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Investigating Ghana's Revealed Comparative Advantage in Agro-Processed Products

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Abstract

Export diversification through agro-processing has been a policy objective of successive governments. In the most recent policy document the processing of horticultural products including fruits has been emphasised. Using four indices of revealed comparative advantage, nine agro-processed product groups have been identified in which Ghana has a comparative advantage. However, the share of agro-processed products in which Ghana has a comparative advantage declined over the period 2004 to 2011. We recommend that policies should be designed to encourage expansion of exports in the nine identified product groups as well as to reverse the decline in the share of agro-processed products in which Ghana has a comparative advantage.

Keywords

Revealed Comparative Advantage, Agro-Processing, Exports, Ghana

1. Introduction

Ghana's exports are dominated by three primary commodities, *i.e*. gold, cocoa and timber. Together they accounted for between 63% and 75% of the total value of merchandise exports in 2004 and 2011 respectively. To reduce the over-reliance on these commodities the focus of government policy is on export diversification through adding value to raw materials. Adding value to agricultural commodities has been identified as the logical step towards achieving the objective of export diversification. In the second Ghana Poverty Reduction Strategy Paper for the period 2006-2009 a component of the trade and industrial strategy was the promotion of small-scale agro-processing for exports. The document did not identify any particular products or industries for support. In the Ghana Shared Growth and Development Agenda for the period 2010-2013, export diversification through agro-processing was again included as a strategy and particular focus was placed on the processing of horticultural crops including fruits.

Agro-processing may be defined as the transformation of raw materials and intermediate products originating

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from agriculture, forestry or fishing into intermediate or final goods [1]. This definition provides the basis for the selection of agro-processed products for our study. Agro-processed exports from Ghana increased from US$ 181.1 million in 2004 to US$ 902.5 million in 2011 representing about 398% growth (**Table 1**). They accounted for 7.4% of total merchandise export earnings in 2004, declining to 4.9% in 2011. The share of agro-processed horticultural products including fruits in total exports averaged less than 1% during the period 2004-2010. These exports escalated in 2011 increasing their share in total exports to 2.6% (**Table 1**).

For Ghana to make progress in diversifying into agro-processed products it would be useful to identify the products in which it has a comparative advantage. In this paper we shall use the concept of revealed comparative advantage to identify the agro-processed products in which Ghana has a comparative advantage and examine the trend in comparative advantage over time. Four measures of revealed comparative advantage will be employed for this purpose.

2. Literature Review

Although there are no previous studies that the authors are aware of on Ghana's comparative advantage there are several studies on this subject on other developing countries. These studies identify products with revealed comparative advantage and trends over time. In a study that examined the Southern African Development Co-operation's (SADC) revealed comparative advantage with the rest of the world it was found that the revealed comparative advantage for most SADC countries and SADC as a trade bloc lay in agricultural and mineral resource-intensive products. The trend in RCA indices during the period 1986-1995 for all SADC countries showed an improvement in comparative advantage in the non-traditional export sectors [2]. Using data for the period 1992-2006 the products for which Barbados had a comparative advantage in the EU market were identified and an analysis of the trends over time was conducted [3]. Vietnam's comparative advantage shifted from primary products towards labour-intensive and technology-intensive manufacturing during the period 1991-96 and a further slow shift towards technology-intensive manufacturing over the same period [4]. Trends in the comparative advantage in Pakistan's leather industry from 2002-2009 and comparison with China, India, Iran finds that Pakistan's revealed comparative advantage improved over time whilst that of India and China had somewhat declined [5]. There was no change in the revealed comparative advantage of Malaysia's non-resource based manufactures during the period 2001-2005 [6]. The results show that Malaysia still had a comparative advantage in electrical and electronic goods and machinery (its largest export item), even though the trend was downwards. Malaysia's export strength had also gradually shifted from non-resource-based to resource-based manufactured exports such as wood and wood products. A study on Asian and Latin American manufactured exports provides evidence which strongly suggests that despite the strong export performance experienced by East Asian economies, they are losing their comparative advantage to lower-tier economies in Southeast Asia and Latin America [7]. An analysis of the evolution of Chinese exports over a 50-year period found that the number of products in which China had a comparative advantage rose from 105 in 1962 to 234 in 1980 out of which 14 were classified as sophisticated [8]. The number of sophisticated export products rose to 65 in 1990 and 100 in 2006.

3. Methodology and Data

Theoretically a country's comparative advantage is determined by costs and prices before the economy is

Table 1. Trend in Ghana's agro-processed exports (2004 to 2011).

Exports	2004	2005	2006	2007	2008	2009	2010	2011
Agro-processed exports ($million)	181.1	232.3	213.5	255.2	137.0	131.9	215.1	902.5
Total exports ($million)	2450.5	3059.7	3614.0	3533.8	3809.9	5070.5	5233.4	18400.6
Agro-processed share in Total exports (%)	7.4	7.6	5.9	7.2	3.6	2.6	4.1	4.9
Horticulture exports ($000)	16.6	19.4	14.0	32.6	13.7	13.5	11.5	469.7
Horticulture share in total exports (%)	0.7	0.6	0.4	0.9	0.4	0.3	0.2	2.6

Source: Authors' calculations based on the HS four-digit data from UN COMTRADE database.

opened up to international trade. This information is not available since almost all economies trade with the rest of the world. To overcome this difficulty, Balassa [9] proposed a simple indicator, the revealed comparative advantage (RCA) that is based on the assumption that the comparative advantage of a country is reflected in its trade pattern. Specifically, a country's exports are dominated by the products in which it has a comparative advantage.

Balassa's revealed comparative index (RCA^1) is

$$RCA_{ij}^1 = B = \frac{\left(X_{ij}/X_i\right)}{\left(X_{wj}/X_w\right)} \tag{1}$$

where

B = the Balassa index for revealed comparative advantage;

RCA_{ij}^1 = first measure of revealed comparative advantage for country *i* in product *j*;

X_{ij} = value of country *i*'s export of product *j*;

X_i = value of country *i*'s total exports;

X_{wj} = value of world exports of product *j*;

X_w = value of world exports.

The Balassa index measures the ratio of the share of a particular product in a country's total exports to the share of that product in world exports. When the value of the index exceeds 1 it is indicative of a revealed comparative advantage in the product. A value less than 1 is indicative of a revealed comparative disadvantage.

Several criticisms have been levelled against the Balassa index. The omission of imports in the estimates by Balassa generates biased results [10]. Three alternative indicators of revealed comparative advantage have been developed which address this limitation of the Balassa index [11]. These measures take into consideration the possibility of simultaneous exports and imports of the same commodity by a country. The first is the relative trade advantage (RTA) which is computed as the difference between the relative exports advantage (RXA) and the relative imports advantage (RMA).

$$RCA^2 = RTA_{ij} = RXA_{ij} - RMA_{ij}. \tag{2}$$

where

$$RXA_{ij} = \frac{\left(X_{ij}/X_i\right)}{\left(X_{wj}/X_w\right)} \quad \text{and} \quad RMA_{ij} = \frac{\left(M_{ij}/M_i\right)}{\left(M_{wj}/M_w\right)}$$

RCA^2 = second measure of comparative advantage

M = imports, X = exports

The second alternative measure is the logarithm of the relative export advantage and is defined as:

$$RCA^3 = \ln\left(RXA_{ij}\right). \tag{3}$$

where

RCA^3 = third measure of comparative advantage

The third and final alternative measure is revealed competiveness (RC) which is expressed as the difference between the logarithm of relative export advantage and the relative import advantage. This final measure is expressed as:

$$RCA^4 = RC = \ln\left(RXA_{ij}\right) - \ln\left(RMA_{ij}\right). \tag{4}$$

where

RCA^4 = fourth measure of comparative advantage

Positive values of all these three indices—RTA, lnRXA and RC—indicate revealed comparative advantage whereas negative values indicate revealed comparative disadvantage. This study will use all the four revealed comparative advantage indices specified above (Equations (1) to (4)) to estimate Ghana's comparative advantage in agro-processed products. A limitation of these four indices however, is that they do not control for the effect of government policies such as import duties on export values.

All four indices can be used to provide three pieces of information on comparative advantage [12]. The RCA indicators can provide information on the degree of comparative advantage a product has compared to other products. This is referred to as the cardinal interpretation [12]. Products may be ranked on the basis of their revealed comparative advantage, thus providing an ordinal interpretation of the indices. Finally, products can be classified into two groups based on their comparative advantage or disadvantage. This is the dichotomous interpretation.

Because the different indices can lead to varying and inconsistent results, statistical tests have been suggested to evaluate the extent to which the different indices are consistent in their identification of revealed comparative advantage [12]. The correlation coefficient of paired indices is used to test for consistency in the cardinal interpretation of the indices. Consistency in the ordinal interpretation is tested using the rank correlation coefficient for each pair of indices. The dichotomous consistency test is the share of products for which paired indices suggest a revealed comparative advantage or revealed comparative disadvantage. Each of these test values can range from 0 to 1. The closer is the value to 1 the higher is the consistency of interpretation across the different indices. To test whether the RCA indices are stable over time we shall employ an indicator proposed by [13]. This indicator assesses the relative importance of specific products which show a revealed comparative advantage in period t but a revealed comparative disadvantage (RCD) in period $t + 1$ or products that reveal a comparative disadvantage in period t but a comparative advantage in period $t + 1$.

The four RCA indices defined in equations one to four are estimated for Ghana's trade in agro-processed products with the rest of the world from 2004 to 2011. The data for this study was sourced from COMTRADE at the four-digit Harmonised System (HS) level of classification. A total of 69 agro-processed products groups have been sampled for this study.

4. Estimation and Results

The annual RCA indices are calculated at the HS four-digit level but reported at the two-digit level. The mean values from 2004 to 2011 for the four indices are presented in **Table 2**.

Ghana has a revealed comparative advantage in 9 product groups; these are products in which at least one of the four indicators shows that there is a comparative advantage. All the four indices show a revealed comparative advantage in only one of the products groups: cocoa and cocoa preparations (HS 18). The performance of

Table 2. Revealed comparative advantage in Ghana's agro-processed industries (2004 to 2011).

Product	RCA^1	RCA^2	RCA^3	RCA^4
02: Meat and edible meat offal	0.00	−0.84	NA	0.26
03: Fish & crustacean, molluscs & other aquatic invertebrate	0.31	−0.07	−2.14	−0.51
04: Dairy prod; birds' eggs; natural honey; edible prod nes	0.20	−1.94	−2.81	−1.11
07: Edible vegetables and certain roots and tubers	12.19	12.06	−1.09	1.74
09: Coffee, tea, mate and spices	2.17	2.05	−0.20	2.07
11: Products mill industry; malt; starches; inulin; wheat gluten	6.05	3.47	−0.06	−0.03
15: Animal/vegetable fats & oils & their cleavage products; etc.	1.01	−1.4	−1.73	0.11
16: Preparation of meat, fish or crustaceans, molluscs etc.	3.49	2.46	−1.86	−0.02
17: Sugars and sugar confectionery	0.20	−5.39	−2.98	−3.01
18: Cocoa and cocoa preparations	39.35	38.99	1.67	2.98
19: Preparation of cereal, flour, starch/milk; pastry cooks' prod	0.67	−1.05	−1.69	−1.63
20: Preparation of vegetable, fruit, nuts or other parts of plants	0.87	−3.37	−1.93	0.18
21: Miscellaneous edible preparations	0.21	−0.79	−2.85	−1.59
22: Beverages, spirits and vinegar	3.46	1.43	−2.24	−1.23

Source: Authors' calculations based on the HS four-digit data from UN COMTRADE database.

the cocoa preparations category is not surprising since Ghana has a long history of processing some of its cocoa beans. Three of the four indices indicate a revealed comparative advantage in two products groups. These products are edible vegetables and certain roots and tubers (HS 07) and coffee, tea, mate and spices (HS 09). Two of the four indices find a revealed comparative advantage in three additional products groups, *i.e*. products of the milling industry, malt, starches, inulin and wheat gluten (HS 11); preparations of meat, fish or crustaceans, molluscs etc (HS 16) and beverages, spirits and vinegar (HS 22). Finally, one of the indices, RCA^4 finds evidence of comparative advantage in two products *i.e*. meat and edible meat offal (HS 02) and preparations of vegetable, fruit, nuts or other parts of plants (HS 20). The varying results and conclusions from the four indices justify the implementation of the consistency and stability tests.

The results of the consistency tests for cardinality, ordinality and dichotomy of the four alternative revealed comparative advantage indices from 2004 to 2011 are presented in **Table 3**. The critical cut-off point to indicate

Table 3. Consistency of the revealed comparative advantage indices.

	2004	2005	2006	2007	2008	2009	2010	2011
Cardinal Test								
RCA^1:								
RCA^2	0.96	0.99	0.99	0.98	0.88	0.83	0.91	0.99
RCA^3	0.61	0.60	0.51	0.60	0.69	0.66	0.61	0.52
RCA^4	0.48	0.52	0.37	0.48	0.54	0.47	0.36	0.34
RCA^2:								
RCA^3	0.55	0.56	0.47	0.52	0.50	0.52	0.49	0.52
RCA^4	0.56	0.56	0.41	0.51	0.62	0.61	0.47	0.40
RCA^3:								
RCA^4	0.75	0.80	0.81	0.78	0.73	0.82	0.80	0.82
Ordinal Test								
	2004	2005	2006	2007	2008	2009	2010	2011
RCA^1:								
RCA^2	0.39	0.50	0.35	0.44	0.26	0.24	0.36	0.38
RCA^3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
RCA^4	0.39	0.25	0.16	0.31	0.03	0.05	0.05	0.20
RCA^2:								
RCA^3	0.43	0.60	0.44	0.47	0.39	0.38	0.48	0.47
RCA^4	0.79	0.77	0.73	0.76	0.78	0.69	0.69	0.77
RCA^3:								
RCA^4	0.72	0.76	0.77	0.73	0.66	0.79	0.79	0.78
Dichotomous Test								
	2004	2005	2006	2007	2008	2009	2010	2011
RCA^1:								
RCA^2	0.81	0.81	0.78	0.75	0.87	0.80	0.88	0.90
RCA^3	0.84	0.70	0.72	0.80	0.70	0.74	0.65	0.71
RCA^4	0.75	0.61	0.61	0.62	0.62	0.64	0.65	0.71
RCA^2:								
RCA^3	0.64	0.49	0.52	0.54	0.55	0.54	0.55	0.69
RCA^4	0.87	0.75	0.81	0.83	0.74	0.72	0.72	0.78
RCA^3:								
RCA^4	0.64	0.49	0.52	0.54	0.55	0.54	0.55	0.61

Source: Authors' calculations based on the HS four-digit data from UN COMTRADE database.

consistency is ≥0.70 [3]. The test of consistency for the cardinal measure show that of the 6 possible pairings for each of the eight years only 16 out of the 48 paired indices or 33.3% show a high level of correlation (*i.e.* ≥0.70). This suggests that the indices are not consistent as cardinal measures of revealed comparative advantage. The results show that only two of the six possible pairings (RCA^1 and RCA^2, and RCA^3 and RCA^4) show a high level of correlation. Similar findings were obtained for the Hungarian agro-food sector [14].

The rank correlation coefficient which is used to examine consistency of the ordinal measure shows that 21 of the 48 paired indices exceed the critical value. Given that less than 50% of the pairings rank the indices in the same manner we conclude that the indices are not consistent as ordinal measures of RCA. It is however interesting to note that one of the pairings (RCA^1 and RCA^2) shows perfect correlation for all the eight years with two other pairings (RCA^2 and RCA^4, and RCA^3 and RCA^4) also having high correlation ≥0.70 for the same period. All the other three pairings showed low correlation throughout. Finally, the test of the indices as dichotomous measure indicates that 25 of the 48 pairings are ≥0.70. This means that 52.1% of all the indices are consistent as dichotomous measures of RCA.

In summary, the sensitivity test results show that the four indices are less consistent as cardinal and ordinal measures but relatively more consistent as a dichotomous measure. This leads to the conclusion that, the RCA measures are useful indicators in determining whether Ghana has comparative advantage or disadvantage in agro-processed products with the rest of the world. However, the indices are less useful in determining the degree of comparative advantage in these products.

The results of the stability test as suggested by [13] are presented in **Table 4**. The products groups in which Ghana had a revealed comparative advantage in 2004 but a disadvantage in 2011 account for between two per cent to five per cent of the total value of products traded in 2004 and less than one per cent of the total value of trade in 2011. The products groups for which there was a switch from RCD in 2004 to RCA in 2011 were slightly higher but still accounted for less than two per cent of total value of commodities traded. The results show that the structure of revealed comparative advantage in the agro-processed products did not change radically between 2004 and 2011.

According to [15], changes in the distribution of the Balassa index provide information on the trend in a country's comparative advantage over time. The distribution of the Balassa index over the period 2004-2011 shows that Ghana's revealed comparative advantage in agro-processing products somewhat weakened over the period 2004 to 2011 (**Table 5**). In 2004, 68% of the products had a Balassa index of less than 1. This share increased to 74% in 2011.

5. Conclusion

This study assesses Ghana's comparative advantage in agro-processed products with the rest of the world. The

Table 4. Stability of revealed comparative advantage indices.

	Percentage Share of Product Groups where:			
	RCA_{2004}	RCD_{2011}	RCD_{2004}	RCA_{2011}
Index	2004	2011	2004	2011
RCA^1:	5.0	0.1	0.1	1.1
RCA^2	4.7	0.0	0.1	0.8
RCA^3	4.6	0.5	0.1	1.2
RCA^4	1.7	0.0	0.1	1.1

Source: Authors' calculations based on the HS four-digit data from UN COMTRADE database.

Table 5. Distribution of the Balassa index.

2004	2005	2006	2007	2008	2009	2010	2011
Percent of products with Balassa index <1							
68	72	77	72	77	77	77	74

Source: Authors' calculations based on the HS four-digit data from UN COMTRADE database.

consistency test results show that the four indices of revealed comparative advantage are less consistent as cardinal and ordinal measures but relatively consistent as dichotomous measures. This means that, the RCA measures are useful indicators in determining whether Ghana has a comparative advantage or disadvantage in agro-processed products. Finally the products in which there was a switch from RCA in 2004 to RCD in 2011 or vice versa account for at most 5% of the total value of trade. This shows that the revealed comparative advantage has not changed radically over the period. However, a careful examination of the Balassa index shows that Ghana's RCA in agro-processed products is somewhat weakening over time. The share of products with revealed comparative disadvantage increased between 2004 and 2011. We find that in addition to horticultural products, which have been given special mention in the most recent policy document, Ghana has a comparative advantage in other agro-processed product groups such as preparations of meat and fish, beverages and products of the milling industry. We thus recommend that specific policy measures should be developed to address constraints facing producers in these industries in order to achieve the objective of diversifying into agro-processed products.

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