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Patterns and Dynamics of Vietnam's Revealed Comparative Advantage and Export Specialization

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Abstract

This paper takes investigation into the patterns and dynamics of Vietnam's revealed comparative advantage and export specialization. Using various analytical tools, the empirical findings are established as follows. First, Vietnam's exports are dominated by unskilled labor and agricultural resource intensive products. Second, between 2001 and 2009, there has been an overall improvement in Vietnam's RCA indices. Third, the pattern of Vietnam's revealed comparative advantage has converged. Fourth, there is a relatively low degree of mobility among industries, which initially have no comparative advantages and those industries, which initially enjoy high comparative advantages, while there is a moderate mobility in the pattern of trade for those industries, which initially have weak comparative advantage and those industries, which initially have medium comparative advantages. Finally, there is a low degree of concentration in Vietnam's exports, and these export patterns are more or less moving toward diversification. Measures to further liberalize trade policy, increase human capital formation and facilitate technological transfer are remedies for Vietnam to diversify the country's export structures and move into human capital and technology intensive exports.

Keywords: Revealed comparative advantage, export specialization, galtonian regression, transition probability matrix, mobility indices, Gini-Hirschman index, Vietnam.

1. Introduction

Over the last two decades, trade liberalization in Vietnam has been regarded as one of the most important pillars of its reform package. The processes of economic reform beginning in 1986 and of deeper integration commencing in 1995 were the major changes, within which, Vietnam's international trade regime were re-shaped. After an initially hesitant start in the late 1980's, the effort of liberalization has been accelerated since 1995 as the result of Vietnam's intensified integration into the regional and world economy with its tight schedule for bilateral and multilateral commitments[1]. Accordingly, a series of important steps have been taken in order to lock in domestic, economic and liberalization reforms, putting the country on the path to become a more open and socialist-oriented market economy.

From the perspective of Vietnam, the potential benefits of trade liberalization include increased trade, economies of scale in production and better access to resources of production. Another major gain could be realized through improved efficiency as a result of greater competition and enhanced access to foreign technology. In connection with this phenomenon, liberalized trade between Vietnam and its trading partners creates potential opportunities for Vietnam to specialize in the production and export of the commodities according to its comparative advantages. It is therefore important to identify groups of commodities in which Vietnam enjoys comparative advantages and analyze the dynamics of Vietnam's trade patterns.

This paper seeks to empirically examine the patterns and dynamics of the comparative advantage and export specialization of Vietnam in the context of trade liberalization. The logic of comparative advantage was originally developed to explain the underlying reasons for international trade and predict the trade pattern resulting from changes in factor endowment and technology. Accordingly, free trade would allow countries to gain from increasing specialization in activities where they have comparative advantages under autarky. Given these facts, the empirical analysis in this study is based on revealed comparative advantage (RCA) index for the period 2001-2009. To this aim, the present paper focuses on the following research objectives:

- To present the basic methods of measuring the revealed comparative advantage.
- To assess the patterns and dynamics of Vietnam's comparative advantage.
- To analyze the mobility of Vietnam's revealed comparative advantage and the degree of export specialization.
- To derive policy implications based on the empirical findings.

The rest of this paper is structured as follows. Section 2 provides the indicators and the background for the analysis of comparative advantage. Section 3 describes the database used. An in-depth analysis of the patterns and dynamics of Vietnam's comparative advantage and export specialization is presented in Section 4. Concluding remarks and policy implications are included in the final section.

2. Methodology

2.1. Measuring revealed comparative advantage

The measurement of a country's relative export performance has been based on the concept of revealed comparative advantage (RCA) developed by Balassa (1965) and modified by Bowen (1983, 1985, 1986). This index pertains to the relative trade performance of

individual countries in particular commodities (Balassa 1965, 1977, 1986)[2]. Balassa (1965) suggested that comparative advantage could be "revealed" by observed trade patterns that reflect differences in factor endowments across nations. Simply put, the revealed comparative advantage of country *j* in the export of product *i* is measured by the ratio of commodity *i*'s share in the country's exports relative to the share of that commodity in the reference group's trade. Specifically, RCA is calculated as follows:

$$RCA_{ij} = \frac{X_{ij} / \sum X_j}{X_{in} / \sum X_n}$$

$$(0 = RCA_{ij} < \infty)$$

Where:RCA_{ij} is revealed comparative advantage for commodity *i* of country *j*.

X_{ij} is the country *j's* exports of commodity *i.*

ΣX_j is the country *j's* total exports.

X_{in} is the reference group's exports of commodity *i.*

ΣX_n is the reference group's total exports.

The RCA index can take on values between zero and infinity. A value of RCA greater than unity is interpreted as being that the country has a revealed comparative advantage in commodity *i* and vice versa. This occurs when the share of that commodity in the country's exports exceeds its share in the reference group's exports. The factors that contribute to movements in RCA are economic, e.g. structural change, improved world demand and trade specialization. By the same token, if a value of RCA is less than unity the country is said to have a revealed comparative disadvantage.

The advantage of using RCA is that it considers the intrinsic advantage of a particular export commodity and is consistent with changes in an economy's relative factor endowment and productivity. The RCA index, however, has its own limitations. The major shortcoming of RCA index is its asymmetric property. The index has a fixed lower bound of zero and a variable upper bound.

Although the strengths and weaknesses of the concept of revealed comparative advantage are still debatable in literature, it stands as the most widely used revealed comparative index (Grigorovici, 2009). In fact, several modifications have been suggested in literature in order to alleviate the skewness nature of the original RCA index[3]. The first improvement was made by Vollrath (1991), who modified the index by taking natural logarithms. So $\ln RCA_{ij}$, not RCA_{ij}, is used in the regression equation. The second improvement was done by Laursen (1998) who suggested normalizing the RCA index with the revealed symmetric comparative advantage. It is expressed as $RSCA_{ij} = (RCA_{ij} - 1)/ (RCA_{ij} + 1)$. The resulting index can take on values between -1 and +1. Finally, Proudman and Redding (2000) and Amador et al. (2007) proposed an alternative measure of revealed comparative advantage in which a country's export share in a given product group is divided by its mean export share in all commodity group. So the resulting index is expressed as $RCA_{ij} / (1/n \Sigma_i RCA_{ij})$.

Hillman (1980) developed a necessary and sufficient condition that has to be fulfilled to obtain a correspondence between the RCA index and pre-trade relative prices in cross-country comparisons for a given product. The Hillman condition is presented as follows:

$$1 - \frac{X_{ij}}{X_{iw}} \succ \frac{X_{ij}}{X_j}\left(1 - \frac{\sum X_j}{\sum X_w}\right)$$

Where, as before, X_{ij} is exports of commodity *i* by country *j*, ΣX_j is total exports of country *j*, X_{iw} is world's exports of commodity *i*, and ΣX_w is world's total exports. Assuming identical homothetic preferences across countries, the condition in equation above is necessary and sufficient to guarantee that changes in the RCA index are consistent with changes in relative factor-endowments. This condition guarantees that growth in the level of a country's exports of a commodity results in an increase in the RCA index.

2.2. Assessing the Structural Stability

2.2.1. The Stability in the Distribution of RCA

Several measures of stability in RCA can be identified in literature. The first measure of the persistence of overall specialization pattern is undertaken through the Galtonian regression (Laursen, 1998; Bojnec and Ferto, 2008). It is the correlation between the RCA index in time period *t* and the index in subsequent time periods. This method allows us to determine if there is any change in the structure of trade specialization between the periods of interest.

$$RCA_{ij}^{t_2} = \alpha_i + \beta_i RCA_{ij}^{t_1} + u_{ij}$$

where superscripts t_1 and t_2 denote the start year and end year respectively. The dependent variable, RCA at time t_2 for sector *i* in country *j*, is tested against the independent variable, which is the value of RCA in year t_1; α and β are standard linear regression parameters and u_{ij} is a residual term.

However, as mentioned before, the problem with RCA index is that it follows an asymmetric distribution. The fixed lower bound of RCA is zero, while the upper bound is variable. In order to solve this problem, Laursen (1998) suggested the revealed symmetric comparative advantage, which is expressed as $RSCA_{ij} = (RCA_{ij} - 1)/ (RCA_{ij} + 1)$. Following Dalum et al. (1998), this paper will perform the following regression analysis:

$$RSCA_{ij}^{t_2} = \alpha_i + \beta_i RSCA_{ij}^{t_1} + u_{ij}$$

- If β = l: The specialization pattern does not alter from t_1 *to* t_2.
- If $\beta > 1$: The country's existing specialization increased in those commodity groups which have comparative advantages and was weakened in those commodity groups which do not have comparative advantages.
- If $0 < \beta < 1$: The commodity groups in which comparative advantages were relatively weak are increasing their competitiveness, while those commodity groups that had strong comparative advantages were losing them. In other words, this implies a pattern of convergence in export specialization.
- If β < 0: There is a complete change in the structure of comparative advantage.

According to Cantwell (1989) and Dalum et al. (1998), β >1 is not a necessary condition for an increase in the overall specialization pattern. It can be shown that:

$$\sigma_i^{2t_2} / \sigma_i^{2t_1} = \beta_1^2 / R_i^2$$

thus,

$$\sigma_i^{t2} / \sigma_i^{t1} = | \beta_i | / | R_i |$$

Where σ^2_i is the variance of the dependent variable, and R is the correlation coefficient obtained from the regression. If β=B, the dispersion of a given distribution is unchanged. When β>B, there is an increase in the degree of specialization (σ- specialization). If β<B, the degree of specialization decreases

(σ- despecialization).

2.2.2. The Intra-distribution Dynamics

There are several measures of stability in the value of RCA index for particular commodity groups from t_1 *to* t_2. Following Proudman and Redding (2000), and Brasili et al. (2000), Hinloopen and van Marrewijk (2001) and Bojnec and Ferto (2008) the author employs Markov transition probability matrices to assess the mobility of revealed comparative advantages as measured by the RCA index. To this date, there is no consensus on the classification of the RCA index into appropriate categories. Drawing on Hinloopen and van Marrewijk (2001), the RCA index is classified into four following categories:

- $0 < \text{RCA} \leqslant 1$: Products without a comparative advantage.
- $1 < \text{RCA} \leqslant 2$: Products with weak comparative advantage.
- $2 < \text{RCA} \leqslant 4$: Products with medium comparative advantage.
- $4 < \text{RCA}$: Products with strong comparative advantage.

In general, a stochastic process of X is considered Markovian if, for every n and all states $i_1 \ldots i_n$

$$P\left[X_n = i_n \mid X_{n-1} = i_{n-1}, \ldots, X_1 = i_1\right] = P\left[X_n = i_n \mid X_{n-1} = i_{n-1}\right]$$

Since the transition matrices in this study are used as in a Markovian analysis, relative frequencies should be interpreted as probabilities. Specifically, the transition matrices are generated by a stationary Markov process:

$$P\left[X_n = j \mid X_{n-1} = i\right] = P\left[X_{n+k=j} \mid X_{n+k-1}\right]$$

for all states *i* and *j*, and *k = (n-1),…, 1, 0, 1,…*

The degree of mobility in patterns of specialization can also be analyzed through several other indices. The first index is M_1, which evaluates the trace (tr) of the transition probability matrix (Shorrocks, 1978; Quah, 1996). M_1 is calculated using the following formula:

$$M_1 = \frac{K - tr(P^*)}{K - 1}$$

where K is the number of cells and $\text{tr}(P^*_c)$ is the trace of the transition probability matrix. A higher value of the index indicates greater mobility, with a value of zero indicating perfect immobility.

The second index of mobility is $M_D(P^*)$, which evaluates the determinant of the transition probability matrix (Geweke at al. 1986). M_2 is computed using the following formula:

$$M_2 = 1 - |\det(P^*)|$$

Where $\det(P^*)$ is the determinant of the matrix, which is calculated as follows:

$$|B| = \sum_{j=1}^{4} b_{1j} |C_{1j}|$$

In this paper, the cofactors $|C_{1j}|$ are of order 3^4.

The third index of mobility is M_3, which is based on the eigenvalues of the matrix (Sommers and Conlisk, 1979). It is calculated as follows:

$$M_3 = 1 - \lambda_2$$

Where the λ_2 is the second largest eigenvalue of P^*.

2.3. The Degree of the Commodity Concentration

In this paper, the commodity concentration is estimated on the basis of Gini-Hirschman coefficient (GH). The index is calculated using the following formula:

$$GH = \sqrt{\sum_{i=1}^{n}\left(\frac{X_{it}}{X_t}\right)^2}$$

Where X_{it} is the value of exports of commodity group *i* in year *t*, and X_t is the total exports in year *t*. The GH coefficient can range from 0 and 1. When there is an export diversification, the index tends to approach zero. When exports are concentrated on a few commodities, the value of the index tends to approach 1. If a country's export consists of only one item, the GH will equal to 1, indicating a complete concentration.

3. Data

In this paper, the annual RCA indices will be calculated at 5-digit level of Harmonized System (HS) nomenclature, but reported at 2-digit level of HS or at section level. The annual export data for this paper were taken from the TradeMap and collected over the period 2001 to 2009. For comparison, the data for the calculation of RCA index on the basis of 3-digit level of SITC were collected from UNSD.

4. Empirical results

4.1. Overview of Vietnam's export pattern

The structure of Vietnam's exports based on HS sections is presented in Table 1[5]. As the data reveal, Animal and Animal Products, Vegetable Products, Mineral Products, Textiles and Footwear are among the largest export sectors in Vietnam. However, the share of agricultural products (e.g., Animal and Animal Products, and Vegetable Products) and Mineral Products in total exports experienced a considerable decline over the period 2001-2009. In contrast, the share of labor intensive products (e.g., Textiles) and technology intensive prod-

Table 1: Commodity's Share in Vietnam's Total Exports (percent)

Code	Product Description	2001	2002	2003	2004	2005	2006	2007	2008	2009
01-05	Animal and Animal Products	13.37	12.51	10.94	8.70	7.99	7.81	7.04	6.43	5.56
06-15	Vegetable Products	12.40	10.72	10.17	10.14	10.40	9.66	10.77	11.59	9.62
16-24	Foodstuffs	2.55	2.61	2.35	2.27	2.25	2.32	2.23	2.31	2.17
25-27	Mineral Products	23.38	21.60	20.98	24.11	26.16	24.84	21.21	20.68	14.92
28-38	Chemicals and Allied Industries	1.14	1.26	1.14	1.09	1.05	1.11	1.15	1.57	1.32
39-40	Plastics/Rubbers	2.26	2.90	3.43	3.63	4.17	5.22	5.15	4.89	2.95
41-43	Raw Hides, Skins, Leather, Furs	1.48	1.37	1.45	1.28	1.30	1.14	1.36	1.40	1.74
44-49	Wood & Wood Products	1.97	2.02	1.74	1.73	1.67	1.71	1.85	1.65	1.69
50-63	Textiles	14.75	18.00	19.23	18.07	16.36	16.39	17.72	16.19	19.03
64-67	Footwear/Headgear	11.11	11.81	11.76	10.68	9.82	9.50	8.67	7.99	11.57
68-71	Stone/Glass	1.53	1.61	1.52	1.57	1.47	1.56	1.79	2.39	4.36
72-83	Metals	1.21	1.46	1.63	1.86	2.09	2.23	2.66	4.83	2.10
84-85	Machinery / Electrical	8.20	6.77	7.77	8.24	8.43	9.33	10.06	10.10	13.65
86-89	Transportation	1.14	1.11	1.15	1.45	1.22	1.22	1.54	1.69	1.14
90-97	Miscellaneous	2.98	3.59	4.18	4.74	5.21	5.58	6.11	5.59	7.67
98-99	Service	0.56	0.67	0.55	0.45	0.43	0.38	0.70	0.68	0.53

ucts (e.g., Machinery) in total exports showed a significant increase during the same period. This structural change implies a movement toward labor and technology intensive exports.

Data in Appendix 1 also show similar results. Specifically, Vietnam's exports are dominated by unskilled labor intensive and agricultural resource intensive products. Mineral resource intensive products made up the third largest portion of exports, followed by technology intensive and human capital intensive products respectively. The most discernable change is the reduction in traditional dominance in exports by agriculture between 1997 and 2008. At the same time, the share of mineral resource intensive products in total exports, the third largest commodity group, has been up and down during the same period. In contrast, the share of unskilled labor intensive products in total exports has been increasing. Another interesting feature of Vietnam's exports has been a consistent increase in the share of human capital and technology intensive commodity exports in total exports. Although still very low, this increase indicates a movement toward knowledge and technology based economy. Taken together, the export patterns of Vietnam have been in conformity with its factor-endowment.

4.2. The pattern of Vietnam's Revealed Comparative Advantage

RCA estimates for 1,222 products at 5-digit HS are summarized in Table 2. For the purpose of mitigating any random factors, which might affect RCA of a single year, I report 3-year average (2001-2003, 2004-2006 and 2007-2009)[6].

According to Table 2, more than 80 percent of product categories have the RCA value lower or equal to unity during the whole period 2001-2009. However, the number of such product categories has been slightly declining over time. This means that the number of products with RCA greater than unity increased, suggesting an improvement in Vietnam's comparative advantage. Since the number of product categories with medium comparative advantage exhibits a decline, the improvement in overall comparative advantage can be attributed to the increase in the number of product categories with weak and high comparative advantages. Taken together, the results indicate a possibly greater diversity in Vietnam's export structure.

RCA estimates at 2-digit level are listed in the Appendix 2. As the data reveal, labor and agricultural resource intensive sectors (e.g.,

Table 2: Frequency Distribution of Vietnam's RCA index

RCA range	2001-2003	2006-2006	2007-2009
0 < RCA≤ l	0.816	0.809	0.802
1 < RCA≤ 2	0.053	0.066	0.066
2 < RCA≤ 4	0.052	0.052	0.041
4 < RCA	0.079	0.075	0.091
Total number of commodities	1,222	1,222	1,222
Mean-RCA	1.582	1.582	1.846
Maximum	66.217	90.955	9.507
Standard deviation	6.376	5.968	219.727

Source: The author's computation using data from UNSD.

Table 3: Top 20 Product Categories with Largest RCA Values

Product Description	2001	2002	2003	2004	2005	2006	2007	2008	2009
64. Footwear	13.90	15.03	15.70	15.67	14.77	15.08	14.11	13.60	16.53
09. Coffee, Tea, Spices	19.51	17.08	18.63	19.90	16.93	20.82	25.00	20.18	14.79
46. Straw	27.44	27.86	27.68	28.11	25.25	22.97	20.73	14.24	13.54
03. Fish	16.60	17.05	16.08	14.35	13.50	14.21	13.97	13.67	9.44
65. Headgear	3.52	5.67	6.38	7.88	7.08	6.57	6.42	5.44	7.00
62. Apparel, not Knitted	5.96	6.37	6.17	6.53	6.17	6.44	6.95	6.46	6.63
61. Apparel, Knitted	1.45	3.31	4.94	4.75	4.43	4.24	5.02	5.54	5.62
10. Cereals	7.43	7.75	6.90	7.41	10.12	7.71	5.86	7.08	5.23
94. Furniture	1.48	2.01	2.53	3.08	3.65	3.98	4.22	3.94	4.83
16. Preparations Meat/Fish	1.76	2.27	2.39	3.22	3.86	4.14	3.91	4.06	4.22
42. Articles of Leather	3.25	3.30	3.64	3.39	3.31	2.96	3.11	3.22	4.18
25. Salt/Sulphur/Lime/Cement	0.44	0.34	0.30	0.47	0.46	0.47	0.64	0.77	3.62
08. Edible Fruit & Nuts	5.33	3.84	3.38	4.04	4.02	3.33	3.52	3.91	3.20
63. Other Textile A rticles	3.14	2.41	2.37	2.90	2.54	3.06	3.12	2.58	2.68
55. Man-made Staple Fibers	1.03	1.78	1.38	1.48	1.58	1.91	2.46	1.79	2.34
54. Man-made Filaments	0.73	0.66	0.62	0.81	0.98	1.49	1.69	1.82	2.19
50. Silk	7.61	6.79	4.24	4.18	4.03	3.74	3.12	2.57	2.16
69. Ceramic Products	2.72	2.66	2.55	2.66	2.70	2.43	2.47	2.12	1.95
11. Malt & Wheat Gluten	2.51	2.15	4.44	3.17	3.34	5.23	4.81	3.58	1.91
14. Other Vegetable Products	12.92	7.88	6.12	5.28	4.21	5.05	3.03	2.26	1.78

Fish, Coffee, Tea, Spices, Straw, Footwear, etc.) are among the ones, which register the high RCA score. In contrast, human capital and technology intensive sectors (e.g., Pharmaceutical Products, Books and Newspapers, Organic Chemical, etc.) have the lowest RCA score. In terms of trends, many agricultural resource and mineral intensive products (e.g., Lubricants/Fuels/Oil, Tin, etc.) experienced a decline in RCA. While labor intensive products showed an improvement in RCA. Although gaining an improvement in RCA, many human capital and technology intensive products are still far from being in the commodity group with a comparative advantage.

Top 20 product categories in the RCA ranking for the period 2001-2009 are displayed in Table 3[7]. Again, in terms of factor intensity classification, labor intensive products (e.g., Footwear, Headgear, Apparel, etc.) and agricultural products (e.g., Cereals, Fish, etc.) are among the sectors with the highest RCA scores. As suggested, while labor intensive products increased in RCA indices, agricultural products declined.

4.3. The Structural Stability of Vietnam's Revealed Comparative Advantage

4.3.1. The Stability in the Distribution of RCA

The stability of the RCA index obtained by Galtonian regression in reported in Table 4. The dependent variable, RSCA at time t_2 for sector i in country j, is tested against the independent variable, which is the value of RSCA in year t_1;

As indicated, the value of β is lower than

Table 4: The Galtonian Regression Results

$RSCA_{ij}^{t1}$	$RSCA_{ij}^{t2}$	Constant	â	R	â/R	t-test	Observations
2001	2002	-0.04	0.87**	0.85	1.03	55.95	1,222
2002	2003	-0.06	0.89**	0.89	0.99	68.26	1,222
2003	2004	-0.08	0.86**	0.87	0.99	61.26	1,222
2004	2005	-0.05	0.90**	0.92	0.99	79.89	1,222
2005	2006	-0.02	0.92**	0.91	1.01	75.15	1,222
2006	2007	-0.04	0.91**	0.90	1.01	73.59	1,222
2007	2008	-0.06	0.88	0.89	0.99	69.12	1,222
2008	2009	-0.12	0.78	0.79	0.98	45.17	1,222
2001	2009	-0.17	0.60	0.60	0.99	26.48	1,222

Source: The author's computation.

Note: * Significant at 0.05 level; ** Significant at 0.01 level.

unity for all cases. This means that the commodity groups in which comparative advantages were relatively weak are increasing their competitiveness, while those commodity groups that had strong comparative advantages were losing them. So the overall trade patterns of Vietnam have not changed significantly from 2001 to 2009. Looking at the β/R ratios, it is evident that the pattern of revealed comparative advantage has converged. They also suggest that the dispersion in the distribution in RCA has been stable.

4.2.2. The Intra-distribution Dynamics

The assessment of the dynamics of RCA indices can be obtained through the analysis of the transition probability matrix, which shows the probability of passing from a state to another between the start period (2001-2003) and the end period (2007-2009)[8]. The estimated transition probability matrix is presented in Table 5. At a glance, the initial and final distributions indicate an improvement in RCA indices for Vietnam.

An in-depth analysis of the transition probability matrix suggests several important characteristics. First, the values of RCA indices are highly persistent from the period 2001-2003 to the period 2007-2009 for observations within class a (comparative disadvantage) and relatively persistent for class d (high comparative advantage). For example, the value of the diagonal element is 0.910 for class a. This implies that the probability of a product with a comparative disadvantage in the period 2001-2003

Table 5: Transition Probability Matrix (2001 -2003 and 2007 -2009)

		Period 2007 -2009			
Period 2001 -2003	**RCA**	**a**	**b**	**c**	**d**
	a	0.910	0.050	0.022	0.018
	b	0.492	0.246	0.108	0.154
	c	0.375	0.156	0.172	0.297
	d	0.177	0.052	0.104	0.667
	Initial distribution	0.816	0.053	0.052	0.079
	Final distribution	0.802	0.066	0.041	0.091

Source: The author's computation.

Table 6: The Mobility Indices

From	To	M_1	M_2	M_3
2001-2003	2004-2006	0.594	0.962	0.548
2004-2006	2007-2009	0.539	0.953	0.596
2001-2003	2007-2009	0.668	0.990	0.672

Source: The author's computation.

being the same status in the period 2007-2009 is 0.910. The probability of moving from class a to class b (weak comparative advantage) and class c (medium comparative advantage) is 0.050 and 0.022 respectively. There is very low chance of moving from class a to class d (high comparative advantage). The RCA indices in class d shows similar status. The diagonal element indicates that a product with a high comparative advantage in the period 2001-2003 has a probability of 0.667 of remaining in class d. There is little chance of moving from class d to class a, b or c.

Second, unlike the observations in class a and d, the observations for RCA indices in class b (weak comparative advantage) and class c (medium comparative advantage) reveal significant variations in their patterns. With regard to class b, the probability of losing comparative advantage for those observations beginning with a weak comparative advantage is relatively high (0.492). There is little chance of moving from class b to class c or d. Within class c, the probability of an observation remaining in this class in the period 2006-2008 is only 0.172. The probability of moving from class c to class a or class d is relatively high. There is little chance of moving from class c to class b.

The mobility indices are presented in Table 6. To this date, there is no unified consensus in international trade literature regarding which index is the most consistent one. Therefore, this paper will report the results of all three indices. However, the focus of analysis is on M_1. As suggested, the values of M_1 show that there is moderate degree of mobility from 2001-2003 to 2004-2006, from 2004-2006 to 2007-2009, and from 2001-2003 to 2007-2009. This is due to the combination of a low degree of mobility in classes a and d, and a high degree of mobility in classes b and c.

Table 7 reports the Gini-Hirschman indices for the period from 2001 to 2009. As it is evident, Vietnam's export structure exhibits a low degree of specialization. In other words, the exports of products are spread among a large number of export lines. There is only one product category (HS 2709- Crude Petroleum Oils), which makes up approximately 15 percent of total exports during 2007-2009 average.

Drawing on Ferto (2007), the perform the regression in which the log of GH index is regressed on a simple time trend. The results show a significant fall in the specialization of

Table 7: The Gini -Hirschman Index

Indicators	2001	2002	2003	2004	2005	2006	2007	2008	2009
GH index	0.24	0.23	0.23	0.24	0.25	0.24	0.21	0.2	0.16

Source: The author's computation based on UNSD data.

exports (the value of β is -0.017 and t-test is -2.97, with adj R of 0.558) .

5. Conclusion

This paper employs various analytical tools to investigate the patterns and dynamics of Vietnam's comparative advantage and export specialization in the period from 2001 to 2009. Conclusions made from this empirical analysis are summarized as follows. *First*, Vietnam's exports are heavily dominated by unskilled labor and agricultural resource intensive products. However, there was a discernable reduction in traditional dominance in exports by agriculture. *Second*, there was an overall improvement in Vietnam's RCA indices. This is illustrated by the fact that the percentage of products with comparative disadvantage decreased, while the corresponding number of products with comparative disadvantage increased. At the same time, the mean-RCA did show a slight increase. Third, as suggested by the Galtonian regression, the pattern of Vietnam's revealed comparative advantage has converged. Commodity groups in which comparative advantages were relatively weak are increasing their competitiveness, while those commodity groups that had strong comparative advantage were losing them. *Fourth,* there is high degree of persistence among industries, which initially have no comparative advantages (class a) and those industries, which initially enjoy high comparative advantages (class d). Industries with weak comparative advantage (class b) have a relatively low probability of moving towards the position of comparative advantages, while industries with medium comparative advantage (class c) have a relatively low probability of moving towards the position of either comparative disadvantage or high comparative advantage. This suggests a relatively low degree of mobility in pattern of trade for classes a and d, and a moderate mobility in the pattern of trade for classes b and c. *Finally*, there is a low degree of concentration in Vietnam's exports, and these export patterns are more or less moving toward diversification.

From the policy point of view, Vietnam is still heavily dependent on agricultural resources and unskilled labor intensive exports. Therefore, measures and policies to promote diversification of the economy and shift towards human capital intensive products are needed in order to catch up with countries in the region. To do so, policies that target education are of paramount importance as an educated population would provide the base, which is indispensable for maintaining the competitiveness of the country. The export base also needs to expand further so that there will be greater comparative advantages across all sectors, not just agricultural and unskilled labor intensive products. At the same time, policies to foster research and development are needed in order to help Vietnam shift towards technology intensive exports.

Trade liberalization alone is not sufficient to increase the market share of Vietnam's exports of human capital and technology intensive products. Other structural factors need to be addressed such as technology and productivity. Whether or not Vietnam can derive maximum benefit from its integration into the world economy depends very much on its ability to increase human capital formation, facilitate technological transfer and create the culture of innovation. By successfully doing so Vietnam will surely move into human capital and technology intensive exports.■

Appendices

Appendix 1: Commodity Share in Vietnam's Total Export, 1997 -2008

Year	Agricultural Resource intensive Products	Mineral Resource intensive Products	Unskilled labor intensive Products	Human capital intensive Products	Technology intensive Products	3-digit sectors not classified
1997	33.35	19.16	33.18	2.70	7.05	4.56
1998	32.78	16.57	30.30	2.30	8.10	9.95
1999	30.11	21.83	34.71	3.14	8.59	1.60
2000	27.30	27.68	30.11	2.70	8.72	3.48
2001	28.72	24.49	31.64	3.96	8.51	2.67
2002	27.72	22.67	36.43	4.41	7.52	1.25
2003	25.31	21.98	38.21	4.72	8.75	1.03
2004	23.07	25.10	36.35	5.51	9.28	0.70
2005	23.36	27.14	34.33	4.81	9.60	0.77
2006	23.36	25.80	34.26	5.20	10.48	0.88
2007	23.33	22.22	35.88	6.19	11.22	1.17
2008	23.23	21.74	33.59	8.41	11.39	1.65

Source: The authors' compilation using UN SD data.

Note: Product classification according to factor intensity is based on Krause (1982).

Appendix 2: Reveal Comparative Advantage of Vietnam

	2001	2002	2003	2004	2005	2006	2007	2008	2009
01. Live Animals	n.a	0.14	0.15	0.10	0.10	0.11	0.09	0.07	0.25
02. Meat & Edible Meat Offal	0.41	0.24	0.16	0.24	0.17	0.11	0.17	0.15	0.10
03. Fish	16.60	17.05	16.08	14.35	13.50	14.21	13.97	13.67	9.44
04. Dairy Produce	2.77	1.49	1.01	0.47	0.77	0.74	0.24	0.27	0.20
05. Other Animal Products	2.80	1.44	0.86	0.56	0.56	0.54	0.34	0.27	0.40
06. Live Trees	0.28	0.07	0.04	0.14	0.18	0.17	0.18	0.18	0.25
07. Edible Vege tables	1.60	1.18	1.28	1.22	1.12	1.55	1.58	1.20	1.66
08. Edible Fruit & Nuts	5.33	3.84	3.38	4.04	4.02	3.33	3.52	3.91	3.20
09. Coffee, Tea, Spices	19.51	17.08	18.63	19.90	16.93	20.82	25.00	20.18	14.79
10. Cereals	7.43	7.75	6.90	7.41	10.12	7.71	5.86	7.08	5.23
11. Malt & Wheat Gluten	2.51	2.15	4.44	3.17	3.34	5.23	4.81	3.58	1.91
12. Seeds	1.42	1.38	0.98	0.59	0.76	0.31	0.55	0.32	0.12
13. Lac, Gums & Resins	1.18	0.60	0.60	1.07	1.37	1.11	0.52	0.35	0.17
14. Other Vegetable Products	12.92	7.88	6.12	5.28	4.21	5.05	3.03	2.26	1.78
15. Fats & Oils	0.96	0.37	0.45	0.52	0.15	0.12	0.23	0.29	0.11
16. Preparations Meat/Fish	1.76	2.27	2.39	3.22	3.86	4.14	3.91	4.06	4.22
17. Sugars	1.09	0.47	0.46	0.27	0.22	0.26	0.45	0.56	0.48
18. Cocoa	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.02
19. Prep. Cereals/Flour/Milk	2.29	1.80	1.32	1.27	1.37	1.38	1.43	1.41	0.71
20. Prep. Vegetables/Fruit/Nuts	1.47	1.50	0.81	0.95	0.71	1.09	0.85	0.89	0.72
21. Misc. Edible Products	1.07	1.01	0.27	0.29	0.42	0.40	0.36	0.36	0.32
22. Beverages	0.13	0.16	0.14	0.13	0.15	0.13	0.20	0.21	0.12
23. Waste from Food Industry	0.10	0.19	0.37	0.15	0.09	0.24	0.24	0.26	0.22
24. Tobacco	0.66	1.09	2.12	2.02	1.62	1.35	1.07	0.97	0.19
25. Salt/Sulphur/Lime/Cement	0.44	0.34	0.30	0.47	0.46	0.47	0.64	0.77	3.62
26. Ores	0.84	0.66	0.74	0.92	0.41	0.43	0.37	0.30	0.40
27. Lubricants/Fuels/Oil	2.35	2.26	2.06	2.11	1.90	1.69	1.46	1.14	0.95
28. Inorganic Chemicals	0.08	0.11	0.07	0.04	0.06	0.08	0.07	0.11	0.20
29. Organic Chemicals	0.09	0.09	0.08	0.10	0.10	0.09	0.08	0.10	0.09
30. Pharmaceutical Products	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
31. Fertilizers	0.21	0.47	0.49	0.42	0.29	0.36	0.38	0.89	0.23
32. Tanning/Dyeing Extracts/Ink	0.10	0.06	0.09	0.06	0.06	0.06	0.08	0.08	0.10
33. Cosmetics	0.28	0.29	0.33	0.32	0.22	0.21	0.19	0.19	0.15
34. Soap, Waxes, Pastes	1.14	0.95	0.70	0.74	0.98	1.17	1.22	1.33	1.24
35. Glues	0.22	0.26	0.28	0.44	0.41	0.40	0.49	0.59	0.40
36. Explosives	0.31	0.22	0.16	0.22	0.10	0.09	0.08	0.07	0.07
37. Photographic Goods	0.31	0.39	0.31	0.07	0.06	0.07	0.01	0.01	0.02

38. Misc. Chemical Products	0.08	0.12	0.10	0.12	0.12	0.17	0.17	0.19	0.21
39. Plastics	0.28	0.29	0.29	0.31	0.41	0.49	0.57	0.62	0.50
40. Rubber	1.53	2.11	2.59	2.69	2.88	3.68	3.26	3.10	1.37
41. Raw Hides & Skins	0.21	0.22	0.21	0.27	0.61	0.76	1.56	2.15	1.58
42. Articles of Leather	3.25	3.30	3.64	3.39	3.31	2.96	3.11	3.22	4.18
43. Furskins	0.93	0.06	0.02	0.06	0.09	0.13	0.14	0.26	0.39
44. Wood	0.93	0.86	0.73	0.77	0.83	0.94	1.10	1.17	1.42
45. Cork	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.03
46. Straw	27.44	27.86	27.68	28.11	25.25	22.97	20.73	14.24	13.54
47. Wood Pulp	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48. Paper & Paper Board	0.26	0.27	0.26	0.25	0.28	0.34	0.40	0.45	0.31
49. Books, Newspapers	0.05	0.21	0.05	0.12	0.05	0.08	0.09	0.08	0.07
50. Silk	7.61	6.79	4.24	4.18	4.03	3.74	3.12	2.57	2.16
51. Wool	0.03	0.00	0.04	0.09	0.12	0.09	0.21	0.19	0.13
52. Cotton	0.39	0.47	0.49	0.37	0.34	0.46	0.54	1.24	1.72
53. Paper Yarn	0.93	1.49	1.34	1.27	1.20	2.14	1.66	1.78	1.48
54. Man-made Filaments	0.73	0.66	0.62	0.81	0.98	1.49	1.69	1.82	2.19
55. Man-made Staple Fibers	1.03	1.78	1.38	1.48	1.58	1.91	2.46	1.79	2.34
56. Wadding	1.23	1.25	1.29	1.07	1.02	1.23	1.18	1.03	1.16
57. Carpets	0.45	0.24	0.20	0.30	0.34	0.25	0.27	0.43	0.33
58. Special Woven Fabrics	0.34	0.45	0.38	0.57	0.63	0.80	0.47	0.45	0.54
59. Laminated Textile Fabrics	0.16	0.21	0.16	0.25	0.35	0.89	0.94	1.27	1.43
60. Knitted Fabrics	0.11	0.11	0.39	0.27	0.29	0.65	0.88	1.01	0.55
61. Apparel, Knitted	1.45	3.31	4.94	4.75	4.43	4.24	5.02	5.54	5.62
62. Apparel, not Knitted	5.96	6.37	6.17	6.53	6.17	6.44	6.95	6.46	6.63
63. Other Textile Articles	3.14	2.41	2.37	2.90	2.54	3.06	3.12	2.58	2.68
64. Footwear	13.90	15.03	15.70	15.67	14.77	15.08	14.11	13.60	16.53
65. Headgear	3.52	5.67	6.38	7.88	7.08	6.57	6.42	5.44	7.00
66. Umbrellas, Walking Sticks	0.35	0.42	0.12	0.11	0.19	0.59	0.35	0.35	0.36
67. Prepared Feathers	1.94	1.95	1.39	1.16	0.93	1.69	0.88	0.44	0.52
68. Stone/Plaster/Cement	0.34	0.42	0.42	0.57	0.59	0.61	0.73	0.73	0.61
69. Ceramic Products	2.72	2.66	2.55	2.66	2.70	2.43	2.47	2.12	1.95
70. Glass and Glassware	0.22	0.28	0.29	0.20	0.22	0.66	0.75	0.91	1.00
71. Jewelry	0.23	0.25	0.22	0.25	0.22	0.21	0.27	0.58	1.24
72. Iron and Steel	0.06	0.09	0.12	0.16	0.20	0.22	0.28	0.88	0.16
73. Articles of Iron or Steel	0.46	0.47	0.49	0.54	0.57	0.56	0.57	0.59	0.57
74. Copper	0.05	0.09	0.06	0.03	0.03	0.06	0.11	0.21	0.09
76. Aluminum	0.09	0.14	0.20	0.17	0.18	0.18	0.17	0.19	0.16

78. Lead	0.11	0.21	0.12	0.08	0.06	0.12	0.06	0.14	0.06
79. Zinc	0.21	0.84	0.46	0.16	0.05	0.05	0.07	0.24	0.53
80. Tin	3.36	3.09	3.38	1.82	1.32	1.70	1.63	1.58	0.85
81. Other Base Metals	0.38	0.05	0.10	0.09	0.06	0.09	0.14	0.11	0.21
82. Tools	0.24	0.40	0.44	0.56	0.65	0.65	0.77	0.75	0.83
83. Miscellaneous Base Metals	0.14	0.18	0.29	0.23	0.25	0.22	0.22	0.28	0.33
84. Computer/Machinery	0.28	0.19	0.22	0.24	0.27	0.32	0.26	0.35	0.39
85. Electrical Equipment	0.28	0.29	0.34	0.36	0.35	0.38	0.52	0.49	0.68
86. Railway	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.09
87. Cars, Trucks, Autos	0.12	0.11	0.11	0.15	0.13	0.14	0.14	0.13	0.10
88. Aircraft, Spacecraft	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.02	0.03
89. Ships, Boats	0.05	0.07	0.04	0.02	0.11	0.09	0.41	0.72	0.32
90. Optical/Medical Instruments	0.12	0.11	0.10	0.10	0.10	0.14	0.20	0.23	0.29
91. Clocks	0.09	0.14	0.16	0.18	0.16	0.15	0.11	0.14	0.12
92. Musical Instruments	0.21	0.36	0.43	0.47	0.33	0.40	0.52	0.63	0.62
94. Furniture	1.48	2.01	2.53	3.08	3.65	3.98	4.22	3.94	4.83
95. Toys	0.58	0.42	0.46	0.48	0.41	0.51	0.51	0.54	1.04
96. Misc. Manufactured Articles	1.15	1.11	1.18	1.15	1.11	1.42	1.24	1.15	1.44
97. Works of Art	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.09
99. Other	0.23	0.26	0.20	0.15	0.16	0.14	0.26	0.25	0.20

Source: The author's computation based on data from TradeMap.

Appendix 3: 30 Products of Vietnam with Highest RCA index in 1997 -1999 and 2006-2008

1997-1999 Average						2006-2008 Average					
Rank	**SITC**	**Product Name**	**FI**	**RCA**	**Share**	**Rank**	**SITC**	**Product Name**	**FI**	**RCA**	**Share**
1	351	Electric current	MRI	33.26	0.005	1	264	Jute and other textile bast fibres	ARI	14.15	0.004
2	222	Oil-seeds and oleaginous fruits	ARI	18.25	0.459	2	212	Furskins, raw	ARI	12.85	0.000
3	024	Cheese and curd	ARI	17.21	0.044	3	246	Wood in chips or particles, wood waste	ARI	10.62	0.371
4	071	Coffee and coffee substitutes	ARI	14.66	5.578	4	071	Coffee and coffee substitutes	ARI	10.22	3.501
5	042	Rice	ARI	11.02	9.691	5	851	Footwear	ULI	9.76	8.343
6	291	Crude animal materials, n.e.s.	ARI	9.85	0.171	6	286	Uranium or thorium ores, concentrates	MRI	8.76	0.001
7	851	Footwear	ULI	9.77	11.043	7	613	Furskins, tanned or dressed	ULI	8.51	0.006
8	883	Cinematographic film	TEI	9.54	0.013	8	034	Fish, fresh , chilled or frozen	ARI	7.94	2.944
9	074	Tea and maté	ARI	9.38	0.479	9	272	Fertilizers, crude	MRI	7.74	0.031
10	261	Silk	ARI	7.74	0.047	10	411	Animal oils and fats	ARI	7.53	0.030
11	246	Wood in chips or particles, wood waste	ARI	7.39	0.102	11	223	Oil-seeds and oleaginous fruits	ARI	7.13	0.075
12	841	Men's or boys' coats, etc.	ULI	6.84	6.854	12	074	Tea and maté	ARI	7.10	0.263
13	846	Clothing accessories	ULI	6.74	0.798	13	841	Men's or boys' coats, capes , etc	ULI	7.08	3.747
14	211	Hides and skins (except furskins), raw	ARI	6.52	0.060	14	265	Vegetable textile fibres	ARI	6.90	0.039
15	287	Ores, concentr ates of base metals, n.e.s.	MRI	6.20	0.127	15	211	Hides and skins (except furskins), raw	ARI	6.72	0.065
16	663	Mineral manufactures, n.e.s.	MRI	6.14	0.653	16	696	Cutlery	HCI	6.59	0.200
17	036	Crustaceans	ARI	5.86	6.710	17	287	Ores, concentrates of bas e metals, n.e.s.	MRI	6.55	0.162
18	333	Petroleum oils	MRI	5.84	15.779	18	831	Trunks, suitcases, vanity cases, etc.	ULI	6.52	0.865
19	659	Floor coverings, etc.	ULI	5.44	0.181	19	842	Women's or girls' coats, capes, etc.	ULI	6.36	3.462
20	658	Made-up articles of textile	ULI	5.04	0.795	20	658	Made-up articles of textile	ULI	6.35	0.841
21	831	Trunks, suitcases, vanity cases, etc.	ULI	4.73	1.324	21	075	Spices	ARI	6.22	0.569
22	035	Fish, dried, salted or in brine; etc.	ARI	4.70	0.186	22	261	Silk	ARI	6.10	0.002
23	057	Fruit and nuts, fresh or dried	ARI	4.66	1.367	23	057	Fruit and nuts, fresh or dried	ARI	6.00	1.605
24	654	Other textile fabrics, woven	ULI	4.42	0.073	24	036	Crustaceans	ARI	5.83	3.622
25	075	Spices	ARI	4.18	0.973	25	222	Oil-seeds and o leaginous fruits	ARI	5.78	0.042
26	025	Eggs, birds', and egg yolks	ARI	3.97	0.067	26	042	Rice	ARI	5.38	3.748
27	022	Milk and cream and milk products	ARI	3.85	0.236	27	035	Fish, dried, salted or in brine; etc.	ARI	5.04	0.151
28	842	Women's or girls' coats, capes, etc.	ULI	3.41	2.577	28	333	Petroleum oils	MRI	4.66	17.976
29	264	Jute and other textile bast fibres	ARI	3.12	0.001	29	012	Other meat and edible meat offal	ARI	4.65	0.087
30	845	Articles of apparel	ULI	3.06	3.189	30	821	Furniture and pa rts thereof	ULI	4.63	4.516

Source: The author's computation based on UNSD database.

Note: FI=Factor intensity; ARI=Agricultural resource intensive; MRI=Mineral resource intensive; ULI=Unskilled labor intensive; HCI=Human capital intensive; TEI=Technology intensive.

Appendix 4A

Transition Probability Matrix (2001 -2003 and 2004-2006)

Period 2001-2003	Period 2007-2009			
RCA	**a**	**b**	**c**	**d**
a	0.940	0.044	0.010	0.006
b	0.415	0.292	0.231	0.062
c	0.219	0.203	0.391	0.188
d	0.105	0.042	0.135	0.729
Initial distribution	0.816	0.053	0.052	0.079
Final distribution	0.808	0.065	0.052	0.075

Source: The author's computation.

Appendix 4B

Transition Probability Matrix (2004 -2006 and 2007-2009)

Period 2001-2003	Period 2007-2009			
RCA	**a**	**b**	**c**	**d**
a	0.940	0.035	0.013	0.011
b	0.450	0.338	0.113	0.100
c	0.159	0.254	0.302	0.286
d	0.065	0.033	0.098	0.804
Initial distribution	0.808	0.065	0.052	0.075
Final distribution	0.802	0.066	0.041	0.091

Source: The author's computation.

Notes:

1. Vietnam became a member of ASEAN in 1995, joined Asia-Pacific Economic Cooperation (APEC) in 1998, concluded a bilateral trade agreement with the United States in 2000, and acceded to the World Trade Organization in January 2007.

2. This index was derived by Blassa (1965), and subsequently applied in a number of empirical studies to analyze the comparative advantage of various sectors of different countries (Balassa and Bauwens, 1987; Son and Wilson, 1995; Kalirajan and Shand, 1998).

3. Our empirical work is consistent with these extensions.

4. For more detail of calculation, see (Chiang, 1984).

5. The structure of Vietnam's exports based on factor intensity is listed in the Appendix 1.

6. The estimated RCA indices are consistent with the Hillman condition. The detailed results are available from the author.

7. Top 30 products with highest RCA (ASEAN as the reference group) is displayed in the Appendix 3.

8. The transition probability matrices for 2001-2003 and 2004-2006, and 2004-2006 and 2007-2009 are listed in the Appendices 4A and 4B.

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