industry and Competitiveness, due to its importance in terms of technical support provided to the institution.

- One-month consultancy assignment in Vienna at UNIDO headquarters to create an International Industrial Observatory that gathers industrial and trade statistics and competitiveness indicators.
- Elaboration of studies requested by the Undersecretary of Competiveness.
- Development of technical notes with current topics about the situation of the industrial sector such as:
  - Central America and the Caribbean as a potential market for the Ecuadorian metallurgical industry.
  - Trade profiles to identify potential new manufacturing products to commercialize with other nations
  - Identification of potential markets for competitive Ecuadorian products.
- Development of the Agroindustrial Development Plan jointly with the Ministry of Agriculture and the Cooperation Interamerican Institute for Agriculture (IICA) (member of the technical committee)
- Technical support to the Regional Program for Trade Capacity Building among Central American countries.
- Technical contribution in the following publications:
  - Business in Ecuador 2006: Country Cost Elements.
  - Industrial Competitiveness Report of Ecuador 2007.
  - Agro-industrial Study of the Pineapple in Ecuador: Value Chain Competitiveness and Market Outlook (Lead author)
  - Business in Ecuador 2005: Country Cost Elements (editorial support for the publication)
  - Agro-industrial Exports of Ecuador and Potential Markets (working paper).

September 2004- April 2005: Office of Agro Studies (OFIAGRO) - Consultant

As part of the consulting team worked on the following studies:

- Possible impact of the Free Trade Agreement (FTA) with the US on 7 agricultural products (potatoes, carrots, onions, goldenberries, strawberries, blackberries, asparagus). Work delivered to the PL480 Chamber of Agriculture.
- Agricultural Policy (Problems and Proposal). Work delivered to the Chamber of Agriculture of the first zone.
- Impacts of the FTA on small farmers in the Andean highland region.

May 2004- July 2004: Ministry of Foreign Relations – Intern

- Contributed to the monthly publication of an article on bilateral foreign trade.
- Participated in the XXXIV General Assembly of the OAS as part of the Foreign Ministry delegation.

June 2003-September 2003: MULTIPLICA (Economic consulting firm) – Researcher

- Consultancy on the possible implementation of a credit bureau in the Ecuadorian market.
- Consultancy for the Inter American Development Bank on possible solutions or aid to promote the most representative sectors of the economy.

June 2000-Septiember 2000: BRITISH AMERICAN TOBACCO – Surveyor

- Market study to identify Lucky Strike and Kent brands positioning.

Publications

- UTEPI (2006). *Piña. Estudio Agroindustrial en el Ecuador: Competitividad de la Cadena de Valor y Perspectivas de Mercado.* (Pineapple. Agro-industrial Study in Ecuador: Competitiveness of the Value Chain and Market Outlook). MICIP-UNIDO Program
- UTEPI (2007). *Competitividad Industrial del Ecuador.* (Industrial Competitiveness Report of Ecuador). MICIP-UNIDO Program
- UTEPI (2007). *Negocios en el Ecuador 2006, Elementos del Costo País* – on line. (Business in Ecuador 2006, Country Cost Elements) – on line. MICIP-UNIDO Program
- MIC-UNIDO (2007). *Boletín de Perspectiva Industrial: La industria ecuatoriana* (Industrial Outlook Bulletin: Ecuadorian Industry).
- MIC-UNIDO (2008). *Boletín de Perspectiva Industrial: Agroindustria, motor de la economía ecuatoriana*. (Industrial Outlook Bulletin: Agro-industry, the engine of the Ecuadorian Economy).

- MIC-UNIDO (2008). *Boletín de Perspectiva Industrial: El sector pesquero ecuatoriano, dinámica comercial y competitividad de la cadena de valor.* (Industrial Outlook Bulletin: The Ecuadorian fishery sector, trade dynamics and competitiveness of the value chain).
- MIC-UNIDO (2008). *Boletín de Perspectiva Industrial: Cadenas productivas no tradicionales, alternativas para el desarrollo industrial.* (Industrial Outlook Bulletin: Non-traditional Production Chains, alternatives for industrial development).
- MIC-UNIDO (2008). *Boletín de Perspectiva Industrial: Cacao, producto símbolo del Ecuador.* (Industrial Outlook Bulletin: Cacao, symbolic product of Ecuador).
  MIC-UNIDO (2008). *Boletín de Perspectiva Industrial: Industria Láctea, oportunidades y perspectivas.* (Industrial Outlook Bulletin: Dairy Industry, opportunities and outlook).
- Ayala, M.E. (2008). *Palma Africana. Estudio Agroindustrial en el Ecuador: Competitividad de la Cadena de Valor y Perspectivas de Mercado*. MIC-ONUDI. (African Palm. Agroindustrial Study in Ecuador. Competitiveness of the Value Chain and Market Outlook).
- MIPRO (2009). Boletín *de Perspectiva Industrial: Venezuela una oportunidad comercial para el Ecuador.* (Industrial Outlook Bulletin: Venezuela, a trade opportunity for Ecuador).
- MIPRO (2009). *Boletín de Perspectiva Industrial: Centroamérica: Un escenario comercial atractivo para el Ecuador.* (Industrial Outlook Bulletin: Central America, an attractive trade scenario for Ecuador).
- MIPRO (2009). *Boletín de Perspectiva Industrial: La caña de azúcar y su importancia para el Ecuador.* (Industrial Outlook Bulletin: Sugar cane and its importance for Ecuador).
- MIPRO (2009). *Política Industrial del Ecuador 2008-2012*. (Industrial Policy of Ecuador).
- MIPRO (2010). *Competitividad Industrial del Ecuador – working paper.* (Industrial Competitiveness Report of Ecuador).
- Ayala, M (2014). Manufacturing the only engine of growth? An extension of Kaldor´s first law of economic growth – Master Thesis. University of Vienna.