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Comparing the Economic Structure and Carbon Dioxide Emission between China and Vietnam

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Abstract: The object of this study is to compare the economic structure through the intersectoral structure of the two economies, Vietnam and China. This research shows differences in levels of economic structure and induced impacts on output, value added, import, energy requirement and emissions of dioxin carbon in producing a final product unit. It also gives an overall picture of economy to help policy makers to make the best decisions for the economy and the environment. we find that on the surface, it seems that the economic structure of Vietnam and China have a lot of similarities, but when looking deeper into the economy, it shows difference between two economies, the economic structure of China has intersectoral linkage indexes better than these indexes of Vietnam, but Manufacturing industry in China has a high level of CO₂ emission, which shows that the current technology cannot suffice for waste disposal. It also recommends that the countries attracting FDI from China should have a strict check for waste treatment.

Keywords: China; Input – Output; Linkage Index; Structure; Vietnam.

JEL Classifications: I31; C43; D57; L60.

1. Introduction

Vietnam and China have the same culture of heavy ritual formality, appearance sometimes is more important than the content. At first glance some general economic indicators of Vietnam and China also have similarities such as: GDP per capita growth in 5 years of China (45,8%) and Vietnam (36,3%) into the world's top team¹, the share of manufacturing output in gross output of Vietnam is about 52% while this ratio of China is about 54%; Proportion of value added in gross value added to Vietnam and China are 38% and 34% Intermediate input ratio on the gross input of Vietnam and China also nearly identical, these ratios are 69% of the VN and China's 66%. However, in recent years the share of final consumption to GDP of Vietnam higher than this ratio of China (71% compare with 51%), while, the share of gross capital formation to GDP of China higher this ratio of Vietnam (46% compared with 32%) (Table 1).

To better understand the depth of structural between the Vietnam and China's economy, this research analyzes how linkages among economic sectors of two countries. It also aims at identifying which economic sectors exhibited the highest intersectoral linkages of Vietnam and China economy. It also shows the relationship between the final demand to production, value added, import requirement, demand for energy and CO₂ emissions of two economies of Vietnam and China.

Table-1. General Structure of the two economies Vietnam and China in 2012

	Vietnam	China
Ratio of intermediate input / Gross input	0.69	0.66
Ratio of intermediate demand / Gross output	0.60	0.50
Ratio of final consumption / Gross Output	0.31	0.34
Ratio of gross capital formation / Gross output	0.101	0.155
Ratio of net export /Gross Output	-0.006	0.009
Ratio of final consumption/GDP	0.70	0.51
Ratio of gross capital formation /GDP	0.32	0.46
Ratio of net export /GDP	-0.02	0.03

Source: Calculate from input – output tables of National bureau of Statistics of China and General Statistics Office Of Vietnam, 2012 (<http://www.stats.gov.cn/english> and www.gso.gov.vn)

¹Source: IMF World Economic Outlook Database

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This article applied the input – output system in order to measure the inter-industrial structure in the economy of each country. These linkage indexes was regarded as economic structure (Wassily, 1941) since then, the input-output system has been widely applied to study structure in an economy. In this research shows backward and forward linkages by sector and these linkage indexes was combination as matrix. The element of this matrix includes porwer of dispersion and sensitivity of dispersion. This matrix give a picture of economy (Guo and Hewings, 2001). The study also compared the spread of domestic final demand to output and value added of Vietnam and China.. Besides, in the study also shows to compare energy requirement and CO₂ emission for a unit final product

In Vietnam, the applications of input-output analysis to comparison the Vietnam and China's economic structure which have been discussed in Bui and Pham (2014) and To TrungThanh *et al.* (2016).

Data: This research based on the input – output tables, 2012 of Vietnam and China², these tables were moved from current price of each country to USD at rate corresponding.

The number of industries or sectors are 17 sectors as below:

Table-2. Sectors in the economy (Input – output tables)

No.	Sectors	No.	Sectors
1	Agriculture, Forestry, Animal Husbandry & Fishery	10	Other Manufacture
2	Mining	11	Construction
3	Manufacture of Foods, Beverage & Tobacco	12	Production and Supply of Electric Power, Heat
4	Manufacture of Textile, Wearing Apparel & Leather Products.	13	Transport, Storage, Post, Information Transmission, Computer Services & Software
5	Coking. Gas and Processing of Petroleum	14	Wholesale and Retail Trades, Hotels and Catering
6	Chemical Industry	15	Real Estate, Leasing & Business Services
7	Manufacture of Nonmetallic Mineral Products	16	Financial Intermediation
8	Manufacture and Processing of Metals and Metal Products	17	Other Services
9	Manufacture of Machinery and Equipment		

The direct CO₂ emission vector caused by sector, these data was compiled from report of Harvard Kennedy school – Belfer Center for science and international affairs (Zhu, 2015). In this research, these data will be used for Vietnam because Vietnam has not existed these data.

2. Methodology

The input-output tables of Vietnam and China are the competitive – import type, in this research these tables was changed from competitive import type to non-competitive import type.

The basic equation of Leontief system as follow:

$$X = (I-A)^{-1}.Y \quad (1)$$

And the equation of the input-output table at non-competitive type as below::

$$X = (I-A^d)^{-1}.Y^d \quad (2)$$

Where: $X = (X_{ij})_{(n \times k)}$ is matrix of gross output created by domestic final demand (Y^d), n is number of sectors and k is number of factors of final demand; $A = (a_{ij})$ is the matrix of technical coefficients; $A^d = (a^d_{ij})$ is the matrix of domestic technical coefficients, $Y = (Y_{ij})_{(n \times k)}$ is matrix final demand with k is number of factors of final demand with k is number of factors of final demand. $Y^d = (Y^d_{ij})_{(n \times k)}$ is matrix domestic final demand. The Leontief matrix $(I - A)$ is non-singular and I is the identity matrix Miller and Blair (1985).

Put, The matrix $B = (I - A^d)^{-1}$ is the Leontief inverse matrix.

The backward linkage $B_j = \sum_{i=1}^n B_{ij}$; it reflects the extent to which the sector's output is used by other sectors as input.

The forward linkage $B_i = \sum_{j=1}^n B_{ij}$; it shows the degree by which its production depends on the inputs from the other sectors.

Guo and Hewings (2001) explained when backward linkage increase will generate greater demand for inputs from other sectors and forward linkage increase lead to more sensitive to changes in the other sectors' output.

From these ideas the power of dispersion and sensitivity of dispersion of each sector was defined as average intensity of all sectors given by:

$$\text{Power of dispersion: } P_j = B_j.(n / T) \quad (3)$$

$$\text{Sensitivity of dispersion: } S_i = B_i.(n / T) \quad (4)$$

Where: $T = \sum B_{ij}$

²(<http://www.stats.gov.cn/english> and www.gso.gov.vn)

Combining indicators of power of dispersion and sensitivity each product to measure in an integrated manner in the relative importance of a sector to other sectors of the economy [Guo and Hewings \(2001\)](#); [Asian Development Bank, 2015](#)). This combining was defined as multiplier product matrix of Leontief system M as follow:

$$M = S.P \tag{5}$$

With: $S = (S_i)_{(n \times 1)}$ and $P = (P_j)_{(1 \times n)}$ Matrix $M = (M_{ij})_{(n \times n)}$ is seen as ‘Economic – Landscape’ at a given point in time, and shows the intersectoral structural through their power of dispersion and sensitivity of dispersion.

On the other hand, this research apply input – output system in order to calculate impacts of final product to value added, energy and CO₂ emission as below:

$$V = v. (I-A^d)^{-1}. Y^d \tag{6}$$

$v = (v_j)_{(1 \times n)}$ is coefficient vector with $v_j = V_j/X_j$. Vector $(v. (I-A^d)^{-1})$ shows value added created by unit of domestic final demand and V is value added vector created by domestic final demand

$$E = e. (I-A^d)^{-1}. Y^d \tag{7}$$

e is coefficient vector of element of energy vector and corresponding element of gross output vector. Vector $(e. (I-A^d)^{-1})$ shows energy requirement for unit of domestic final demand.

And:

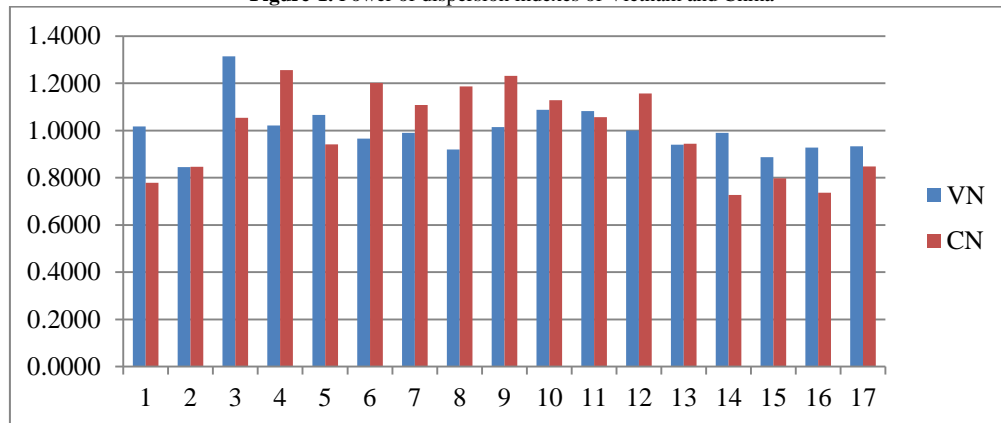
$$C = c. (I-A^d)^{-1}. Y^d \tag{8}$$

c is direct CO₂ emission vector caused by sector, these data was compiled from ‘China’s emission report 2015’ Harvard Kennedy school – Belfer Center for science and international affairs (Zhu Liu). In this research, these data will be used for Vietnam because Vietnam has not existed these data. So, $(c. (I-A^d)^{-1})$ is vector of total impact on CO₂ emission created by unit final used.

3. Empirical Results

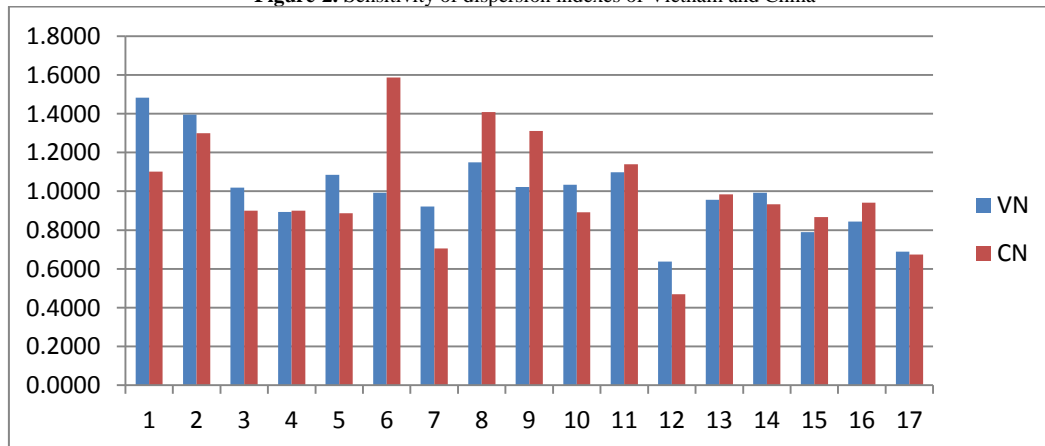
The goal of sector structure analysis is to identify the sectors that generate an above-average impact on the economy either when they expand, or as a result of changes in the other sectors [Sonis and Hewings \(1999\)](#), [Asian Development Bank \(2015\)](#). The power of dispersion and sensitivity of dispersion of Vietnam and China are very difference, some sectors can be key sectors of Vietnam economy and other some sectors are key sectors of China [\(Figure 1, 2 and Table 1\)](#).

Figure-1. Power of dispersion indexes of Vietnam and China



Note: VN: Vietnam, CN: China

Figure-2. Sensitivity of dispersion indexes of Vietnam and China



Note: VN: Vietnam, CN: China

The sectors are important for Vietnam such as Agriculture, Forestry, Animal Husbandry & Fishery (sector number 1) and Manufacture of Foods, Beverage & Tobacco. While important sectors of China economy are

Manufacture of Textile, Wearing Apparel & Leather Products (sector number 4) and Chemical Industry (sector number 6). However, both Vietnam and China do not have any of the service sector index power and sensitivity of dispersion > 1. This shows that the whole Vietnam and China economy have not fully developed.

Table-3. Rank of power of dispersion and sensitivity of dispersion indexes for sectors more than unit

No.	Sectors	Rank of sensitivity of dispersion		Rank of power of dispersion	
		VN	CN	VN	CN
1	Agriculture, Forestry, Animal Husbandry & Fishery	1	6	6	
2	Mining	2	4		
3	Manufacture of Foods, Beverage & Tobacco	8		1	9
4	Manufacture of Textile, Wearing Apparel & Leather Products.			5	1
5	Coking, Gas and Processing of Petroleum	5		4	
6	Chemical Industry		1		3
7	Manufacture of Nonmetallic Mineral Products				7
8	Manufacture and Processing of Metals and Metal Products	3	2		4
9	Manufacture of Machinery and Equipment	7	3	7	2
10	Other Manufacture	6		2	6
11	Construction	4	5	3	8
12	Production and Supply of Electric Power, Heat				5
13	Transport, Storage, Post, Information Transmission, Computer Services & Software				
14	Wholesale and Retail Trades, Hotels and Catering				
15	Real Estate, Leasing & Business Services				
16	Financial Intermediation				
17	Other Services				

Figure 3 and 4 present economic –landscape from multiplier product matrix, these figures shown the difference in intersectoral linkage of China and Vietnam; VN economy dependent on resource extraction, while the strength of China is manufacturing sectors. The economic picture can help policy-makers select policy and appropriate policy adjustments.

Figure-3. Intersectoral structure picture for 17 sectors of Vietnam

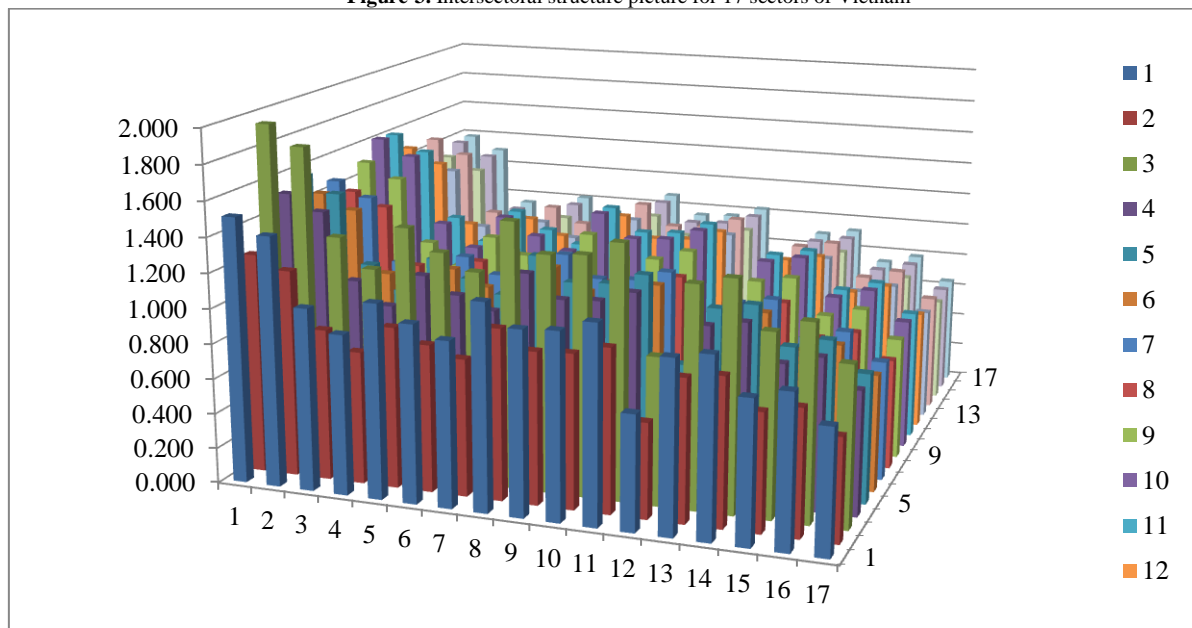
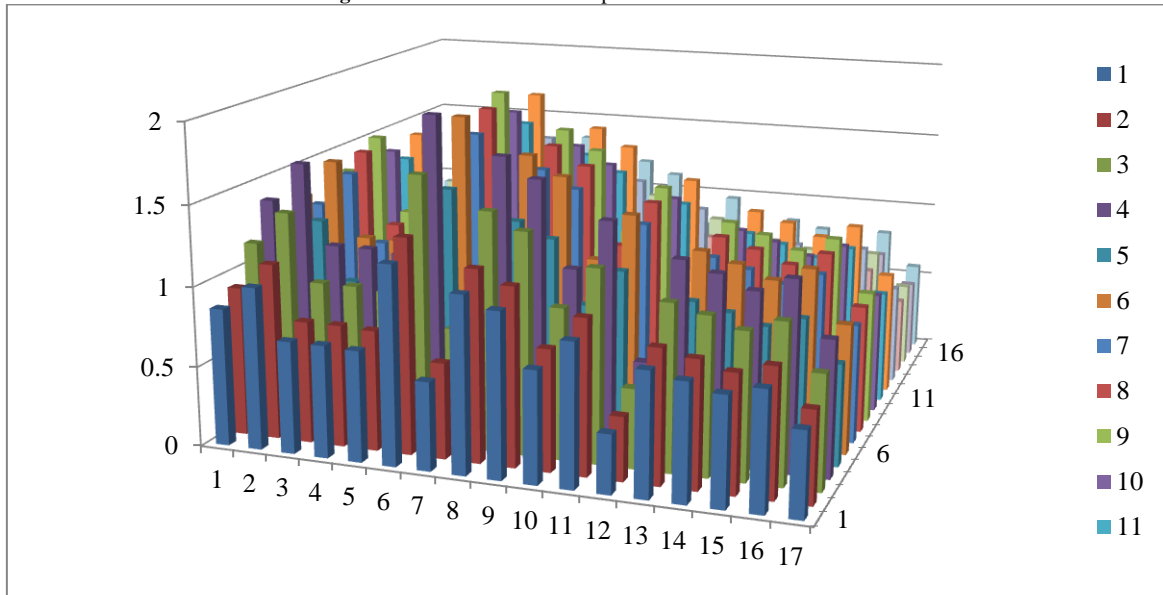
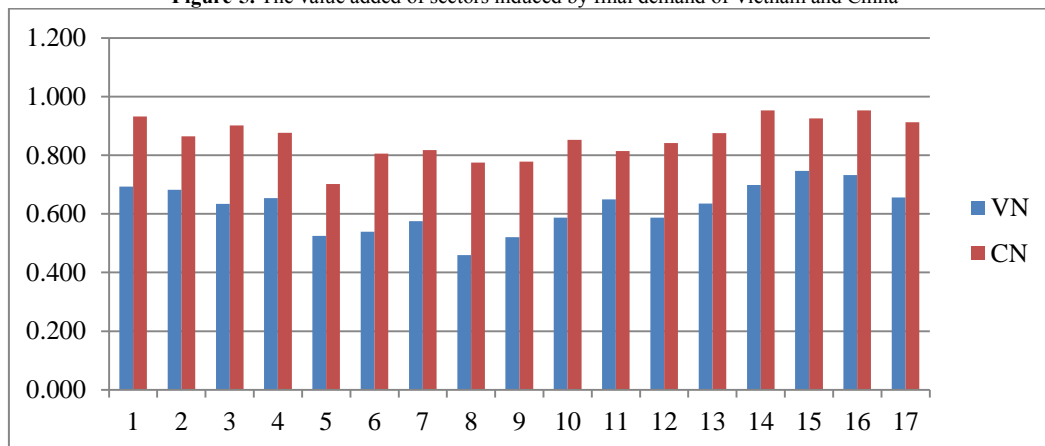


Figure-4. Intersectoral structure picture for 17 sectors of China



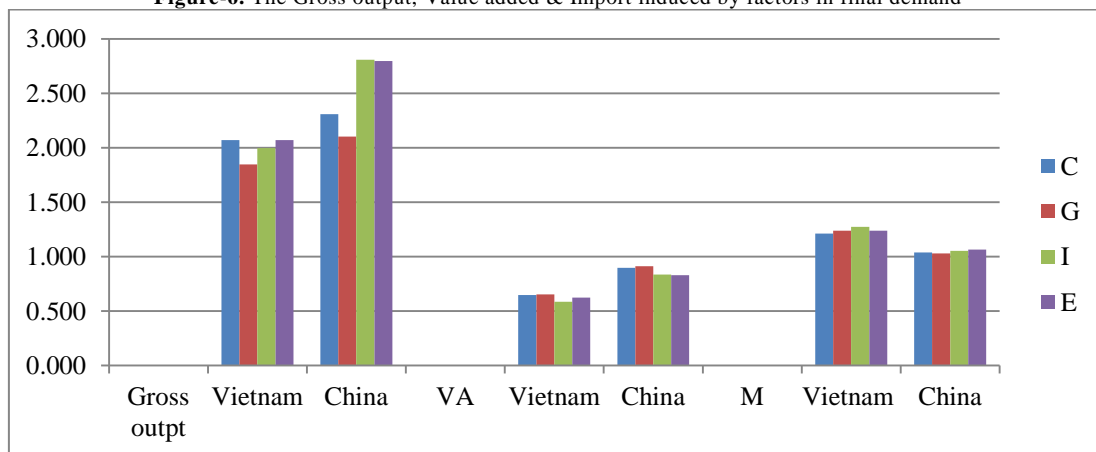
However, the power of dispersion and sensitivity of dispersion indices are about output by sectors. What the country needs is the dispersion of final demand to value added or income. Comparing the dispersion of final demand to value added or income between Vietnam and China, it shows that the dispersion of final demand to value added of China is quite higher than that of Vietnam, it means that this shows Vietnam's production is heavily processing, assembling so the value added content is low in value chain. Figure 5 also shows that most of the manufacturing industry has low the dispersion of final demand to value added.

Figure-5. The value added of sectors induced by final demand of Vietnam and China



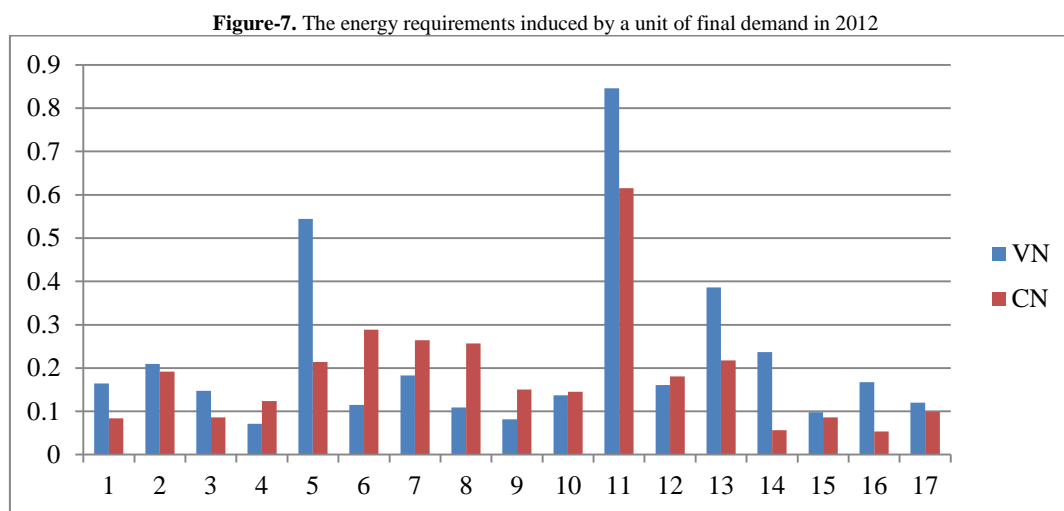
Note: VN: Vietnam, CN: China

Figure-6. The Gross output, Value added & Import induced by factors in final demand



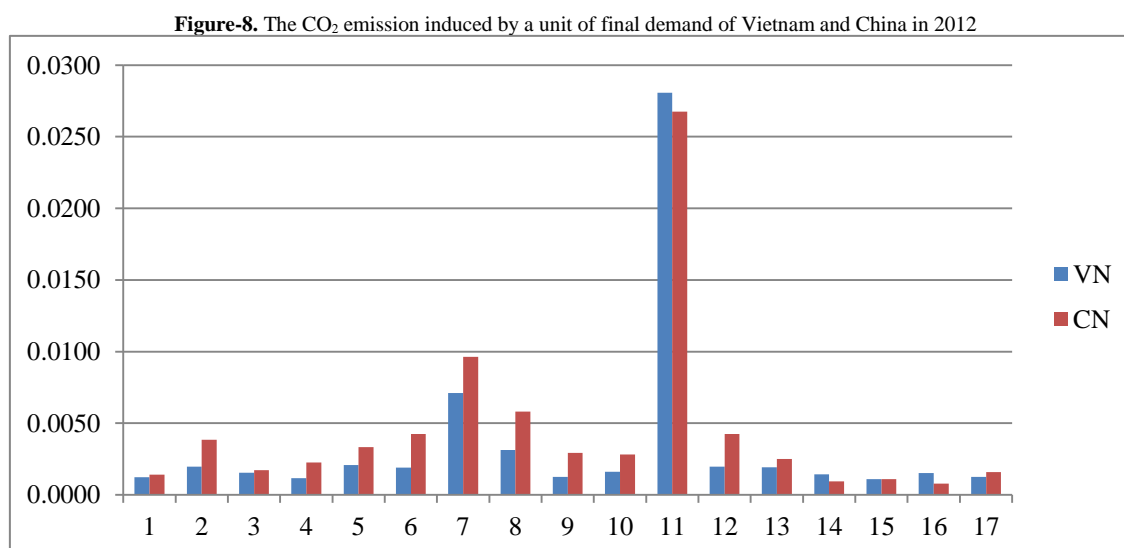
C: Final household consumption; G: Government consumption expenditure; I: Gross capital formation; E: Export, VA: Value added; M: Import

Figure 6 shows that the induced impacts by factor of domestic final demand to gross output and value added of China is significant higher than that of Vietnam, but the induced impacts by factor of domestic final demand to import of Vietnam is higher than that of China, it shows that Vietnam seems to have not any auxiliary product. The products label Vietnamese brand, but it is the fact that these products are also imported products. Notably, the final consumption of the Chinese stimulus the highest to gross output and added value in the factors of final demand, but according to data of National bureau of Statistics of China showed final consumption in China's GDP accounted only around 50% for years (Appendix 1). Thus, if final consumption of China's rise, it will affect the well on production and income (GDP). While final consumption in Vietnam's GDP is relatively high, but most of the factors of Vietnam's final demand does not spread much to value added (Appendix 2). This implies that China can continue to apply demand management policies while Vietnam should not hang around with demand management policies that need to turn to supply-side policies.



Note: VN: Vietnam, CN: China

Although the dispersion of component of domestic final demand to production and income of Vietnam is significant lower than that of China but Figure 7 shows the energy requirements induced by a unit of final demand of Vietnam is higher than that of China, with 21%. Especially, the Coking, Gas and Processing of Petroleum; Construction; Transport, Storage, Post, Information Transmission, Computer Services & Software; Wholesale and Retail Trades, Hotels and Catering; Real Estate, Leasing & Business Services sectors have the energy requirements induced by a unit of final demand that are much higher than that of China. These sectors are the reasons that made the average of energy requirements induced by a unit of final demand in Vietnam is higher than China.



Note: VN: Vietnam, CN: China

Figure 8 shows the emission (CO₂) induced by final demand of China is higher than that of Vietnam, with 26%. Almost sectors in China emit CO₂ higher than Vietnam, except construction sector. This implies that when Vietnam attracts Foreign Direct Investment (FDI) from China, Vietnam need to check the waste treatment processes strictly. It appears that the Chinese Manufacturing Industry has not been focusing in technology that practices waste treatment (CO₂).

4. Conclusions

This study attempts to present a picture of the economic structure of Vietnam and China in order to give a suggestion for overall policy. From the empirical research results, it leads to the following conclusions:

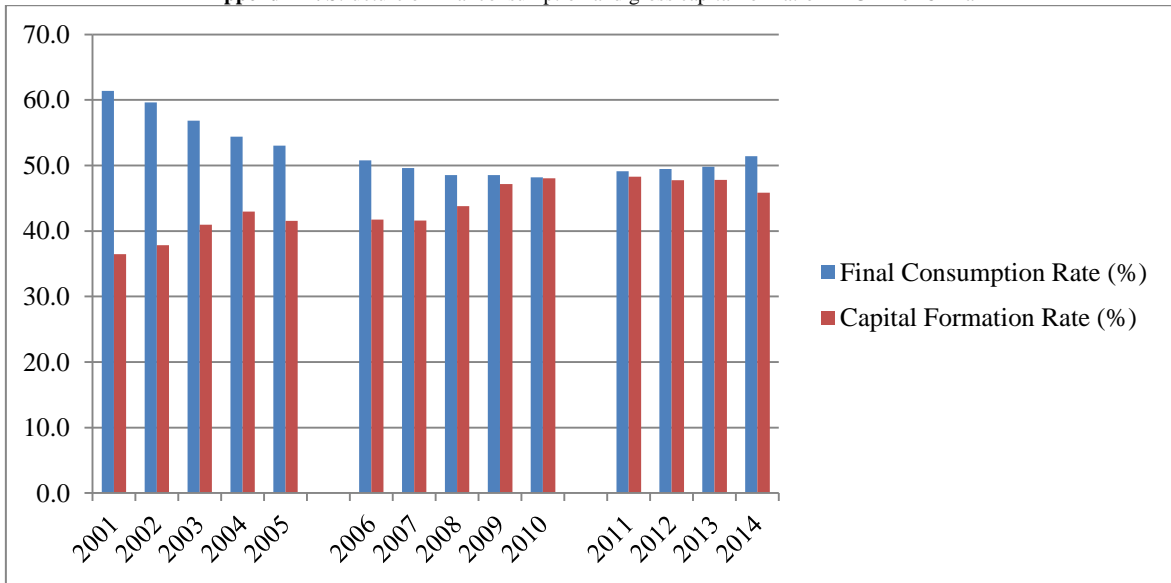
- ▶ On the surface, it seems that the economic structure of Vietnam and China have a lot of similarities. The percentage of VA versus GO Vietnam and China seem equally and these structures are similar by sectors.
- ▶ However, considering the degree of spillover from factors of final demand to output and value added of China is higher than these indexes of Vietnam. Moreover, the imports requirement induced by domestic final demand of China is lower than that of Vietnam, which means that the level of self-producing auxiliary input Chinese is much higher than Vietnam. In other words, China and Vietnam are processing countries, but China is at the higher level of processing also participates in global value chains more.
- ▶ Manufacturing industry (except manufacturing agricultural products) of Vietnam will not contribute much to Vietnam's economy; it only brings the trade deficit, pollution, and energy waste.
- ▶ Manufacturing industry in China has a high level of CO₂ emission, which shows that the current technology cannot suffice for waste disposal. It also recommends that the countries attracting FDI from China should have a strict check for waste treatment.
- ▶ Besides, looking at the economic structure and the degree of spillover from final demand to production, imports and value added between Vietnam and China, it show that China should have policies that focus on the domestic consumption to stimulate this market. It implies that China can continue to apply demand management policies while Vietnam should not hang around with demand management policies that need to turn to supply-side policies
- ▶ Note that the ratio of imported to Vietnam from China is increasing. If the 2005 rate of imports from China is about 16%, then by 2015 the proportion was 30%. Of which over 90% is imported for production. Thus can be seen VN increasingly dependent on Chinese technology, and with it the environmental risks. If VN does not change the structure of the industry will lead to not only imported goods but also imports both pollution.

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Appendices

Appendix-1. Structure of final consumption and gross capital formation in GDP of China



Appendix-2. Structure of final consumption and gross capital formation in GDP of Vietnam

