ANEXO B

Quadro 1 – Lista de Países e Classificação

Países	Código	Grupo Econômico
Austrália	AUS	Economia Desenvolvida
Áustria	AUT	Economia Desenvolvida
Bélgica	BEL	Economia Desenvolvida
Canadá	CAN	Economia Desenvolvida
China	CHN	Economia em Desenvolvimento
República Tcheca	CZE	Economia Desenvolvida
Alemanha	DEU	Economia Desenvolvida
Dinamarca	DNK	Economia Desenvolvida
Espanha	ESP	Economia Desenvolvida
Finlândia	FIN	Economia Desenvolvida
França	FRA	Economia Desenvolvida
Reino Unido	GBR	Economia Desenvolvida
Grécia	GRC	Economia Desenvolvida
Hungria	HUN	Economia Desenvolvida
Índia	IDN	Economia em Desenvolvimento
Indonésia	IND	Economia em Desenvolvimento
Irlanda	IRL	Economia Desenvolvida
Itália	ITA	Economia Desenvolvida
Japão	JPN	Economia Desenvolvida
República da Coreia	KOR	Economia em Desenvolvimento
Luxemburgo	LUX	Economia Desenvolvida
México	MEX	Economia em Desenvolvimento
Holanda	NLD	Economia Desenvolvida
Polônia	POL	Economia Desenvolvida
Portugal	PRT	Economia Desenvolvida
Rússia	RUS	Economia em Desenvolvimento
República Eslováquia	SVK	Economia Desenvolvida
Eslovênia	SVN	Economia Desenvolvida
Suécia	SWE	Economia Desenvolvida
Turquia	TUR	Economia em Desenvolvimento
Estados Unidos	USA	Economia Desenvolvida
Países excluídos*	**Código**	**Grupo Econômico**
Bulgária	BGR	Economia Desenvolvida
Ciprus	CYP	Economia Desenvolvida
Estônia	EST	Economia Desenvolvida
Latvia	LVA	Economia Desenvolvida
Lituânia	LTU	Economia Desenvolvida
Malta	MLT	Economia Desenvolvida
Romênia	ROU	Economia Desenvolvida
Taiwan	TWN	Economia em Desenvolvimento

Nota: *Países excluídos do banco de dados devido à ausência na disponibilidade de dados de câmbio ou índice de preços para o cálculo da taxa de câmbio real bilateral setorial.

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A LEI DE VERDOORN-KALDOR-THIRLWALL: UMA ANÁLISE EMPÍRICA

The Verdoorn-Kaldor-Thirlwall's law: an empirical analysis

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Resumo: O crescimento de longo prazo de um país depende de sua renda - elasticidades das exportações e importações (Thirlwall, 1979). O debate sobre esta lei evoluiu para uma abordagem multissetorial, tal como desenvolvida por Araújo e Lima (2007). Segundo os autores, essa abordagem permite identificar aqueles setores que podem contribuir relativamente mais para a estratégia de crescimento do país: basta que priorize os setores com maior proporção de elasticidades-renda das exportações, quando comparado com a elasticidade-renda das importações. O objetivo deste artigo é analisar empiricamente a relação entre o Brasil e seu principal parceiro comercial, a China. Para tanto, foram realizadas estimações usando a metodologia de painel de dados econométricos com dados anuais dos estados brasileiros para o período 1999-2009. Os resultados confirmaram que apenas a indústria de transformação apresentou razao das elasticidades maiores do que a unidade, mas esta estratégia de crescimento da economia brasileira não é necessariamente dinâmica no sentido de Kaldor-Verdoon. Assim, propõe-se a "Lei de Verdoorn-Kaldor-Thirlwall", que considera simultaneamente a razão das elasticidades e a elasticidade produto do emprego maiores do que a unidade para que esta estratégia de crescimento seja completa.

Palavras-Chave: Lei de ThirwallMultissetorial, Crescimento Econômico, Dados em Painel, Brasil, China.

Abstract: The long term growth of a country depends on its income - elasticities of exports and imports (Thirlwall, 1979). The debate over this law has evolved into a multisectoral approach, as developed by Araujo and Lima (2007). According to these authors the sector analysis makes it possible to identify what sectors can contribute relatively more to the growth strategy of the country: it suffices that prioritizes the sectors with highest ratio of income elasticities of exports when compared to the income elasticity of imports. The aim of this paper is to analyze empirically the relationship between Brazil and its main trading partner, China. To achieve the goal and test the hypothesis launched, estimations were perform using annual data of the Brazilian states for the 1999-2009 period and using the panel data econometric methodology. The results confirmed that only the manufacturing sector shows a ratio of elasticities greater than unity, which implies a change in strategy for long term growth that prioritizes this sector, but it is not necessarily dynamic in the sense of Kaldor-Verdoorn. Thus, it is proposed the "Verdoorn-Kaldor-Thirlwall's Law", which consider the product elasticity of employment for this strategy to be full.

Key Words: MultisectoralThirlwall's Law, Economic Growth, Panel Data, Brazil, China.

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1 Introduction

The debate over the long term growth of the Brazilian economy and the "stop and go" behavior of the country stretches from the adoption of liberalizing reforms of the 1990s. With the implementation of the Real Plan at Brazil came a new growth model in which the country replaces the model of import substitution by a strategy of growth with foreign savings. The hypothesis of this study is that the low economic growth in the country is associated with this strategy of integration into the international market, which is highly concentrated in sectors whose income elasticity of exports are relatively low.

According to Thirlwall (1979), economic growth in the long term is defined by the ratio between the rate of growth of exports and the income elasticity of imports. Recently, this debate has evolved into a multisectoral approach, as developed by Araújo and Lima (2007). The authors state that there are sectors which relatively can contribute more to the growth of the country, those that are more dynamic, with the largest ratios of income elasticities of exports and imports. Thus the Brazilian economic growth rate can rise even if the world growth rate remains constant. To this, it is enough that the sectoral composition of exports and imports prioritize the sectors with scale dynamic economies, such as the industrial sector. Therefore, we intend to evaluate the hypothesis that this situation can be improved through an understanding of the relationship between Brazil and its major trading partners – such as China. The change should start by implementing a growth strategy led by exports of the sectors that have the highest ratios of income elasticity of exports and imports, which are those sectors of the Brazilian economy that have increasing returns to scale.

To achieve the goal and test the proposed hypothesis, besides this introduction, this paper provides a review of the literature in the first sections, which considers the seminal article by Thirlwall (1979) and the multisector model developed by Araújo and Lima (2007), who addressed the production decisively structure impacts on the path to long term growth of economies. The fourth section presents the methodology and data used in the empirical analysis. In the following section, attention turns to the Verdoorn-Kaldor-Thirlwall's Law and the empirical analysis of Brazil-China bilateral relationship, using estimation of dynamic panel data models. Finally, some concluding remarks are pointed out.

2 Multisectoral Thirlwall's Law: The Araujo and Lima Model (2007)

To avoid an exhaustive review of the various theoretical and empirical models available in the literature, we present a brief explanation of the main contributions of this theme. After the initial contribution of Thirlwall (1979) several extensions were made, seeking to adapt to the country realities.

In 2007, Araujo and Lima showed a multisectoral extension of "Thirlwall's Law" (LTMS). This multisectoral model allows the study of sectoral trade relations between the countries. In this work, we consider only the bilateral relationship between Brazil and China, as this is the main partner of the Brazilian economy.The authors advocate the thesis that the overcoming of external constraint involves the modification of the productive structure.

The Araujo and Lima's model simplify the issue when they say that labor is the only factor of production. Wages and productivity define the unit costs of production and the pattern of specialization. For simplicity, only three sectors in the economy are considered, namely, the commodities (Sector 1), semi-manufactured products (Sector 2) and manufactured products (Sector 3).

The basic conditions can be summarized by three: the condition for full employment of labor, the full expenditure of national income and the trade balance equilibrium. According to Araujo and Teixeira (2004, p. 117), "The conditions for full employment, full expenditure of national income and trade balance, equilibrium are established along with solutions for the systems of physical quantities and prices in an open economy".

As shown by Araujo and Teixeira (2004) in a dynamic and open economic system, the effective demand condition is divided into two conditions, in other words one for full employment and one for total spending of national income. The reason we have two conditions instead one is clear: in an open economy, national income can be spent on imported products and if so the fulfillment of the condition of full income spent does not imply the satisfaction of the condition of full employment. As pointed out by these authors, when we met two conditions simultaneously, another is automatically satisfied, since it is the equilibrium of the balance of payments (ARAÚJO; TEIXEIRA, 2004 *apud* ARAUJO, 2012, p. 597).

The Araujo and Lima Model (2007) is represented by the following equation:

$$y^t = \frac{\sum_{i=1}^{n-1} \xi \varepsilon_i \left(\frac{L_{it}}{L}\right)}{\sum_{i=1}^{n-1} \left(\frac{L_{it}}{L}\right) \pi_i} (z_t) \qquad (1)$$

Equation (1) is the first important result of the work of Araujo and Lima (2007), which shows the relationship between the growth rate of per capita income in the Brazilian (and Chinese) economy. From this equation, it is concluded that the growth rate of *per capita* income of the Brazilian economy is directly proportional to the growth of exports. The benefits of international trade for economic growth depend largely on income elasticities of exports and imports in sectoral terms, that is the higher is income elasticity of demand for the export sector and the smaller is the income elasticities of demand for import sector, the greater are the benefits of this bilateral relationship with China.

In short, the authors found a similar result to those presented by Thirlwall (1979), but considering the income elasticities weighted by coefficients that measure the share of each sector in total imports and exports. Empirically, the idea is to calculate the percentage of foreign income directed to the purchase of products of the basic, manufactured and semi-manufactured sectors. Similarly, there is a percentage of household income directed to the import of products in each of the three sectors mentioned above.

3 MultisectoralThirlwall's Law: some empirical evidence

The empirical literature of this multisectoral approach is scarce, since there were few papers about the theme: Gouvêa and Lima (2009), Gouvêa (2010), Carbinato (2010), Queiroz et al. (2011), Romero, Silveira and Jayme Jr. (2011), Gouvêa and Lima (2013), Tharnpanich and McCombie (2013), Romero and McCombie (2014), and others.

The research developed by Gouvea and Lima (2009) estimated the sectoralelasticities for various countries of Latin America and Asia, coming to the conclusion the technology-intensive sectors have higher income elasticity. With this analysis the authors presented the first evidence that for overcoming the external constraint it is necessary the increase of the participation of production with medium and high technological intensity, which would increase the income elasticity of exports in the economy and would reduce the income elasticity of imports, since there would be a drop in the need to import these products with a higher technological content.

The paper of Gouvea (2010) uses empirical tests to validate the MultisectoralThirlwall's Law for Brazil from 1962-2006, and concluded economic growth was restricted by the external sector.

Carbinato (2010) examines the relationship between industry standards and the external constraint in Brazil. From the Araujo and Lima (2007) model, which takes into account the importance of the sector to economic growth, the author emphasizes the importance of specialization and the need to direct efforts to boost exports in sectors that have high income elasticity. Queiroz et al. (2011) also concluded that between the original Thirlwall's Law and Multisetorial the model that best fitted the Brazilian economy was the latter, since the statistical data demonstrates a prediction error of 0.69 % of the multisectoral model, versus 1.26 % of the original Thirlwall's Law. Thus, the Multisectoral version adjusted better in determining the growth rate of Brazil in 1962-2008 period. Indeed, for the authors, the growth of the Brazilian economy in this period occurred under external constraint, and that changes in the sectoral share of the importer and exporter tariffs in the country will result in higher growth rates for country driving most of its exports to goods with higher technological intensity.

The empirical results confirm the validity of MultisetorialThirlwall's Law in the Brazilian case, which fits better than the original Thirlwall's Law. Note that there are different methods to estimate the income elasticity, but in general the high-technology goods have higher elasticities. It can also be concluded that the pattern of specialization of an economy affects its growth rate constrained by the balance of payments.

4 Methodology

In this section, we intend to use empirically "MultisectoralThirlwall's Law" under the Brazilian experience. Therefore, the methodology employs panel data to estimate the sectoral elasticities of exports and imports of products in the Brazil trade relationship with China, which is the main trading partner of the Brazilian economy.

According to Wooldridge (2002), panel data models have a number of advantages, the main one being the ability to control unobservable characteristics of the data, besides correcting problems of omitted variables bias.

So we believe that this work will contribute to the theme in two ways: i) to employ dynamic models of panel data, due to the problems related to the bias omission of relevant variable, and ii) in evaluating the bilateral trade relation between Brazil and China, in order to draw lessons for the improvement of trade integration strategy of the Brazilian economy in the international market.

4.1 Panel Data methodology in the presence of non-observed effects

The panel data methodology for the analysis proposed in this work is the most suitable, since it makes possible to articulate a time series to "cross -section" data. One of the advantages of the estimation with panel data is its capture the influence of individual heterogeneity on the response variable. The standard fixed effects regression can be initially represented as follows:

$$Y_{it}= x_{it}\beta+c_i+u_{it} \quad (2)$$

Where Y_{it} is the vector of observable explanatory variables, u_{it} and c_i are respectively the idiosyncratic error term and the specific unobservable component of the cross-section units, fixed on time and varying across individuals. According to Wooldridge (2002), static panel data models are subdivided into two types of models: fixed effects models and random effects models.

The "fixed effects" model considers that there is a correlation between the explanatory variables and the individual non-observed effects, whereas in the "random effects" model it is assumed that this correlation is zero that is no correlation between the observed explanatory and unobserved effects (WOOLDRIDGE, 2002). To choose the best model, we perform the Hausman test, whose null hypothesis is that the errors are not correlated with the explanatory variables.

For dynamic panel data models, GMM estimator (generalized method of moments) is generally used, to find a consistent estimator with a minimum of moment restrictions.

The Difference GMM estimator, also known as an Arellano-Bond estimator, seeks to address the problem of endogeneity with the instrumental variables technique. The problem encountered in GMM Difference is the lagged dependent variable, correlated with the error term by construction in the differenced equation.

We estimated the model also by the method of the Arellano-Bover/Blundell-Bond estimator, also known as GMM-system. The additional assumption in this estimation technique is that the first differences of the instrumental variables are not correlated with the fixed effects term. This allows the use of more instruments, which can greatly improve the efficiency of estimation, when compared with the first estimator.

This extension aims to provide more consistent and efficient estimators, showing how the first-difference estimators of Arellano and Bond are biased due to the use of weak instruments or problems with measurement errors.

We realized the Hansen Difference Test to find what the most appropriate model. If the p-value for this test is high, it means that the additional instruments are also valid, and therefore GMM system adds to the GMM Difference valid information, and should be chosen as the most suitable estimation.

Table 1 – The data base of Brazil-China commercial relations in the 1999-2009 period

Variable	Description	Source	Unity	Observation
XMCh	Manufactured Products, Exports to China, by state.	ALICEWEB	Dollar (US$)	Weights of these exports under the total exports to China were calculated in the period.
XSCh	Semi-manufactured products, Exports to China, by state.	ALICEWEB	Dollar (US$)	
XBCh	Basic products Exports to China, by state.	ALICEWEB	Dollar (US$)	
MMCh	Manufactured Products Imports from China, by state.	ALICEWEB	Dollar (US$)	Weights of these imports under the total imports from China were calculated in the period.
MSCh	Semi-manufactured products, Imports from China, by state.	ALICEWEB	Dollar (US$)	
MBCh	Basic products, Imports from China, by state.	ALICEWEB	Dollar (US$)	
PIBChXM	China's GNP multiplied by the manufactured product weight	-	- -	The weights calculated for exports were used to weight China's GDP by sector.
PIBChXS	China's GNP multiplied by the semi-manufactured product weight	-	- -	
PIBChXB	China's GNP multiplied by the basic product weight	-	- -	
PIBEstMM	GNP of the federative units multiplied by the weights of manufactured products.	-	- -	The weights were calculated from the import values and were used to ponder the GNP of federative units by sector.
PIBEstMS	GNP of the federative units multiplied by the weights of semi manufactured products.	-	- -	
PIBEstMB	GNP of the federative units multiplied by the weights of basic products.	-	- -	
CamXM	Exchange rate multiplied by the weights of the exports of manufactured.	-	- -	The weights calculated from the exports were used to obtain the effective exchange rate by sector.
CamXS	Exchange rate multiplied by the weights of the exports of semi manufactured.	-	- -	
CamXB	Exchange rate multiplied by the weight of exports of basic products.	-	- -	
CamMB	Exchange rate multiplied by the weights of imports of manufactured products.	-	- -	The weights calculated from the imports were used to obtain the effective exchange rate by sector.
CamMS	Exchange rate multiplied by the weights of imports of semi manufactured products.	-	- -	
CamMM	Exchange rate multiplied by the weights of imports of basic products.	-	- -	
CamBrasChi	Effective Real Exchange rate Yuan/Real.	-	World Bank Yuan/ Real	The effective exchange rate was calculated multiplying the nominal exchange rate by the China inflation and divided by the inflation of Brazil federative unities, obtained from IBGE.
PIBEst	Federative Unit GNP	IBGE	Dólar (US$)	The Federative unit GNP was converted to US$ using the nominal exchange rate and were multiplied by the weights of imports manufactured products from China.
Pib_China	China GNP	World Bank	Dólar (US$)	It was used in the model the China's GDP Multiplied by weights of the manufactured products exports of the federative units.

Source: Prepared by the authors, 2016.

The calculations were performed using Stata software, version 12. The dependent variables are the sectoral exports to China and the sectoral imports from China, and the others variables defined in Table 1 are explanatory variables. Thus, we intend to evaluate the sectors whose ratio of income elasticities of exports and imports are better for the country in this commercial relationship with the Chinese economy.

4.3 Presentation of empirical results of Multisectoral Thirlwall's Law

China is the largest emerging power and currently is considered a very integrated economy with the world, both in terms of foreign trade and in terms of capital flows, which helps explain its higher rate of growth in recent decades" (VILELA; VERISSIMO, 2009, p. 21).

Because of its importance in the world and in particular for the Brazilian economy, this analysis focuses on the relationship between Brazil and China, which became the main trading partner of the country since 2009. With regard to the country of origin of Brazilian imports, the USA remains the main country of origin, but now with China closely watches the performance of the US economy and is also close to becoming the leading supplier of products in Brazil.

In recent years, Table 2 indicates an increase in the percentage share of commodities at the expense of the share of manufacturing in total income for the recent increase in commodity prices. Manufacturing sectors were negatively affected by currency appreciation. The behavior of Chinese demand helps to consolidate this situation, since its imports are concentrated in the commodity sector, largely raw material.

Table 2 – Exports from Brazil for aggregate factor

Year	Brazil (Total)				Brazil (Destination - China)			
	US$ Millions FOB	Bas. (%)	Sem. (%)	Man. (%)	US$ Millions FOB	Bas. (%)	Sem. (%)	Man. (%)
1999	48.012	25,40	16,60	56,16	676	62,60	21,50	15,80
2000	55.119	22,80	15,50	58,91	1.085	68,20	13,00	18,80
2001	58.286	25,70	13,60	57,42	1.902	60,70	14,40	24,40
2002	60.438	24,90	13,70	57,97	2.521	61,50	17,50	20,60
2003	73.203	29,10	15,00	53,75	4.533	50,00	23,80	25,90
2004	96.677	31,50	13,70	53,25	5.441	59,40	22,70	17,80
2005	118.529	27,60	14,50	56,00	6.835	68,40	14,70	16,70
2006	137.807	27,90	13,70	56,03	8.402	73,90	15,20	10,50
2007	160.649	30,60	13,90	53,51	10.749	73,80	18,00	8,10
2008	197.942	35,30	13,50	48,55	16.442	77,50	15,70	6,70
2009	152.994	42,00	12,6	43,32	21.004	77,70	15,50	6,80

Source: Prepared by authors from the MDIC (2013).

Despite the increase in total transactions, we should not neglect the composition of exports, since the decrease in participation of the manufacturer observed in the table does not lead to a situation of sustainable export growth.

In sequence, we present the estimation results of the demand functions for imports and exports sectors.

Estimators are performed due to the existence of endogeneity between the variables (GMM - Difference and GMM - System).

The Tables 3 and 4 presents the results for the estimation of the GMM system model. We note the number of observations used in the estimations at the bottom of the table, the number of instruments used (j), the p-values corresponding to the autocorrelation tests of first and second order differentiated disturbances (Arellano-Bond autocorrelation test), the p-value (saraganp) corresponding to Sargan statistic for testing restrictions on the over identification test (not robust, but not weakened by many instruments), the p-value (hansenp) corresponding to the Hansen statistical test about restrictions on the over identification (robust but weakened by many instruments), the p-value (difftest 1) corresponding the test statistic Difference-in-Hansen exogenous subset of instruments which is the Hansen exclusion test groups (null = additional instruments are valid), and finally (difftest 2) corresponding to the test statistic Difference-in-Hansen for the exogeneity of the subset of additional instruments (null hypothesis = exogeneity).

The estimation results for exports are shown in Table 3. The first column shows the results of the estimation of commodity exports to China (XBCh) obtained by the GMM System method of estimation. Due to the presence of lagged explanatory variable (L.XBCh), the model does not require the presence of the constant. The other explanatory variables used were China's GDP allocated to commodities (PIBChXB), which show us that the value of income elasticity of exports is 0,605. The explanatory variable defined by the real effective exchange rate (CamXB) captures the price elasticity of exports, which showed a positive and significant value of 0.165, indicating that an increase in this exchange rate raises the exports of products, as expected.

The second column shows the results for the dependent variable (XSCh), exports of semi-manufactured products to China, also having significance for both elasticity parameters. China's GDP of semi-manufactored products (PIBChXS) showed a positive income elasticity of 0.569, while the estimates of the sensitivity of the sector changes due to the real effective exchange rate (CamXS) were 0.206.

In the last column, we can see the results of the estimations for manufactured exports to China (XMCh). As in previous cases, the explanatory variables were significant and positively responded to changes in China's GDP of manufactured products (PIBChXM) and variations in the real effective exchange rate (CamXM), with income and price elasticities are 0.602 and 0.143, respectively. Comparing the three sectors, currency devaluation favors more the export of basic and semi-manufactored products.

Table 3 – Results of regression models with panel data (GMM System) - dependent variables: exports of basic, semi-manufactured and manufactured products to China from federative units (Brazil) - 1999-2009

Variables	XBCh	XSCh	XMCh
L.XBCh (B/S/M)[1]	0.234 (0.080)***	0.293 (0.087)***	0.221(0.065)***
PIBChXB (B/S/M)[1]	0.605 (0.062)***	0.569 (0.071)***	0.602 (0.050)***
CamXB (B/S/M)[1]	0.165 (0.028)***	0.206 (0.039)***	0.143 (0.020)***
Observations	196	195	164
Numberof ID	23	21	21
F_p	0	0	0
J	32	32	36
ar1p	0.004	0.001	0.016
ar2p	0.727	0.321	0.324
sargannp	0.000	0.020	0.000
hansenp	0.785	0.884	0.987

Source: Prepared by the authors from Stata12.
(1) Robust standard errors in parentheses, significant at 10%.

The estimates of imports from China are shown in Table 4. In the first column, the results are presented for the dependent variable imports of basic commodities from China (MBCh) with the GMM System method of estimation. The explanatory variables are those defined by the GDP of the Brazilian states of basic products, which captures the value of income (PIBEstMB) and real effective exchange rate (CamMB) elasticity. The coefficients show the expected signs, 0.662 and -0.085 although the latter does not present significance.

The second column shows the results for the dependent variable (MSCh), imports of semi-manufactured products from China. The explanatory variables have expected signs, and the sensitivity of the dependent variable to the GDP states is positive and significant (0.632). The sensitivity for the real effective exchange rate of the semi-manufactured products imports

(CamMS) was -0.003, but not significant.

In the last column are presented the results for the variable imports of manufactured goods from China (XMCh). Another time the explanatory variables where the GDP of the Brazilian states directed to the acquisition of manufactured products (PIBEstMM), and the real effective exchange rate of manufactured products (CamMM), as defined in the theoretical framework. The results showed that income elasticity is also positive and significant, on the order of 0.231, while the price elasticity presented a negative though not significant value of -0.016.

Table 4 – Results of regression models with Panel Data (GMM System) - dependent variables: Commodity basics of China; commodity semimanufactured China and imports of manufactured products from China to federative unities (Brazil) - 1999 to 2009

Variables	MBCh	MSCh	MMCh
L.MBCh(B/S/M)[1,2]	0.241 (0.116)*	0.325 (0.199)	0.777 (0.052)***
PIBEstMB(B/S/M)[1,2]	0.662 (0.100)***	0.632 (0.178)***	0.231(0.054)***
CamMB(B/S/M)[1]	-0.085 (0.051)	-0.003 (0.040)	-0.016 (0.047)
Observations	98	80	249
Numberof ID	19	14	27
F_p	0	0	0
J	32	32	32
ar1p	0.0423	0.0224	0.001
ar2p	0.379	0.0395	0.780
sargannp	0.001	0.379	0.012
hansenp	0.997	0.999	0.634

Source: Prepared by the authors from Stata12.
(1) Robust standard errors in parentheses.
(2) * Significant at 1%; *** Significant at 10%.

With these empirical results and applying the "Thirlwall's Law" for the three sectors into account, we see that the first two sectors (basic and semi-manufactured commodities) have a ratio around 0.91. Thus lower than unity, while the manufactured sector has a much higher ratio (2.60). This result is important for understanding the strategy of export-led growth, because it shows that the relationship of the Brazilian economy with the Chinese economy is not advantageous for the first country, considering that the first two sectors account for the largest percentage of Brazilian exports to China with 85%) while the manufacturing product sector only accounts with 15%, the only sector that showed a ratio of income elasticity greater than unity.

4.4 The Verdoorn-Kaldor-Thirlwall's Law: An Empirical Analysis

Considering the MultisectoralThirlwall's Law the manufacturing sector was the one with the highest ratio of elasticities in Brazil-China bilateral relationship. Thus we sought the manufacturing sector to identify those sub-sectors or branches with more dynamic relatively. For this purpose we used the data of exports and imports by state, directed to and from China and obtained in Aliceweb Portal. After the classification of the sectors in Basic, Semi-Manufactured and Manufactured, we considered only the latter from NCM (Mercosur Common Nomenclature) eight-digit code and for these were defined ratings of Technological Intensity.

To define the technological intensity ratings, we used the methodology proposed by the Organization for Economic Co-operation and Development (OECD), the institution responsible for publishing the International Standard Industrial Classification of All Economic Activities (ISIC) that attaches a certain level of technological intensity to the classification code of the industries. This publication identifies the branches or subsectors of high and medium-high technology by the intensity of spending on R & D, while the branches or sub-sectors with medium-low and low technology are identified by intensity of labor and capital. Correspondence of methodologies allows the relationship of the NCM classification with the level of technological intensity, defined by ISIC code. The Brazilian data were extracted from the Analysis of Foreign Trade Information System (AliceWeb2).The data used are shown in Tables 5 and 6, which contain the share of each sub-sector of the manufacturing industry in total imports and exports of the bilateral relationship with China. The Table 5 indicates a predominant presence of manufactured products of high and medium-high technological intensity in the resulting imports from China on the 1999-2009 period, representing an average of 76% of imports of manufactured products.

Table 5 – Brazilian imports of industrial subsectors from China classified by technological intensity (Share%) 1999 – 2009

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
CurrentValues (US$ Million)	**776**	**1.105**	**1.169**	**1.308**	**1.795**	**3.270**	**5.041**	**7.702**	**12.207**	**19.073**	**15.612**
High-Tech Industry(I)	**38,2%**	**44,2%**	**36,5%**	**45,1%**	**48,2%**	**49,4%**	**51,9%**	**49,3%**	**42,2%**	**40,1%**	**39,3%**
Aeronautics and Aerospace	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Pharmaceutics	6,0%	4,8%	6,2%	5,8%	5,1%	3,9%	3,2%	2,6%	2,1%	2,4%	2,4%
Office & Computer	8,6%	11,8%	8,7%	8,3%	8,3%	8,2%	9,6%	10,9%	10,9%	10,0%	10,6%
Equipment Radio, TV and Communication	18,6%	20,1%	16,2%	24,4%	28,1%	30,7%	32,3%	30,4%	23,2%	21,6%	21,3%
Medical Optical and Precision Instruments	5,0%	7,4%	5,3%	6,6%	6,7%	6,6%	6,8%	5,5%	6,0%	6,1%	5,0%
Medium-High Technology Industry (II)	**33,8%**	**32,6%**	**37,8%**	**29,7%**	**30,6%**	**30,8%**	**28,1%**	**29,2%**	**33,0%**	**34,4%**	**34,3%**
Machinery, Equipment and Electrical Equipment	10,0%	11,1%	14,6%	9,3%	10,4%	10,8%	9,1%	8,9%	8,8%	8,4%	8,9%
Motor Vehicles and Semitrailers	0,2%	0,1%	0,2%	0,3%	0,4%	0,7%	0,8%	1,0%	0,9%	1,7%	1,6%
Chemicals, Excl. Pharmacists	13,2%	13,8%	11,9%	12,0%	12,7%	11,1%	9,5%	9,1%	10,5%	10,7%	9,6%
Railroad Equipment and Transport Equipmentn.e.	1,0%	0,9%	1,0%	1,3%	1,1%	2,1%	1,3%	1,3%	1,4%	1,7%	1,3%
Mechanical Machinery and Equipment	9,5%	6,7%	10,1%	6,6%	6,0%	6,1%	7,4%	9,0%	11,4%	12,0%	12,8%
Low-Tech Industry (III)	**22,2%**	**17,0%**	**19,3%**	**17,4%**	**15,7%**	**14,0%**	**13,4%**	**13,5%**	**14,0%**	**13,4%**	**15,9%**
Food, Beverages and Tobacco	0,5%	0,2%	0,4%	0,4%	0,4%	0,3%	0,3%	0,3%	0,3%	0,5%	0,5%
Wood and Wood Products, Pulp and Paper, Printing	0,6%	0,4%	0,7%	0,3%	0,3%	0,3%	0,2%	0,4%	0,5%	0,5%	0,7%
Textiles, Leather and Footwear	11,7%	8,6%	11,4%	11,1%	11,4%	9,7%	9,4%	9,4%	9,6%	9,1%	10,9%
Manufactures Not Specified	9,4%	7,8%	6,9%	5,5%	3,6%	3,7%	3,4%	3,4%	3,6%	3,2%	3,8%
Medium-Low-Technology Industry (IV)	**5,8%**	**6,1%**	**6,4%**	**7,9%**	**5,4%**	**5,8%**	**6,7%**	**7,9%**	**10,8%**	**12,1%**	**10,6%**
Rubber and Plastic Products	1,8%	1,7%	1,8%	1,5%	1,4%	1,7%	2,3%	2,4%	2,6%	2,9%	2,6%
Metallic Products	3,0%	3,5%	3,1%	3,3%	2,6%	2,8%	3,0%	4,3%	6,7%	7,6%	6,3%
Other Non-Metallic Mineral Products	0,9%	0,9%	1,1%	1,2%	1,2%	1,2%	1,4%	1,1%	1,4%	1,5%	1,5%
Refined Petroleum Products and Other Fuels	0,0%	0,0%	0,4%	1,9%	0,2%	0,0%	0,0%	0,0%	0,0%	0,1%	0,1%
Ship Building and Repair	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Products Not Manufactured (V)	0,1%	0,1%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%

Source: Prepared by the authors from Aliceweb2 (2013).

The exports to China presented in Table 6 indicate 50% of these exports composed of products of low and medium-low technology and 45% of products are of high and medium-high technology.

Table 6 – Brazilian exports of industrial subsectors arising from China by technological intensity (share %) 1999 – 2009

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
CurrentValues (US$Million)	**106**	**198**	**413**	**510**	**1.164**	**948**	**2.054**	**2.216**	**2.363**	**4.216**	**4.131**
High-Tech Industry (I)	**7,4%**	**26,3%**	**16,0%**	**5,8%**	**2,9%**	**7,2%**	**11,5%**	**16,3%**	**17,5%**	**20,2%**	**28,0%**
Aeronautics and Aerospace	0,0%	18,7%	9,2%	0,0%	0,7%	3,7%	0,8%	0,3%	1,5%	5,8%	8,5%
Pharmaceutics	0,3%	2,3%	0,8%	0,9%	0,3%	0,3%	0,5%	0,5%	0,7%	0,4%	0,5%
Office & Computer	0,3%	0,1%	0,2%	0,1%	0,0%	0,1%	0,2%	0,2%	0,2%	0,1%	0,1%
Equipment Radio, TV and Communication	4,9%	3,3%	4,8%	3,5%	1,3%	2,1%	0,0%	0,0%	0,0%	0,0%	0,0%
Medical Optical and Precision Instruments	1,9%	2,0%	1,0%	1,3%	0,6%	1,0%	10,1%	15,2%	15,1%	13,9%	18,9%
Medium-HighTechnology Industry (II)	**56,9%**	**45,1%**	**61,1%**	**56,8%**	**44,1%**	**43,0%**	**10,7%**	**8,5%**	**7,5%**	**6,3%**	**3,5%**
Machinery, Equipment and Electrical Equipment	2,3%	2,2%	6,2%	8,1%	2,7%	3,1%	9,8%	7,5%	6,6%	5,4%	2,7%
Motor Vehicles and Semitrailers	5,0%	6,5%	34,7%	26,3%	26,2%	20,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Chemicals, Excl. Pharmacists	31,1%	23,2%	5,7%	9,7%	7,8%	7,8%	0,4%	0,6%	0,4%	0,4%	0,3%
Railroad Equipment and Transport Equipmentn.e.	0,0%	0,0%	0,0%	0,0%	0,2%	0,0%	0,5%	0,3%	0,4%	0,4%	0,4%
Mechanical Machinery and Equipment	18,4%	13,3%	14,5%	12,6%	7,1%	12,1%	0,0%	0,1%	0,1%	0,1%	0,1%
Low-Tech Industry (III)	**17,6%**	**11,3%**	**9,0%**	**10,8%**	**8,1%**	**15,4%**	**40,6%**	**24,3%**	**25,8%**	**26,1%**	**21,9%**
Food, Beverages and Tobacco	8,6%	3,8%	3,8%	3,5%	2,8%	11,4%	9,8%	10,1%	16,9%	22,2%	13,4%
Wood and Wood Products, Pulp and Paper, Printing	8,3%	6,8%	4,4%	6,5%	4,8%	3,2%	1,5%	1,8%	1,3%	0,8%	0,8%
Textiles, Leather and Footwear	0,3%	0,3%	0,3%	0,5%	0,3%	0,4%	5,4%	7,7%	4,8%	1,9%	1,0%
Manufactures Not Specified	0,4%	0,3%	0,5%	0,3%	0,1%	0,5%	23,9%	4,7%	2,8%	1,3%	6,8%
Medium-Low-Technology Industry (IV)	**18,1%**	**16,9%**	**13,5%**	**26,6%**	**44,8%**	**33,7%**	**30,5%**	**41,5%**	**39,8%**	**43,8%**	**35,5%**
Rubber and Plastic Products	1,7%	0,8%	0,5%	1,3%	1,1%	1,2%	0,4%	0,5%	0,8%	0,4%	0,3%
Metallic Products	12,6%	12,4%	10,4%	22,3%	42,8%	30,7%	28,1%	40,0%	38,4%	42,3%	34,1%
Other Non-Metallic Mineral Products	3,7%	3,6%	2,6%	3,0%	0,7%	0,9%	0,8%	0,0%	0,0%	0,0%	0,1%
Refined Petroleum Products and Other Fuels	0,0%	0,0%	0,0%	0,0%	0,1%	1,0%	0,2%	0,2%	0,2%	0,1%	0,3%
Ship Building and Repair	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	1,1%	0,8%	0,5%	0,8%	0,6%
Products Not Manufactured (V)	0,1%	0,5%	0,4%	0,1%	0,2%	0,7%	6,7%	9,4%	9,4%	3,6%	11,1%

Source: Prepared by the authors from Aliceweb2 (2013).

Among the main products exported to China, we can highlight the "Metallic Products" with an average of 28% and "Food, beverages and tobacco" with 10% of share in the total exports. The significant increase in Chinese demand for metallurgical products can be explained by the high investments in infrastructure and construction in this country which have had rapid demographic growth and the growth of the production of capital and durable consumer goods, which were driven by greater export (PUGA, 2005). In order to determine that subsectors/industries are more dynamic, first, we must estimate the elasticities of exports, the variables were transformed into logarithms. The explanatory variables for the estimation of income and price elasticities of exports are: (*a*) the logarithm of the lagged dependent variable (X_{Mcht}), where (X_{Mcht}) are the exports of manufactured products (*M*) to China (i) trading partner in period (*t-1*); (*b*) the logarithm of China's GDP (i), (Z_{ch}), weighted by the share of exports of each subsector/industry in total manufacturing exports ($X_{Mch(t-1)}$) in the period, representing the share of income directed to each subsector/industry; (*c*) the logarithm of the real exchange rate ($p^f_{MCht}+E_{MCht}-p_{MCht}$) weighted by the relative share of exports of each subsector/industry in total manufacturing exports in the period; and, finally (*d*), the error term.

$$lnX_{M_{Ch_t}} = \beta lnX_{M_{Ch(t-1)}} + \varepsilon_M lnz_{M_{Ch_t}} + \eta_M ln(p_{M_{Ch_t}} + E_{M_{Ch_t}} - p_{M_{Br_t}}) + u_{M_{Ch_t}} \quad (7)$$

In this way, generalized for twenty equations, it is possible to obtain the parameters (M) and which represent, respectively, the price and income elasticities of demand for exports for each subsectors.

Analogously to what was done to the calculation of income and price elasticities of exports we can formulate the generic equation for estimation of income and price elasticities of imports of various subsectors:

$$lnM_{M_{Ch_t}} = \beta lnM_{M_{Ch(t-1)}} + \pi_M lny_{M_{Br_t}} + \Psi_M ln(p_{M_{Ch_t}} + E_{M_{Ch_t}} - p_{M_{Br_t}}) + u_{M_{Ch_t}} \quad (8)$$

Thus the above equation represents a generalization of twenty equations that were estimated in order to obtain the parameters (Ch) and it represents respectively the price and income elasticities of demand for imports of the various sectors.

The estimation results were obtained from the GMM-System method, since this methodology takes into account the heterogeneity of individual Brazilian states, correlation between the explanatory variables and the unobserved effects through internal instruments and generating more robust estimates to withdraw intrinsic endogeneity problems.

Although considering that the results are for a small sample we had make econometric estimations using the "Small" tool in Stata 12, which performs the correction of the standard errors for small samples.

The estimated results are presented in Tables 7, 8 and 9. In all estimations the GMM-System model proved to be effective in eliminating the dynamic panel bias, since the Arellano-Bond test did not reject the null hypothesis of no second order autocorrelation, but rejected the first order autocorrelation. The Hansen and Sargan tests not rejected the hypothesis that the instruments are valid. Finally, the difference-Hansen test does not reject the exogeneity hypothesis of the additional instruments. Thus, the estimates are efficient and consistent. The subsectors with higher ratios of elasticities are those with comparative advantages in the bilateral relationship with China, so it can boost GDP growth of the country when they are stimulated. It is the most dynamic sectors and should be most encouraged by the public sector.

In the Table 7 three subsectors had the highest ratios (income elasticity of exports / income elasticity of imports) which are classified as being of low technological intensity: "Manufactures and Recycled Goods", "Textiles, Leather and Footwear" and "Food, Beverages and Tobacco".

Table 7 – Estimates of income elasticities of subsectors of manufacturing industries: ratio of elasticities greater than one

$\left(\frac{\varepsilon}{\pi}\right)>1$				
Subsector	**$\varepsilon^{1,2}$**	**$\pi^{1,2}$**	**ε/π**	**Technological intensity**
Manufactures not specified	0,727 (0,013)*	0,256 (0,126)*	2,830	Low
Textiles, leather and footwear	0,700 (0,015)*	0,272 (0,152)*	2,573	Low
Food, beverages and tobacco	0,680 (0,041)*	0,294 (0,119)**	2,312	Low
Machinery, Equipment and Electrical Equipment n.e.	0,654 (0,024)*	0,352 (0,127)*	1,857	Medium-High
Equipment Radio, TV and Communication	0,706 (0,011)*	0,452 (0,096)**	1,561	High
Office & Computer	0,689 (0,013)*	0,457 (0,125)*	1,507	High
Products not manufactured	0,738 (0,012)*	0,501 (0,119)*	1,473	No industrial
Wood and Wood Products, Pulp and Paper, Printing	0,657 (0,036)*	0,459 (0,084)*	1,431	Low
Chemicals, Excl. Pharmacists	0,701 (0,036)*	0,514 (0,119)**	1,363	Medium-High
Pharmaceutics	0,742 (0,024)*	0,564 (0,134)*	1,315	High
Medical Optical and Precision Instruments	0,699 (0,014)*	0,618 (0,146)*	1,131	High
Mechanical Machinery and Equipment n.e.	0,651 (0,026)*	0,615 (0,111)*	1,058	Medium-Low

Source: Prepared by the authors from Stata12.
(1) Robust standard errors in parentheses.
(2) * Significant at 1%; ** Significant at 5%.

Note that when the ratio of the elasticities was greater than 1.5, the subsectors of low technological intensity prevailed, but when the ratio was found between 1 and 1.5, the predominant subsectors are High and Medium-High technological intensity. So these are the most important subsectors, that is, it can contribute to overcoming the external constraint of the country.

Now, Table 8 presents the sectors in which the ratio of the elasticities (income elasticity of exports/income elasticity of imports) is less than 1 and greater than zero. In terms of technological intensity, these sectors are mainly Medium-Low technological intensity.

Table 8 – Estimates of income elasticities of sub-sectors of manufacturing industries: ratio of elasticities greater than zero and less than one

$\left(\frac{\varepsilon}{\pi}\right)<1$				
Subsectors	**$\varepsilon^{1,2}$**	**$\pi^{1,2}$**	**ε/π**	**Technological Intensity**
Rubber and plastic products	0,675 (0,025)*	0,742 (0,103)*	0,909	Medium-Low
Motor vehicles and semitrailers	0,426 (0,064)*	0,546 (0,098)*	0,780	Medium-High
Refined petroleum products and other fuels	0,718 (0,005)*	0,927 (0,053)***	0,774	Medium-Low

Source**:** Prepared by the authors from Stata12.
(1) Robust standard errors in parentheses
(2) * Significant at 1%; *** Significant at 10%.

Table 9 – Estimates of income elasticities of sub-sectors of manufacturing industries no robust statistical results

Subsectors	$\varepsilon^{1,2}$	$\pi^{1,2}$	ε/π	Technological Intensity
Metallic Products	0,0009 (0,000)*	0,010(0,005)*	0,090	Medium-Low
Ship Building and Repair	-0,304 (1,169)***	0,281 (0,239)*	-1,081	Medium-Low
Other Non-Metallic Mineral Products	0,660 (0,017)*	0,498 (0,115)*	1,322	Medium-Low
Railroad Equipment and Transport Equipment n.e.	0,753 (0,016)*	0,584 (0,189)***	1,289	Medium-High
Aeronautics and Aerospace	-	-	-	High

Source: Prepared by the authors from Stata12.
(1) Robust standard errors in parentheses
(2) * Significant at 1%; *** Significant at 10%.

In short, through the "Multisectoral Thirlwall's Law" the dynamic sectors were those with a ratio of elasticities greater than one, but those are not necessarily dynamic in the sense of Kaldor-Verdoorn.

Note that Thirlwall does not take into account the product elasticity of employment in sub-sectors or branches of the Brazilian manufacturing industry. Thus, we intend to estimate the income elasticity of employment in the various sub-sectors or branches of the Brazilian manufacturing industry in order to identify which are the sectors most important in creation job, increased productivity and economic growth of the country in the relation with the Chinese economy.

According to Kaldor (1988) the manufacturing industry is the engine of economic growth. So we intend to analyze the Brazilian economy in the period 1999-2009, considering the product elasticity of employment. In this way it is possible to identify which sub sectors/industries have a greater impact on growth of Brazilian states.

The source of the data used for the estimation of the equation that determine the employment of sectors of the manufacturing industry in Brazil is the Annual Industry Survey (PIA) released by the Brazilian Institute of Geography and Statistics (IBGE) for the years 1999-2009. Based on PIA, it was possible to obtain the series of employment and income for the 27 states and conjointly for the 24 subsectors of the manufacturing industry. These data were aggregated as shown in Table 10 to match exactly with the subsectors/branches estimated in Brazil-China bilateral relationship, through the OECD methodology.

Table 10 – Subsectors of the Manufacturing Industry

	Subsectors of the manufacturing industry	Aggregation
1	Manufacture of food products and beverages	Food, beverages and tobacco
2	Manufacture of tobacco products	
3	Manufacture of textiles	Textiles, leather and footwear
4	Manufacture of wearing apparel and accessories	
5	Preparation of leather and manufacture of leather goods, travel goods and footwear	
6	Manufacture of wood products	Wood and wood products, pulp and paper, printing
7	Manufacture of pulp, paper and paper products	
8	Publishing, printing and reproduction of recorded media	
9	Manufacture of coke, refined petroleum, nuclear fuel development and production of alcohol	Refined petroleum products and other fuels
10	Manufacture of chemicals	Chemicals, Excl. pharmacists
11	Manufacture of rubber and plastic	Rubber and plastic products
12	Manufacture of non-metallic mineral products	Other non-metallic mineral products
13	Metallurgy	Metallic products
14	Manufacture of fabricated metal products, except machinery and equipment	
15	Manufacture of machinery and equipment	Mechanical machinery and equipment

	Subsectors of the manufacturing industry	Aggregation
16	Manufacture of office machinery and computer equipment	Office & Computer
17	Manufacture of machinery, equipment and materials	Machinery, equipment and electrical equipment
18	Manufacture of electronic material and communication equipment and apparatus	Equipment radio, TV and communication
19	Manufacture of medical instrumentation equipment, precision instruments and optical	Medical optical and precision instruments
20	Industrial automation equipment, timers and watches	
21	Manufacture and assembly of motor vehicles, trailers and bodies	Motor vehicles and semitrailers
22	Manufacture of other transport equipment	Railroad equipment and transport equipment n.e.
23 24	Manufacture of furniture and miscellaneous products Recycling	Manufactures n.e. and recycled goods

Source**:** Prepared by the authors, 2016.

We used data of total employment (formal and informal) in each of the sub-sectors of the manufacturing industry, from data of PIA/IBGE for the calculation of the sectoral elasticities. The income elasticity of employment measures the "sensitivity" of the product due to percent changes in employment. Formally the elasticity is the ratio of the percentage change of the product the percentage change in employment, as shown below:

$$\gamma_n = \frac{\Delta Y\%}{\Delta N\%} \quad (9)$$

Assuming that there is a fundamental arithmetic relationship that is given by:

$$Y = AN \quad (10)$$

Where(Y) is the income, (N) is the employment and (A) is the labor productivity. Indeed, it follows that change in the income resulting from changes in employment and productivity:

$$\Delta Y\% = \Delta A\% + \Delta N\% \quad (11)$$

From this identity, we get:

$$\frac{\Delta Y\%}{\Delta N\%} = \frac{\Delta A\%}{\Delta N\%} + \frac{\Delta N\%}{\Delta N\%} \quad (12)$$

$$\gamma_n = \left(\frac{\Delta A\%}{\Delta N\%}\right) + 1 \quad (13)$$

$$\Delta A\% = \Delta N\% (\gamma_n - 1) = \Delta N\% (\frac{\Delta Y\%}{\Delta N\%} - 1) \quad (14)$$

$$\Delta N\% = \frac{\Delta Y\%}{\Delta N\%} = \frac{\Delta A\%}{[(\Delta Y\%/\Delta N\%)-1]} \quad (15)$$

In short, the growth in labor productivity increases income elasticity of employment. For the empirical analysis, estimations were performed again with panel data using the GMM–System, which incorporates the presence of the dependent variable (economic growth rate) and lagged explanatory variables. Equation (16) below summarizes the sixteen equations estimated for the 1999-2009 period. Thusto obtain the relevant variable, the income elasticity of employment (γ_n), it was considered the rate of income growth of the subsectors $(\Delta Y\%)_{kt}$ as the dependent variable, where (*k*) represents the sixteen sectors; and the explanatory variables are: (1) the rate of sectoral employment growth in sub-sectors of the industry $(\Delta N\%)_{kt}$; and (2) the lagged dependent variable $(\Delta N\%)_{k(t-1)}$.

$$\Delta Y\% = \beta (\Delta Y\%)_{k(t-1)} + \gamma_n (\Delta N\%)_{kt} + u_i \quad (16)$$

Thus the estimates were made assuming that the increase in the rate of employment growth in sub-sectors of the manufacturing industry affects output growth of these subsectors and hence the economy as a whole.

The empirical analysis sought to identify the impact of changes in rates of employment growth of the sixteen sectors/branches of industry on the growth rate of these sectors. The results suggest a direct relationship between the variables in the long run.

All estimates were considered suitable for the results of the Arellano-Bond autocorrelation tests, Hansen test for the validity of instruments and the test for exogeneity of the additional instruments (Hansen-Difference).

Analyzing the estimation results, it is possible noted that most sectors showed a positive change in income elasticity of employment, indicating the dynamic sub sectors which increase the level of employment and productivity growth.

For purposes of analysis, let us consider Table 11:

Table 11 – Classification of sectors regarding dynamism

Elasticities Ratio Income Elasticity of Employment	$\left(\frac{\varepsilon}{\pi}\right) \leq 1$	$\left(\frac{\varepsilon}{\pi}\right) > 1$
$(\gamma_n \leq 1)$	Non-Dynamic Industry	Dynamic Export Industry in the Thirlwall Sense
$(\gamma_n > 1)$	Dynamic Export Industry in the Verdoorn- Kaldor Sense	Dynamic Export Industry in the Verdoorn-Kaldor -Thirlwall Sense

Source: Prepared by the authors

The Table 11, denotes that a subsector of the industry is classified as "not dynamic" when the ratio of the elasticities is less or equal to one $(\varepsilon/\pi) \leq 1$ and the income elasticity of employments less or equal to one $(\gamma_n \leq 1)$. If the Brazilian economy was exporting products just from this subsector (concentrating their exports in this subsector), being the exports larger than imports $(X_n > M_n)$, we have a scenario in which besides the subsector does not to contribute significantly to the country's growth does not generate jobs.

The subsector of the export industry is "dynamic in External Sector" (in the sense of Thirlwall) when the ratio of the elasticities is greater than one $(\varepsilon/\pi) > 1$, but the income elasticity of employment is less or equal to one $(\gamma_m \leq 1)$, this subsector is capable of generating positive trade surpluses, but without the greater capacity to generate new jobs. If the Brazilian economy was exporting products just from this subsector (concentrating their exports in this subsector) being the exports larger than imports $(X_e > M_e)$ we have a scenario in which the sub-sector contributes significantly to the country's growth, but employment generation is low.

If a sub-sector presents income elasticity of employment greater than one $(\varepsilon/\pi) \leq 1$, but does not provide a elasticity ratio less or equal to one $(\varepsilon/\pi) \leq 1$, it means that this subsector is "Dynamic in KaldorVerdoorn Sense". Indeed, if the Brazilian economy mainly exported products from this subsector, while not contributing significantly to the export-led growth of the country, the sub-sector contributes to employment generation.

Now, the subsectors that showed the elastiticity ratio greater than one $(\varepsilon/\pi) > 1$ and also the income elasticity of employment greater than one $(\gamma_n > 1)$ are considered "dynamic in the sense Verdoorn-Kaldor-Thirlwall", because it have business advantages, creates new jobs and increases productivity of the economy. If the Brazilian economy is exporting products just from this subsector (concentrating their exports in this sub-sector), being exports greater than imports $(X_t > M_t)$**,** we have a scenario in which the sub-sector contributes significantly to the growth driven by country exports, and contribute to job creation and increase of productivity.

In short, Table 12 shows the classification of manufacturing industry sub-sectors. The results indicate that 18% of the exports of the manufacturing sector are concentrated in the most dynamic subsectors, in the sense of Verdoorn-Kaldor-Thirlwall. This value is high, but the new law says that the country should increase this percentage concentrating their exports in these subsectors.

The dynamic sectors in the sense of the Kaldor-Verdoorn and of the Thirlwall concentrated together 43 % of exports. To become active and contributing significantly to the strategy of export-led growth these sectors need to be further stimulated by the public sector. For the betterment of the country's growth strategy, we should perform a change in the production structure which is associated with the development of a new pattern of specialization of the country's industry. Indeed, we believe that it is possible move the economy to a sustainable strategy, with one more presence in the foreign market in the medium and long term.

Table 12 - Classification of Manufactured Industry Subsectors

	Subsectors	Elasticities ratio	Income Elasticity of Employment	Share in Total of Export	Share in Total of Imports	Commercial Trade of Subsector: Share of Exports in Total	Commercial Trade of Subsector: Share of Imports in Total	Share in Total of Employment	Share in Total of Production	Technological Intensity	Classification
1	Textiles, leather and footwear	2,57	2,30	1,9%	10,2%	10,3%	89,7%	19,3%	6,1%	Low	Dynamic export industry in the Verdoorn-Kaldor-Thirlwall sense
	Food, beverages and tobacco	2,31	2,13	9,7%	0,4%	45,9%	54,1%	20,3%	20,6%	Low	
	Mechanical machinery and equipment	1,06	1,37	7,0%	8,9%	18,7%	81,3%	6,4%	5,8%	Medium-Low	
	Sum (1)			*18,6%*							
2	Motor vehicles and semitrailers	0,78	6,50	10,7%	0,7%	50,4%	49,6%	5,9%	10,9%	Medium-High	Dynamic export industry in the Verdoorn- Kaldor sense
	Sum (1 + 2)			*29,4%*							
3	Manufactures n.e. and recycled goods	2,83	0,43	3,6%	5,0%	27,3%	72,7%	4,9%	1,7%	Low	Dynamic export industry in the Thirlwall sense
	Machinery, equipment and electrical Equipment	1,86	0,18	5,2%	10,0%	19,0%	81,0%	2,9%	2,7%	Medium-High	
	Equipment radio, TV and communication	1,56	0,30	1,7%	24,3%	72,6%	27,4%	1,5%	3,3%	High	
	Office & computer	1,51	0,42	0,6%	9,6%	0,7%	99,3%	0,5%	0,9%	High	
	Wood and wood Products, pulp and paper, printing	1,43	0,23	3,6%	0,5%	16,0%	84,0%	9,3%	6,6%	Low	
	Chemicals, excl. pharmacists	1,36	0,15	7,9%	11,3%	13,4%	86,6%	5,2%	12,6%	Medium-High	
	Medical optical and precision instruments	1,13	0,64	7,4%	6,1%	69,6%	30,4%	1,1%	0,7%	High	
	Other Non-metallic Mineral products	1,32	0,26	1,5%	1,2%	22,9%	77,1%	5,4%	3,1%	Medium-Low	
	Railroad equipment and transport equipment n.e.	1,29	0,68	0,6%	1,3%	5,7%	94,3%	1,2%	2,1%	Medium-High	
	Sum (1 + 2 + 3)			*61,5%*							
4	Refined petroleum Products and other fuels	0,77	0,06	0,1%	0,3%	49,9%	50,1%	1,7%	7,7%	Medium-Low	Non-dynamic Industry
	Metallic products	0,09	0,17	28,5%	4,2%	71,2%	28,8%	9,5%	11,8%	Medium-Low	
	Rubber and plastic products	0,91	0,76	0,7%	2,1%	14,7%	85,3%	4,9%	3,5%	Medium-Low	
	Sum (1 + 2 + 3 + 4)			*90,8%*							
5	Products not manufactured	1,47	NA	3,7%	0,0%	84,4%	15,6%	NA	NA	Non industrial	Unclassified
	Pharmacists	1,32	NA	0,6%	4,0%	12,9%	87,1%	NA	NA	High	
	Ship building and repair	-1,08	NA	0,4%	0,0%	0,7%	99,3%	NA	NA	Medium-Low	
	Aeronautics and aerospace	NA	NA	4,5%	0,0%	97,3%	2,7%	NA	NA	High	
	Sum (1 + 2 + 3 + 4 + 5)			*100,0%*							

Source: Prepared by the authors, 2016.