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Working Paper Series No. 2012/ 17

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Le Duc Niem<sup>1</sup>

Tay Nguyen University

<sup>1</sup> Le Duc Niem (Leniem@gmail.com), Department of Economics, Tay Nguyen University, Vietnam.

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# **Linder Hypothesis and Vertical Intra-industry Trade: An Empirical Case of Cosmetic Industry in China**

**By Le Duc Niem<sup>1</sup>**

**Tay Nguyen University**

*In this paper, we tested if country similarity positively affects the index of vertical intra-industry trade share (VIIT), given that the lower developed country is bigger in size. By using the trade data of the cosmetic industry in China, we found that VIIT is higher when China trades with a country similar in size or similar in level of economic development. This finding suggests that perhaps recent papers failed to derive any support for Linder Hypothesis because their model settings did not take the asymmetric impact of relative country size into account.*

JEL Code: F12, L13

Keywords: Linder Hypothesis, Country Similarity, and Intra-Industry Trade,

## **I. Introduction**

Intra-industry trade (IIT) was discovered in the beginning of the 1960's but until Grubel and Lloyd's work (1975), systematic investigation on this topic just began. Krugman (1979) and Lancaster (1980) are widely and typically known with seminal papers on IIT determinants. They promoted a theoretical framework associating intra-industry trade resulted from economies of scale in production and varieties of horizontally differentiated products. However, there are many arguments against this theory. Finger (1975) proved that there is a larger variation of factor intensities within industries, which then determines international trade. Torstensson (1991) provides evidence of Sweden's specialization in quality connecting closely with countries that are at different levels of per capita income. Schott (2004) finds that US imports exhibit a wide variance in unit values within product categories.

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<sup>\*\*</sup> Le Duc Niem (Leniem@gmail.com), Department of Economics, Tay Nguyen University, Vietnam.

The Linder (1961) suggested a hypothesis that countries with similar demand structures would trade more with one another. The ‘*so called*’ Linder Hypothesis has been the focus of much empirical research for decades. However, few empirical studies provide consistent evidence supporting this hypothesis.<sup>2</sup> Hallak (2010) showed that aggregation across sectors induced a systematic bias against finding support for this hypothesis, and argued that the Linder hypothesis should be formulated at the sector level, where inter-sectoral determinants of trade can be controlled for.

In this paper, the impact of country similarity on trade was tested with a control of relative country size as proposed by a theoretical model of Kim and Niem (2010)<sup>3</sup>. The cosmetic industry of China was selected to ensure the relative country size in the econometric model (defined as the ratio of trading partner’s population to Chinese population) being less than 1.

## **II. The theoretical model summary**

Kim and Niem (2010) considered a 2x2x2 model: two countries, two firms, and two varieties of goods. One country is called Home, and the other is referred to as Foreign. Home is a low-income country, and Foreign is a high-income country. Each country is assumed to have only one firm. The level of technology measured by product quality produced in Home is lower compared with the one in Foreign.<sup>4</sup> For these reasons, this model assumes trade between a developing and a developed country. The game is over two stages. In the first stage, each firm chooses the quality level of their goods such that the Foreign firm’s goods are higher in terms of quality compared with the Home firm’s goods. In the second stage, the firms compete simultaneously in price. .

The findings of Kim and Niem (2010) are summarized in the following table and figure:

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<sup>2</sup> Schott (2004), Hummels and Klenow (2005).

<sup>3</sup> This paper has been accepted by Manchester School in 2010

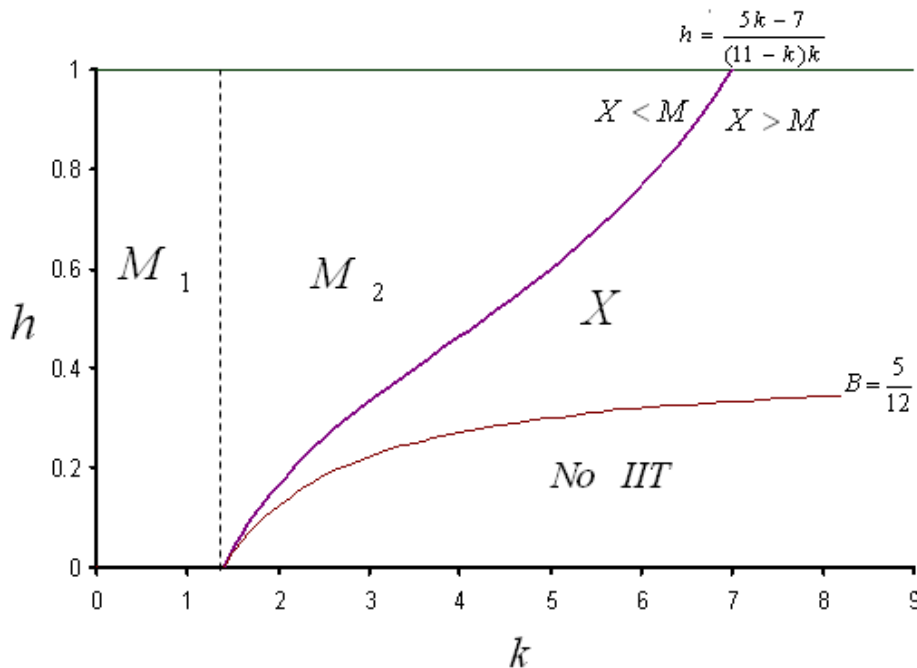
<sup>4</sup> This assumption is the same as Flam and Helpman (1987).

Table 1: *Effects of preference similarity and relative country size on the IIT index*

Area	$M_1$	$M_2$	$X$
Effects of preference similarity	$\frac{\partial IIT}{\partial h} > 0$	$\frac{\partial IIT}{\partial h} < 0$	$\frac{\partial IIT}{\partial h} > 0$
Effects of country size	$\frac{\partial IIT}{\partial k} > 0$		$\frac{\partial IIT}{\partial k} < 0$
Trade Balance	$X < M$		$X > M$

In the above table, vertical intra-industry trade index is denoted IIT. The relative country size  $k$  is defined by the ratio of Foreign population divided by Home's while economic development similarity  $h$  is measured by Home income divided by Foreign's. It is worth noting that if the country size of Home is bigger than Foreign's, an increase in  $k$  carries the meaning that the two countries are similar in terms of population. Similarly, an increase in  $h$  means the two countries are similar in terms of economic development.

Figure 1: *Preference similarity, relative country size, and the IIT index*



The above findings show that if Home is the bigger country, the Linder Hypothesis can be evidenced. For this reason, we selected China as a developing country while its trading partners serving as a developed one.

### **III. The Econometric Model**

#### *1) Trade Measurements*

In this paper, the formula of Grubel-Lloyd index (GL- index) will be used to measure IIT. The total trade in an industry is called volume of trade or the sum of export value and import value ( $X + M$ ). The total trade consists of two components: intra-industry trade (IIT) and inter-industry trade. Inter-industry trade is defined by the absolute difference between export value and import value and intra-industry trade is defined by the difference between total trade and inter-industry trade. Thus,  $IIT_i = (X_i + M_i) - |X_i - M_i|$  where  $X_i$  and  $M_i$  are the export value and import value of industry  $i$ . The GL-index is defined as the share of IIT in the total trade in an industry and expressed as:

$$IIT_i = 1 - \frac{|X_i - M_i|}{X_i + M_i} \quad (1)$$

The export  $X_i$  and import  $M_i$  are calculated at four digit level of the SITC classification by the summings-up of exports or imports of all good items within the industry.

#### *2) Measure Vertical Intra-industry Trade Index*

To decompose total IIT into vertical IIT and horizontal IIT, unit value is popularly used as an indirect way to measure quality level of goods in most of empirical studies. Up to now, unit value seems to be the best means to evaluate good quality in trade data (Abd-el-Rahman, 1991; Greenaway, Hine and Milner, 1994).

In this paper, trade flows are classified as horizontal IIT when the spread in the unit value of exports to the unit value of imports is less than 15% at the four-digit SITC (Standard Industrial Trade Classification) level. If relative unit values are outside this range, products are considered as vertically differentiated.

$$IIT = VIIT + HIIT \quad (2)$$

Following the above methodology, the unit value index (UV) is calculated for exports and imports of the cosmetic industry of China at the four-digit level of the SITC. Horizontal and vertical IIT are defined based on the ratio between unit value of exports  $UV_i^X$  and the unit value of imports  $UV_i^I$ . More specifically, horizontal IIT is calculated by following formula:

$$0.85 \leq \frac{UV_i^X}{UV_i^I} \leq 1.15 \quad (3)$$

When the unit value index (UV) was outside the +/-15% range, vertical IIT is defined for this industry. The vertical IIT is further broken down into two dependent shares of V1 and V2 using the following condition:

$$V_1 : \frac{UV_i^X}{UV_i^I} > 1.15 \quad \text{or} \quad V_2 : \frac{UV_i^X}{UV_i^I} < 0.85 \quad (4)$$

Formula (4) implies that V1 is the exports and imports of goods such that the export goods have higher quality compared with the import goods. Similar, V2 is trade flows of goods whose export goods have lower quality than that of import goods.

### 3) Regression Model:

$$VIIT_{Cjt} = \alpha_0 + \alpha_1 ABI_{Cjt} + \alpha_2 RI_{Jct} + \alpha_3 RCS_{Jct} + \varepsilon_{jt} \quad (5)$$

Where:

$VIIT_{Cjt}$  : Vertical IIT between China and j country in year t.

$ABI_{Cjt}$  : Weighted per- capita income of China and J country by weights of country sizes, used as proxy for development level of both countries in year t.

$RI_{Cjt}$  : Relative per-capita income by dividing Chinese per-capita income with that of J partner, used as a proxy for country similarity in economic development in year t.

$RCS_{jCt}$  : Relative country size between j country and China measured by relative population in year t.

Based on the findings derived in part II of this paper, we expect the signs of our regression coefficients as follows:

- $\alpha_1 > 0$  : Regional development has positive impact on VIIT.
- $\alpha_2 > 0$ : Similarity in country development increases VIIT.
- $\alpha_3 > 0$ : VIIT is higher in trade with a similar-sized country.

#### 4) *Countries under Consideration*

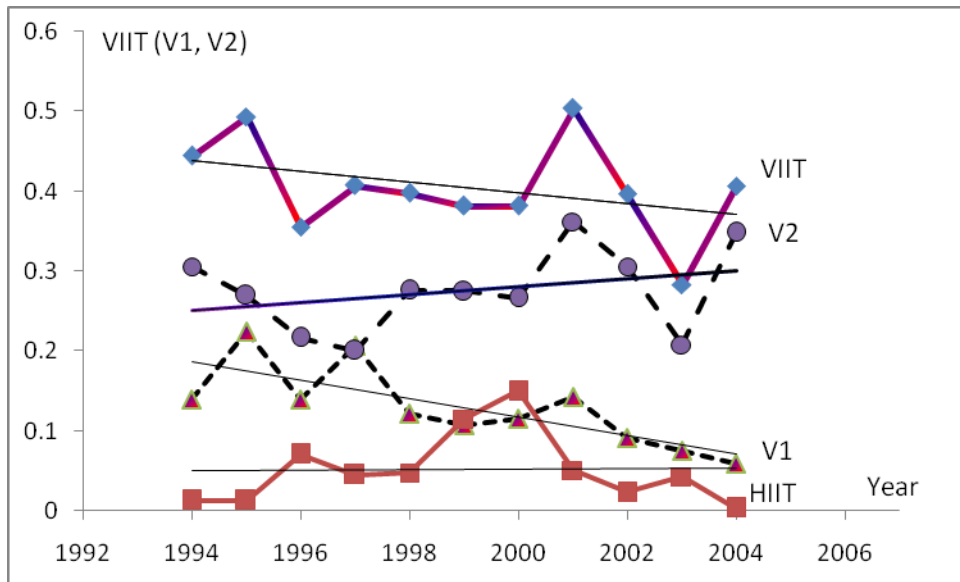
Because China is a large country in terms of population, we consider China as the low-income country as in part II of this paper. The trading partners under consideration need to be high-income and relatively small in population. Based on the availability of trade data, we derived 14 representative countries (or autonomous zones) including Korea, Canada, Australia, France, England, Singapore, Italy, Spain, Netherlands, Hong Kong, Taiwan, Japan, USA, and Germany to be considered as trading partners of China.

#### 5) *Data*

The official trade statistics of OECD is the main source for trade data (from 1994 to 2004) to calculate trade indices. Other variables are obtained on internet at ERS (Economic Research Service<sup>5</sup>) for per-capita income by countries and IDB (International Data Base<sup>6</sup>).

**IV. Findings and Discussions:**

As showed in figure 2, vertical IIT captures the main share of total IIT in the cosmetic industry of China but it tends to decrease from 1994 to 2004. An interesting fact is that the share of low-quality export is increasing while that of high-quality export tends to decrease over time. This phenomenon can be explained by the export-oriented strategy of China that stimulates firms to produce cheap goods for exportation.



Source: OECD data

**Figure 2:** *Intra-industry Trade in Cosmetic Industry of China*

*1) Regression Analysis*

<sup>5</sup> <http://www.ers.usda.gov/>

<sup>6</sup> <http://www.census.gov/ipc/www/idb/country.php>



Actually, we do not have a complete theoretical model for all determinants of intra-industry trade. As a result, there may be some relevant variables which are excluded from the model. In addition, the countries under consideration are selected based on the availability of trade data. To cope with this fact, we split our study into two parts. The former involves tests of IIT determinants with roughly calculated data and the later regards “fixed effect model” with transformed data.

*i) Regression Analysis 1*

In this section, we assume that cross-sectional heterogeneity is not high and that the econometric model presented in this paper well includes all relevant independent variables of VIIT. This assumption is relatively strong and we will relax it later in the next analysis.

In order to investigate relationships between trade dependent and explanatory variables, we refer to the regression analysis 1. In this setting, vertical IIT, V1, and V2 are, one by one, put in the regression model as explained variable. The explanatory variables include average per-capita income used as a proxy for level of development of China and its trading partner (ABI), relative per-capita income as a proxy for economic development similarity (RI), and relative population as relative country size (RCS).

As in table 2 in the appendix, the sign of RCS coefficients derived from the regressions with VIIT and V2 as a dependent variable are both positive as we predicted. In other words, it is significant that VIIT is higher when China trades with a similar-sized country. However, we cannot find any strong relationship between relative country sizes (RCS), average income (ABI), or relative income (RI) and V1. Thus, V1 is not significantly explained by those independent variables in our model<sup>7</sup>. This implies that the intra-industry trade with export of high quality goods may behave differently from those of low quality goods. This gives an implication for future empirical studies that trade data should be decomposed into V1 and V2 as they may have

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<sup>7</sup> Please note that regression 2.1 has a serious problem of multicollinearity thus results in 2.2 and 2.3 are considered.

different natures. The regression outcomes also show that the level of regional development (represented by ABI) has positive impact on VIIT and V2. Both of these findings support Linder Hypothesis. Finally, we do not have enough confidence to conclude that relative income (RI) does not significantly determine VIIT and V2. This relationship would be clearer when we use a fixed effect model.

*ii) Regression Analysis 2*

Now we consider a case when cross-sectional heterogeneity is significant and the econometric model may not include relevant variables. Because our model has such a large number of countries, the use of dummy variables will consume a lot of degree of freedom. Thus, it is better if we cope with this problem by transforming our data. The transformation is as follows:

- Calculate means of all variables
- Calculate the deviation from the means

We carried out the second regression analysis with the below econometric model. It is noteworthy that intercept constant is restrained to zero.

$$\Delta VIIT_{Cjt} = \alpha_1 \Delta ABI_{Cjt} + \alpha_2 \Delta RI_{JCt} + \alpha_3 \Delta RCS_{JCt} + \varepsilon_{jt} \quad (6)$$

It is worth noting that  $\Delta$  is simply the mathematic operator.

Based on the table 3 in the appendix, some findings are derived as follows: First, the signs of independent variables (when regressions do not have a multi-collinearity problem and when determinants are significantly tested) are the same as theoretical predictions in part II of this paper. Particularly, the main regression with VIIT as a dependent variable shows that ABI, RI, and RCS significantly increase VIIT. This finding strongly supports Linder Hypothesis. Second, the findings in the regression 1 are reconfirmed with higher level of confidence when

the fixed effect model is used. Third, we find that the relative economic development (RI) is strongly determining V1 while it is weakly explaining V2. This implies that the trade with exports of high quality goods is positive to the development similarity between trading countries. However, we do not have enough confidence to make the same conclusion for the trade with exports of low quality goods.

## **V. Conclusion**

The main goal of this paper is to provide an initial check of Linder Hypothesis with a control of relative country size as proposed by Kim and Niem (2010). Generally, the empirical tests support the hypothesis. First, the signs of determinants are corresponding with the theoretical prediction. In details, relative country size, relative income and average income are asserted to have a positive impact on VIIT. Recall that an increase in the relative country size carries the meaning that trading countries are more similar in size and an increase relative income means trading countries are more similar in level of development. Thus, VIIT is higher when we trade with a country of a similar size or a similar level of development. Furthermore, the finding confirms that VIIT increases as development levels of both countries are higher. These findings suggest that some previous papers failed to derive any support for Linder Hypothesis because their model settings did not take the asymmetric impact of relative country size into consideration. Second, the behaviors of V1 and V2 are somehow different. This phenomenon shows that a decomposition of VIIT into V1 and V2 is needed for empirical studies because the determinants of V1 may differ from those of V2. It also implies a certain determinant may have opposite impact on V1 compared with that on V2.

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**VII. Appendix**

**Table 2: Regression 1**

Variable coefficients	Dependent variable: VIIT			Dependent Variable: V1			Dependent Variable: V2		
	Regression 1.1	Regression 1.2	Regression 1.3	Regression 2.1	Regression 2.2	Regression 2.3	Regression 3.1	Regression 3.2	Regression 3.3
<i>Intercept</i>	0.371	0.235	0.237	0.213	0.099	0.059	0.158	0.136	0.178
<b>ABI</b>	-0.142***	0.035**	-	-0.163***	-0.014	-	0.021	0.050***	-
<b>RI</b>	2.303*	1.914	2.257*	1.793**	1.468	1.741	0.509	0.446	0.516
<b>RCS</b>	5.682***	-	1.414***	4.760***	-	-0.140	0.922	-	1.554***
<b>F</b>	6.240	3.503	5.761	7.915	3.460	2.484	6.115	9.023	9.129
<b>R</b>	0.333	0.211	0.266	0.370	0.209	0.178	0.330	0.327	0.328
Collinearity stat.	VIF			VIF			VIF		
<b>ABI</b>	18.056	1.108		18.056	1.108	-	18.056	1.108	-
<b>RI</b>	1.118	1.108	1.118	1.118	1.108	1.118	1.118	1.108	1.118
<b>RCS</b>	18.214	-	1.118	18.214	-	1.118	18.214	-	1.118

*Note:*

- “\* “significant at the 0.1 level, “\*\*\*” significant at the 0.05 level, and” “\*\*\*\*” significant at the 0.01 level.
- As there is a serious multi-collinearity problem in regressions 1.1, 2.1, and 3.1, we dealt with this problem by dropping out one explanatory variable.

**Table 3: Regression 2**

Variable coefficients	Dependent variable: $\Delta$ VIIT			Dependent Variable: $\Delta$ V1			Dependent Variable: $\Delta$ V2		
	Regression 1.1	Regression 1.2	Regression 1.3	Regression 2.1	Regression 2.2	Regression 2.3	Regression 3.1	Regression 3.2	Regression 3.3
<i>Intercept</i>	-	-	-	-	-	-	-	-	-
$\Delta$ ABI	-0.360**	0.049***	-	-0.267**	-0.002	-	-0.094***	0.051***	-
$\Delta$ RI	0.011	3.682***	3.349**	.702	3.076***	3.170***	-0.691	0.607	0.178
$\Delta$ RCS	12.027***	-	1.532***	7.775**	-	0.014	4.251***	-	1.517***
F	7.119	6.691	7.623	6.553	6.422	6.405	6.497	9.140	9.529
R	0.354	0.284	0.302	0.339	0.279	0.279	0.338	0.328	0.334
Collinearity Sta.	VIF			VIF			VIF		
ABI	138.694	1.230	-	138.694	1.230	-	138.694	1.230	-
RI	2.411	1.230	1.141	2.411	1.230	1.141	2.411	1.230	1.141
RSC	128.622	-	1.141	128.622	-	1.141	128.622	-	1.141

Note:

- “\* “significant at the 0.1 level, “\*\*\*” significant at the 0.05 level, and” \*\*\*\*” significant at the 0.01 level.
- As there is a serious multi-collinearity problem in regressions 1.1, 2.1, and 3.1, we dealt with this problem by dropping out some variables one by one