

BIOECONOMY MALAYSIA REPORT



ISSUE 1 | OCTOBER 2015

REVEALED COMPARATIVE ADVANTAGE OF BIO-BASED PRODUCTS: A MALAYSIAN CASE STUDY

Abstract

The paper adopts the Balassa's Revealed Comparative Advantage model through comparing the structure of Malaysia's specialisation in trade vis-à-vis the rest of the world to analyse the competitiveness of the country's bio-based industries. The paper gives a brief on the structure of Malaysian bio-based exports and its performance over time, and later applied the model to see how competitiveness in some of the products have evolved. The findings shows that Malaysia has comparative advantages in oil & fats, organic chemicals and rubber. Meanwhile animal based, vegetable based, foodstuffs, pharmaceuticals and other products have comparative disadvantages. A discussion on the implications of the findings and possible policy reactions concluded the study.

Keywords: Malaysia, bioeconomy, biotechnology, bio-based, palm oil, rubber, RCA, revealed comparative advantages

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INTRODUCTION



INTRODUCTION

Growing global prominence in biotechnology has not go unnoticed by policymakers across the world. The scientific progress, advances in research capabilities, and ongoing breakthrough discoveries have helped in encouraging further development in the biotechnology sector which leads to its increasing importance in the global economy.

In Malaysia, the interest in biotechnology had its beginnings in the late 1980's under the 5th Malaysia Plan. However, it was only in the 8th Malaysia plan (2001-2005) that biotechnology was given due recognition. Following the cue from the developmental focus in information and communication technology (ICT) earlier on, Biotechnology was identified as the next source of growth that could capitalise on Malaysia's strength and push the country further upwards the technology ladder. As a result, the Malaysian government launched National Biotechnology Policy (NBP) outlining strategies on enhancing prosperity and wellness of the nation by 2020. Launched in 2005, the NBP is a comprehensive framework designed to guide the development of the local biotechnology industry through creation of a favourable R&D environment and focused industry development that leverages on the existing strengths of the country. It envisions that biotechnology will be a new economic engine for Malaysia, enhancing the nation's quality of life, generate new wealth and income for both the rural and urban population, and improve the socio-economic status of people as a whole (Kamal & Che Dir, 2015).

Ten years after introduction, the NBP is currently reaching the end of Phase 2 (2011-2015) which focuses on commercialisation efforts of biotechnology research, following 5 years of capacity building (2005-2010). The next step is to move to Phase 3 (2016-2020) – Going Global which aims to put forward locally grown companies on the international fora. Specific strategies like the Bioeconomy Transformation Programme (BTP) has been launched as a platform for the private sector to channel and maximise commercial opportunities.

Despite the ambitious goals, there is still considerable hurdle to go over with respect to the development of comprehensive Bioeconomy environment for companies to grow. At this stage, it is crucial for the government to identify areas that are lacking with respect

to funding, policies, or implementation that could hamper further progress. There is a need to first identify how well bio-based industry is performing. One such area of interest is to see whether Malaysian biotechnology products are competitive enough in the world market. If Malaysian bio-based companies were not able to perform on the global basis, there should be a way to identify this and find a solution to address this lacking.

We are interested to look at competitiveness particularly because it is considered a key criterion for accessing the success of an industry. World Economic Forum define competitiveness as the set of institutions, policies and factors that determine the level of productivity of a country. The level of productivity, led to more market share, greater profitability and long-term stability, and in turn, sets the level of prosperity that can be earned by an economy, thereby improving the welfare and living standards of people (Mehralian & Shabaninejad, 2014). Putting it in perspective, countries and industries must be well competitive in order to survive.

In this paper, we seek to explore Malaysia's relative competitiveness in bio-based industry and compare the structure of its specialisation in trade vis-à-vis the rest of the world. The empirical analysis of this paper is based on the Revealed Comparative Advantage (RCA) approach which has been a widely known method in analysing trade data and comparative advantages. We will apply this method on bio-based exports as a proxy of bio-based products. Since we are interested in measuring the trade performance against all other competitors, we will use exports to global markets to represent global context.

The structure of the paper is as follows. The next section discusses Malaysia export-oriented development strategy and its tie-in with the bio-based industry. The paper continues by exploring existing literature on the use of the model and existing work that has been done on comparative advantages in Malaysia. Next sections explore possible ways to measure RCA and the final section discusses the results.

MALAYSIA'S MOVE INTO BIOTECHNOLOGY



MALAYSIA'S MOVE INTO BIOTECHNOLOGY

Malaysia has always been a key player in international exports. From a primary producer with a gradual industrialisation strategy, the Malaysian economy has undergone transformation into a highly-open economy through greater trade and financial integration since the late 1970s. Contributing to this structural changes is the shift in focus towards export-oriented industrialisation strategy which is defined as a deliberate government policy with the explicit intention to increase exports, thus going beyond laissez-faire. It involves various incentives and regulations, including tax exemptions and subsidies, investments guarantee agreements, regulations on credit and interest rates, exchange control rules, provision and pricing of physical infrastructure (Osman-Rani & Piei, 1990). As a result, Malaysia's trade openness is among the highest in the region, reaching a peak of 192% of GDP in 2000.

Evidently the strategy worked in supporting GDP growth as investments and exports continue to remain strong. In the 1980's it led to a sharp shift away from the commodity sector (mainly rubber and tin) and into manufacturing. Even within the manufacturing industry, there is also a shift in sub-index away from food, beverages and tobacco production and into electrical machinery. The rise of importance in the electrical & electronics (E&E) industry is so prevalent that all throughout the 1990's to the early 2000's, the degree of concentration remains strongly within the E&E industry. This heavy reliance of electrical and electronics were well in tandem with the growing appetite for products particularly computers and laptops.

However, the E&E sector faces significant challenges in maintaining growth with growing competition from China, Taiwan, Singapore and other Asian countries. Over the last 10 years, E&E's share of Malaysian exports has gradually declined. Of greater significance, however, is Malaysia's position in the value chain compared to our competitors. Malaysia's E&E sector remains focused on assembly, the lower value added part of the industry while countries like Taiwan, South Korea and Singapore have captured the higher value-added activities in research and development (R&D), design and manufacturing (Pemandu, 2011).

As a result, there is a need to diversify and further develop other industries to reduce reliance on a single source of growth yet able to create value that is competitive, innovative and consistent with the aspirations of Vision 2020. As life sciences are regarded as one of the most promising frontier technologies, there is a profound interest of pursuing biotechnology as it offers not just improvement in economy but also on health and environmental protection. Thus, the country's industrial competitiveness as well as standard and quality of living will be improved in line with the improvement of the industry. In addition, Malaysia has rich natural resources and vast local diversity, hence a move towards creating an enabling environment to develop and apply biotechnology would be natural and symbiotic.

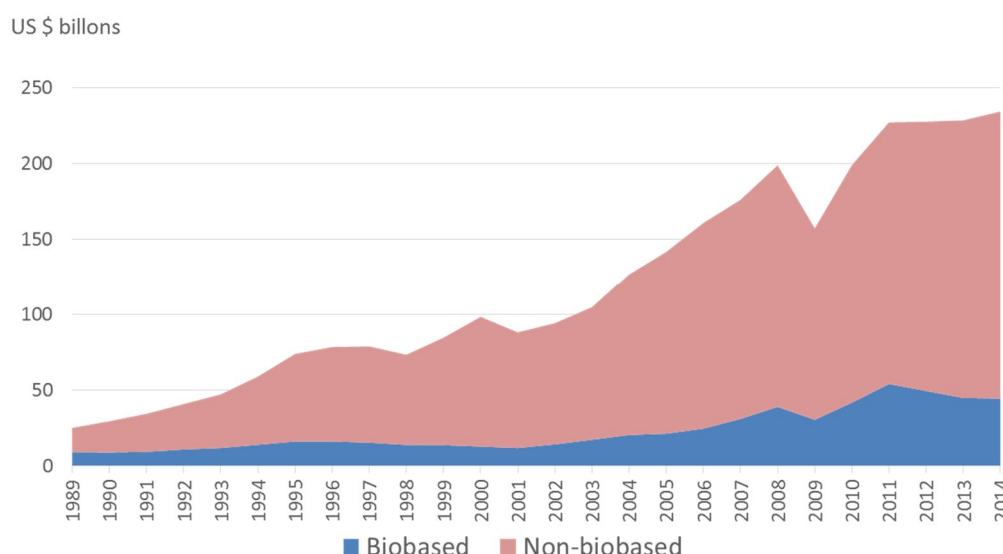
A LOOK INTO BIO-BASED EXPORTS



A Look into Bio-based Exports

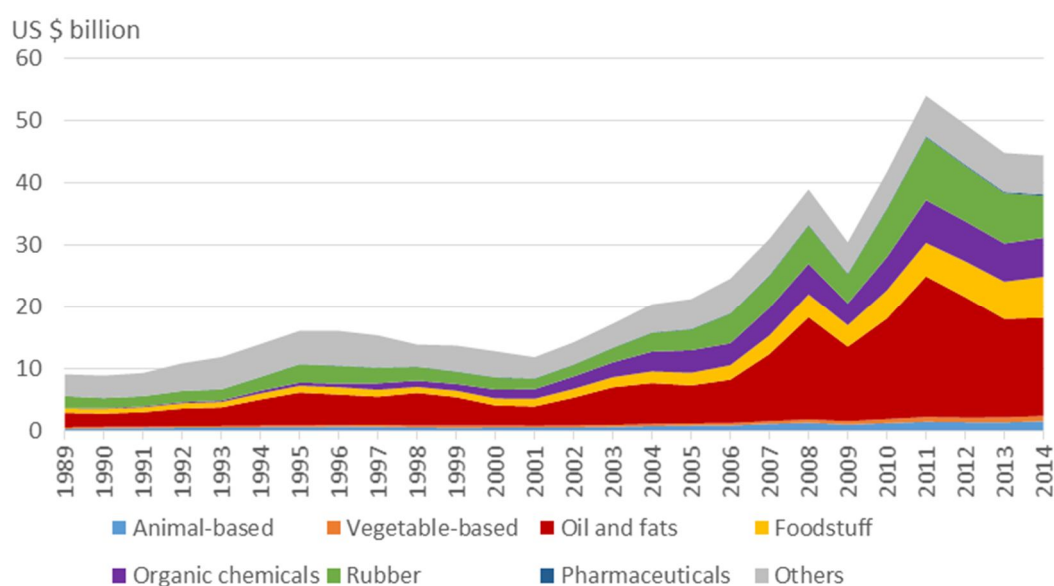
We are interested in looking at bio-based industry rather than biotechnology due to practical factors. The Malaysian National Biotechnology Policy defines biotechnology as any technique which uses living organisms to make or modify products, improve plant or animal productivity or to develop micro-organisms for specific use. This definition encompasses new biological tools such as cell fusion or recombinant DNA. However, there are two problems stemming from this definition; first, it captures a narrow scope of the industry, not taking into account the larger value chain of which biotechnology can be adopted since some of the processes of products does not fulfil the definition criteria. Second, in the trade data, the definition is difficult to apply because biotechnology is a process rather than a product. Trade data records the output rather than how a product was made. While a biotechnology company can produce a certain product, other non-biotechnology company can also produce the same product under traditional or other processes. In the trade data, there is no distinction made between products that is produced through a biotechnology processes against the ones that is produced by non-biotechnology processes. As a result, this leads to difficulties in narrowing down on biotechnology product through its direct definition.

Our solution to this problem is to define biotechnology product on a broader basis. We define export products that are derived from any biological natural resources (excluding minerals such as oil and gas) as 'bio-based' and use this term loosely to represent biotechnology products. Our argument is, any biological natural resources would undergo some form of transformation, be it simple (i.e.: frozen, packed) or complex (i.e.: trans-esterified) before being exported. And this transformation process may involve some form of biotechnology or they are yet able to be transformed under biotechnology processes. As such, the term bio-based exports involved both product that are, and can be used for biotechnology-related processes. As long as the product are produced through biological means using biological products it can be considered as bio-based, however we draw the limit to product that are clearly non-biologically processed such as production of furniture or apparels, although wood and cotton production is bio-based. Using this term makes defining and calculating exports performance much easier. The list of product classification under bio-based are presented in the appendix.

Figure 1: Value of Bio-based Exports and Non Bio-based Exports

Using the method mentioned above, we were able to dissect certain export pattern in bio-based products. Figure 1 highlighted the value of Malaysian exports of bio-based products and non-bio-based yearly over the period from 1989 (the date the earliest data available) up to 2014. In 1989, value of bio-based exports were only USD9 billion but grew to USD44.3 billion by 2014, a CAGR of 6.6% over the period. While the growth is commendable, it was shadowed by a stronger growth in non bio-based exports – which rose from USD16 billion up to USD189.8 billion over the same period, a CAGR of 10.4% over the 25 year term. In percentage share, bio-based exports account for 36% of total exports in 1989 and the share continue to decline steadily as non bio-based exports grew faster. By 2014, bio-based exports account for 19% of total Malaysian exports.

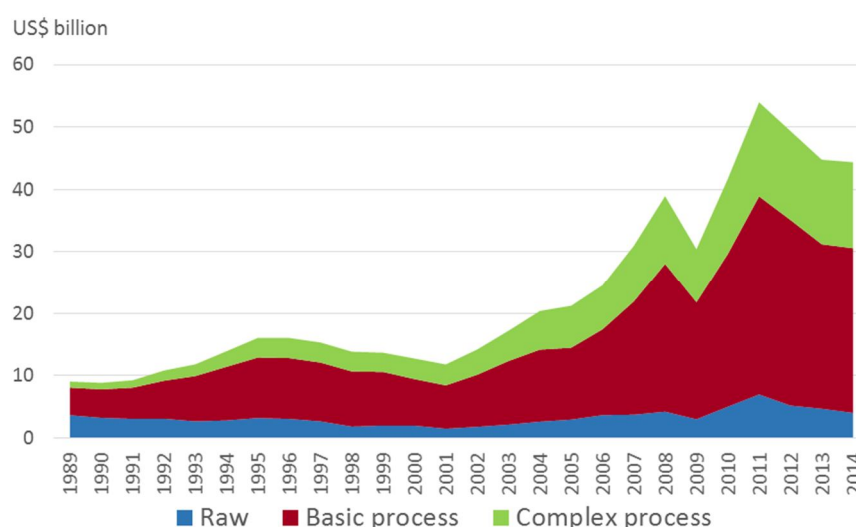
The slower pace of growth for bio-based exports compared to non bio-based are not at all surprising given the stronger government emphasis on E&E exports during the 90's and early 2000's. The interesting part is that the growth of bio-based exports are not always positive. The year 2009 showed a sharp decline in exports value and this is in tandem with the decline in global demand amid the Global Financial Crisis in the advanced economies. Bio-based exports are also affected in the years of 2012-2014 as the value declined slightly amid the weakening commodity prices which affected the value of exports.

Figure 2: Bio-based Exports by Types of Product

Analysis by types of Malaysian bio-based products shows an even more interesting development. Oil and fats takes up the largest portion of exports as well as the highest pace of growth, primarily due to palm oil and palm oil derivatives. Rubber took the second largest share at 18% of bio-based exports in 2014. Interestingly enough, the growth of foodstuff and organic chemicals have shown impressive progress over the years. Both foodstuff and organic chemicals share grew from a mere 7% and 1% respectively in 1989 up to 13.6% and 13.8% respectively in 2014.

Further, we separate the export products by level of processes to determine the development of product based on their complexity. Products that requires little or no transformation (i.e.: fresh, live, cut, frozen, packed) is classified as raw products; meanwhile basic products take into account the products that have some level of transformation which can range from simple to specialised but able to be made on small scale or non-industrial basis (i.e.: refined products, production of cheese or honey, cooked or canned items). Lastly, complex products are products that requires chemical modifications or that which requires specified complex knowledge in order to produce. There are typically chemicals, medicals or cosmetics of bio-based derivatives¹. Figure 3 highlights the findings.

¹ We noted concerns over the liberal distinction between such classifications as certain product may fall into a different category depending on the view of the person assessing it. Hence we agree that the definitions can

Figure 3: Bio-based Exports by Types of Product Complexity

By product complexity, it is clear that Malaysia has been increasingly focused on the development of higher value added products evidenced by the increasing share of complex processes in the export mix. The share of complex process to total bio-based exports are only 7% in 1989 but grew to over 26% by 2014. In terms of value, it grew from USD653 million to USD11.4 billion over the same period. Meanwhile, basic processes also grew from 52% to 65% from 1989 to 2014, capturing the value of USD29 billion in 2014 up from a mere USD4.7 billion in 1989. The raw products however showed little progress over the years as it remained stable at USD3-4 billion.

Overall, the general assessments of the nature and performance of bio-based export product may highlight some form of indication as to what the RCA modelling would entail. In particular, we could expect products that generally are growing rapidly would signal that it is competitive in the global market. At the same time, a decline in some product may indicate that Malaysia is losing its competitiveness in that said product. Nevertheless, relying in inference too much can be dangerous as an industry can drop in its RCA ranking over time, while still improving its revealed comparative advantage in absolute terms. The only way to confirm our predictions then is to run the model which is discussed in the following sessions.

easily be argued. Nevertheless, our objective is to get a general 'feel' of the nature of the products being exported although every possible efforts has been made to keep it fairly reasonable.

LITERATURE REVIEW



Literature Review

The study of comparative advantages of Malaysian exports has been widely explored by the international economics community. However, the scope and depth of study differs among researchers. In particular, a lot of interest is given on analysing Malaysia's manufacturing competitiveness in the wake of a greater competition from China and other Asian economies. Meanwhile, any available studies on resource-based industries primarily focused on petroleum and industrial crop commodities such as palm oil and rubber. As to our knowledge there has been no studies done on competitiveness of Malaysian bio-based industry in its entirety thus far.

In general, RCA studies on overall Malaysian exports have confirmed the dominance of electrical & electronics, textile, clothing, wood, rubber and chemical industries. RCA patterns before the year 2000 shows that categories such as office equipment, electrical & electronic goods and telecommunication products have maintained their comparative advantages as well as able to move into relatively technological and high-skill labour intensive areas (Mahmood, 2000). Post-2000 however, there has been a general agreement among researchers that the comparative advantage that Malaysia have, has deteriorated over time (Goswami et al. 2011). Loke (2008) indicated that Malaysia's comparative advantages in many of the electrical and electronic manufactures have been eroding given the structural change that the Malaysian economy has undergone in the past two decades which has led to labour shortage as well as rising wages. Shinobul (2013) in comparing RCA using China and ASEAN markets as a comparison has pointed out that Malaysia comparative advantage is in mineral fuels & lubricants as well as machinery and transport equipment, while having comparative disadvantage in chemicals and related products.

Available studies on bio-based products has shown that Malaysia has comparative advantage in various products. Hassanpour & Ismail (2010) stated six products: palm oil, coconut, palm kernel oil, cocoa butter, cocoa powder, cocoa paste and pepper. Meanwhile, Rydster (2014) stated that Malaysia had RCAs in vegetable oil, cocoa preparation, cereal preparation, miscellaneous edible preparation, tobacco products, and rubber products. The differences in results are not utterly surprising given the different approach on

methodology as well as the years the data is being used. But typically, the findings shows that Malaysia have advantage in its industrial crops especially palm oil and derivatives and selected food items.

METHODOLOGY AND MODELLING



Methodology and Modelling

The theory of comparative advantage stated that countries are assumed to differ only in their productive capacities where comparative advantage belongs to a country which can produce a product with the least use of resources. In a two countries, two product scenario, a prominent 18th century economist, David Ricardo have proven that even when one country is technologically superior in the production of both products, it could still be better off for both countries to specialise only in one product and trade with another country that specialises in the production of another product. The reason both countries can benefit in this case is because productivity is also constrained by resources such as hours of work hence a country which efficiently distribute its working hours into an industry that it is most efficient could yield a higher output. Ricardo demonstrated that by specialising in producing the products that one has a comparative advantage, the world can expand total world output with the same quantity of resources and improve total welfare for everyone².

The difficulties in measuring comparative advantage of a sector is the limited information on factor endowments (i.e.: cost of inputs, wages and technological level) which is used to determine relative prices. Given this fact, Balassa (1965) proposes that it may not be necessary to include all factors effecting country's comparative advantage. Instead, he suggests that comparative advantage is "revealed" by observing trade patterns. When a country has a comparative advantage in a sector or a product, then under the assumption of free market economics, international buyers will demand more of that product in such a way that a country will be producing more than the rest of the world could. Having a higher share of production of a product indicates comparative advantage. In a way, Balassa's method of calculation lets the market "reveal" itself whether a country has a comparative advantage rather than to determine the underlying sources of comparative advantage.

² For more detailed readings on the theory of comparative advantage, please refer to:
<https://internationaleconpolicy.wordpress.com/2007/10/03/a-lesson-on-comparative-advantage/>

Balassa's Revealed Comparative Advantage (RCA) model is one of the most applied tools to measure the export specialisation of an export product or sector. The RCA is measured by taking the share of particular industry (or product) to the country's total exports and dividing it to the share of the industry's exports in the 'markets' total exports. For example, the RCA of country n in product p is the ratio of the share of a product p in n 's total exports to the share of p in the total markets' exports. Here, the 'markets' are defined as the whole world or a trade bloc such as the European Union depending on the objective of the study. In our case, we are interested to measure global bio-based exports competitiveness, hence we identify the world as our product market. Defined as such, the mathematical representation of RCA is:

$$RCA = (X_{np} / X_{nt}) / (X_{wp} / X_{wt}) \quad (1)$$

Where

X_{np} = value of exports of commodity p by country n

X_{nt} = value of total exports by country n

X_{wp} = value of world exports of commodity p

X_{wt} = value of total world exports

The computation will yield a positive number which indicates how many times a country's product share is bigger than world's share. Essentially, a comparative advantage is "revealed", if $RCA > 1$. It is also understood that the higher the number, the stronger the competitiveness of that product or sector in the country. If RCA is less than 1, the country is said to have a comparative disadvantage in the product/sector.

An improvement to the Balassa's RCA methodology is to measure an exclusion of import content into the export so as to only measure the net exports (export minus imports). The equation can be written as follows:

$$RCA_2 = (X_{np} - M_{np}) / (X_{nt} + M_{nt}) \quad (2)$$

Where

X_{np} & M_{np} = value of exports & imports of commodity p by country n

X_{nt} & M_{nt} = value of total exports & imports by country n

This methodology will yield value ranging between $[-1;1]$, with a neutral value of zero, where negative implies competitive disadvantage and a positive value implies an advantage. However, Greenaway and Milner (1993) highlighted interpretation difficulties when the RCA value is zero.

There are also further alternative to the model, in particular, to fairly measure the strength of competitiveness of a country since the original index value is asymmetric as it ranges between $[0: \infty]$. For a fair interpretation, the value should be symmetric around 1. Vollrath (1991) suggests to take the logarithm to the RCA, as a solution to this problem:

$$RCA_3 = \ln [(X_{np} / X_{nt}) / (X_{wp} / X_{wt})] * 100 \quad (3)$$

However, if the value of an export for a product under study is zero, the index will be undefined, leading to difficult circumstances in analysis and interpretations.

In retrospect, a full range of alternative models to the Balassa's RCA continues to be developed ever since. As such, in the literature, there have been multiple interpretations of countries' competitiveness of a product/sector depending on the types of models used. In this paper, we prefer to opt for the standard model (Equation 1) as our method of calculation and leave to explore other methods of calculations possibly on a different study.

DATA AND EMPIRICAL RESULT



DATA AND EMPIRICAL RESULT

In order to measure the RCA of Malaysian bio-based products following the model developed by Balassa (1965), we used up to 4-digits HS (Harmonised System) code obtained from the UN COMTRADE database. The exports data are annual from 1995 to 2013, involving 141 countries. For calculation of total world exports, data for other countries apart from the 141 countries specified, are not available in the UN database and are excluded. We assume that these countries' exports are small and insignificant and does not change the share of world product exports as much.

The following are the result of the calculation using Equation 1. We have classified the product into a similar cluster of products as in Figure 2.

Table 1: RCA by Major Bio-based Product Clusters

	Animal Based	Vegetable Based	Oil & Fats	Foodstuff	Organic Chemicals	Rubber	Pharmaceuticals	Others*
1995	0.30	0.11	10.80	0.40	0.26	4.13	0.07	1.81
1996	0.31	0.12	11.91	0.40	0.29	3.59	0.06	1.85
1997	0.34	0.15	10.33	0.40	0.54	1.76	0.06	1.75
1998	0.31	0.15	12.73	0.38	0.56	3.10	0.05	1.32
1999	0.25	0.17	11.14	0.38	0.50	1.59	0.04	1.41
2000	0.25	0.16	9.82	0.40	0.59	1.52	0.04	1.28
2001	0.25	0.15	10.46	0.45	0.70	1.60	0.03	1.11
2002	0.26	0.15	11.40	0.47	0.79	2.31	0.03	1.08
2003	0.28	0.13	12.83	0.49	0.83	2.45	0.03	1.03
2004	0.29	0.12	11.64	0.49	0.91	2.61	0.03	1.04
2005	0.31	0.13	11.18	0.52	0.87	2.65	0.02	1.11
2006	0.28	0.12	10.69	0.51	0.87	3.19	0.02	1.17
2007	0.33	0.11	12.65	0.59	1.02	3.08	0.03	1.13
2008	0.34	0.11	13.48	0.65	1.08	3.40	0.03	1.05
2009	0.29	0.12	13.05	0.63	0.91	3.18	0.02	1.11
2010	0.32	0.13	14.30	0.76	1.08	3.74	0.03	1.03
2011	0.31	0.13	14.84	0.76	1.23	3.67	0.03	0.97
2012	0.31	0.12	13.62	0.81	1.12	3.47	0.03	1.02
2013	0.28	0.12	11.95	0.79	1.06	3.46	0.03	0.93

Note: RCA>1 implies competitive advantage in the cluster

*Others refers to bio-based products that does not fall into the product clusters. These includes organic fertilisers, essential oils, and raw and primary derivations of leather, wood, cotton, wool, and silk. Please refer to the appendix for details of products under this category.

The following are the RCA of products at 4-digit HS code that have shown comparative advantage ($RCA > 1$), by major product cluster and on selected years:

Table 2: RCA of Selected Animal Based Products ($RCA > 1$)

	HS code	1995	2000	2005	2010	2011	2012	2013
Live poultry such as chicken, ducks, geese, turkeys and guinea fowls	105	6.00	5.97	5.27	5.14	4.76	4.68	4.40
Live fish	301	1.50	2.60	2.37	3.80	3.07	3.06	2.36
Crustaceans, whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; smoked	306	0.72	0.90	1.78	1.86	1.70	1.55	1.22
Aquatic invertebrates other than crustaceans and molluscs	308	0.00	0.00	0.00	0.00	0.00	0.00	1.32
Birds' eggs, in shell, fresh, preserved or cooked	407	1.86	2.79	2.30	2.24	2.57	2.49	2.02
Edible products of animal origin, not elsewhere specified or included	410	4.23	1.04	1.81	3.59	3.49	0.93	1.68

Table 3: RCA of Selected Vegetable Based Products ($RCA > 1$)

	HS code	1995	2000	2005	2010	2011	2012	2013
Pepper of the genus Piper; dried or crushed or ground fruits of the genus Capsicum or of the genus Pimenta.	904	3.49	4.45	2.50	2.22	2.22	1.76	1.96
Flour, meal and powder of the dried leguminous vegetables, of sago or of roots or tubers	1106	2.81	2.04	1.64	2.73	3.37	2.98	2.71

Table 4: RCA of Selected Oil & Fats Products (RCA > 1)

	HS code	1995	2000	2005	2010	2011	2012	2013
Soya-bean oil, fractions, not chemically modified	1507	0.94	1.88	1.28	1.11	1.14	1.25	1.18
Palm oil and its fractions, whether or not refined, but not chemically modified.	1511	37.77	33.57	31.21	29.85	31.14	29.98	27.88
Coconut, palm kernel, babassu oil, fractions, refined	1513	28.66	8.11	12.52	13.15	15.40	13.34	12.95
Animal or vegetable fats and oils and their fractions, partly or wholly hydrogenated, inter-esterified, re-esterified or elaidinised, whether or not refined, but not further prepared.	1516	16.53	14.96	23.28	35.42	33.76	29.96	25.17
Margarine; edible mixtures or preparations of animal or vegetable fats or oils or of fractions of different fats or oils of this Chapter, other than edible fats or oils or their fractions of heading 15.16.	1517	3.98	4.79	4.16	4.62	4.42	3.66	3.46
Animal or vegetable fats and oils and their fractions, boiled, oxidised, dehydrated, sulphurised, blown, polymerised by heat in vacuum or in inert gas or otherwise chemically modified, excluding those of heading 15.16	1518	0.13	0.15	1.26	2.13	0.94	1.73	3.37
Glycerol, crude; glycerol waters and glycerol lyes.	1520	19.00	24.83	20.21	1.21	0.67	0.51	1.83
Vegetable waxes (other than triglycerides), beeswax, other insect waxes and spermaceti, whether or not refined or coloured.	1521	0.06	0.04	1.23	1.18	1.07	3.12	6.16
Degras; residues resulting from the treatment of fatty substances or animal or vegetable waxes.	1522	5.89	2.01	6.59	6.23	3.99	3.44	3.98

Table 5: RCA of Selected Foodbased Products (RCA > 1)

	HS code	1995	2000	2005	2010	2011	2012	2013
Extracts and juices of meat, fish or crustaceans, molluscs or other aquatic invertebrates.	1603	3.50	0.54	1.70	1.58	1.61	2.40	1.79
Cocoa paste, whether or not defatted.	1803	1.69	2.36	3.22	4.23	5.58	4.72	3.00
Cocoa butter, fat, oil	1804	4.86	4.50	8.46	10.21	9.00	8.19	6.26
Cocoa powder, unsweetened	1805	2.42	3.02	6.18	8.73	9.72	10.18	8.47
Malt extract; food preparations of flour, groats, meal, starch or malt extract	1901	1.49	0.82	1.11	2.18	2.21	2.70	2.46
Tapioca and tapioca substitutes	1903	4.59	1.77	0.31	0.98	0.68	1.26	1.03
Bread, pastry, cakes, biscuits and other bakers' wares	1905	0.92	0.77	0.77	1.11	1.16	1.21	1.16
Extracts, essences, concentrates of tea, coffee, mate	2101	0.44	1.13	1.56	2.83	2.96	3.57	3.67
Sauces and preparations therefor; mixed condiments and mixed seasonings; mustard flour and meal and prepared mustard.	2103	0.57	0.70	0.76	1.10	1.14	1.20	1.14
Food preparations not elsewhere specified or included.	2106	0.41	0.36	0.51	0.89	1.02	1.23	1.23
Waters, including mineral waters and aerated waters	2202	0.60	0.73	0.56	0.88	1.13	1.32	1.36
Oil-cake and other solid residues, resulting from the extraction of ground-nut oil.	2305	0.01	0.00	0.00	0.02	0.08	0.93	7.85
Oil-cake and other solid residues, resulting from the extraction of vegetable fats or oils	2306	5.67	3.29	3.44	3.68	4.25	3.43	3.87
Tobacco, tobacco substitute products nes	2403	0.78	1.65	1.51	2.02	1.99	2.82	1.51

Table 6: RCA of Selected Organic Chemical Products (RCA > 1)

	HS code	1995	2000	2005	2010	2011	2012	2013
Cyclic hydrocarbons	2902	0.02	0.50	1.22	1.02	1.28	1.04	1.43
Acyclic alcohols and their derivatives	2905	1.05	1.58	2.75	3.24	3.43	3.76	3.23
Saturated acyclic monocarboxylic acids and their anhydrides, halides, peroxides and peroxyacids; their halogenated, sulphonated, nitrated or nitrosated derivatives.	2915	0.96	1.48	2.97	3.77	4.02	4.37	3.63
Unsaturated acyclic monocarboxylic acids, cyclic monocarboxylic acids, their anhydrides, halides, peroxides and peroxyacids; their halogenated, sulphonated, nitrated or nitrosated derivatives.	2916	0.01	0.88	2.96	3.66	3.85	2.92	2.93
Polycarboxylic acids, their anhydrides, halides, peroxides and peroxyacids; their halogenated, sulphonated, nitrated or nitrosated derivatives.	2917	0.04	1.97	1.30	1.32	1.42	1.21	1.19
Glycosides, natural or reproduced by synthesis, and their salts, ethers, esters and other derivatives.	2938	0.00	0.01	0.03	7.77	2.95	4.29	4.05
Industrial monocarboxylic fatty acids; acid oils from refining; industrial fatty alcohols.	3823	1.01	15.22	17.53	19.39	18.88	16.84	15.45

Table 7: RCA of Selected Rubber Products (RCA > 1)

	HS code	1995	2000	2005	2010	2011	2012	2013
Natural rubber, balata, gutta-percha, guayule, chicle and similar natural gums, in primary forms or in plates, sheets or strip.	4001	0.00	0.00	0.00	8.32	0.00	5.27	6.85
Reclaimed rubber in primary forms or in plates, sheets or strip.	4003	0.00	1.73	3.20	3.93	5.48	4.73	5.94
Compounded rubber, unvulcanised, in primary forms or in plates, sheets or strip.	4005	0.53	0.24	0.86	10.23	9.17	12.49	10.96
Vulcanised rubber thread and cord.	4007	30.60	26.80	28.00	24.08	24.81	22.08	21.03
Rubber plate, sheet, strip, rod etc, except hard	4008	1.77	1.50	1.43	1.79	1.58	1.65	1.28
Tubes, pipes and hoses, of vulcanised rubber other than hard rubber, with or without their fittings (for example, joints, elbows, flanges).	4009	0.29	0.41	0.63	0.94	1.05	1.12	1.14
Retreaded or used pneumatic tyres of rubber; solid or cushion tyres, tyre treads and tyre flaps, of rubber.	4012	0.32	0.29	0.64	0.37	0.92	1.18	1.35
Hygienic or pharmaceutical articles (including teats), of vulcanised rubber other than hard rubber, with or without fittings of hard rubber.	4014	4.20	2.78	3.13	6.44	6.39	7.35	9.02
Rubber clothing and accessories, except hard rubber	4015	24.08	25.44	27.46	34.69	34.75	36.49	38.30

Table 8: RCA of Selected Others Products (RCA > 1)

	HS code	1995	2000	2005	2010	2011	2012	2013
Artificial fur and articles thereof	4304	0.00	0.05	0.00	0.48	3.21	4.34	5.48
Wood charcoal (including shell or nut charcoal)	4402	3.85	3.47	2.56	4.53	2.70	2.45	1.81
Wood in the rough or roughly squared	4403	6.67	5.76	4.95	2.77	3.54	3.65	3.43
Railway or tramway sleepers (cross-ties) of wood	4406	8.86	3.52	1.94	1.95	1.40	1.70	2.20
Wood sawn or chipped lengthwise, sliced or peeled	4407	3.08	2.19	1.99	3.01	1.96	1.91	1.79
Veneers and sheets for plywood etc <6mm thick	4408	6.63	5.40	2.54	3.44	2.79	3.10	2.77
Wood (including strips and friezes for parquet flooring, not assembled)	4409	5.85	4.30	3.04	1.02	3.64	3.56	3.21
Particle board, similar board, wood, ligneous materia	4410	0.31	0.54	0.56	3.00	1.09	1.12	1.06
Fibreboard of wood or other ligneous materials	4411	2.01	3.57	2.33	9.46	2.74	2.86	2.61
Plywood, veneered panels and similar laminated wood.	4412	14.14	9.38	10.12	0.39	8.88	8.59	8.71
Wooden frames for paintings, photographs, mirrors etc	4414	2.44	2.02	2.55	1.31	3.37	3.73	3.23
Packing cases, boxes, crates, drums and similar packings, of wood	4415	0.96	0.84	0.74	0.01	1.23	1.51	1.57
Builders' joinery and carpentry of wood	4418	1.37	1.64	1.94	0.18	1.71	1.71	1.47
Waste of wool or of fine or coarse animal hair	5103	0.68	0.26	2.22	3.05	0.66	1.12	1.37
Wool and fine or coarse animal hair, carded or combed	5105	1.47	0.06	0.45	0.49	0.88	1.04	1.68
Yarn of combed wool, not put up for retail sale.	5107	2.63	1.83	1.02	0.92	1.02	1.06	1.03
Cotton waste (including yarn waste and garnetted stock).	5202	1.99	1.32	1.31	1.50	1.04	1.14	1.24
Cotton yarn (except sewing) < 85% cotton, not retail	5206	0.31	1.51	0.06	1.20	1.23	0.83	1.05
Woven cotton, <85% cotton with manmade fibre, <200g/m2	5210	2.35	2.01	1.50	1.90	1.92	1.95	2.37

RESULT ANALYSIS



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From Table 1, the findings are as follows:

- 1) Sector that have revealed comparative advantage in 2013 are *oil & fats*, *organic chemicals* and *rubber*. Meanwhile *animal based*, *vegetable based*, *foodstuffs*, *pharmaceuticals* and *others* have comparative disadvantage in 2013.
- 2) *Oil & fats* cluster of products have a considerably high RCA score implying significant competitiveness of Malaysia in the production of such products. This is followed by *rubber* products which also have moderately high RCA score.
- 3) Product clusters that show sustained improvement in the RCA scores are *foodstuff*, *organic chemicals* and *rubber*, while product clusters that show a sustained decline in RCA scores are in the *others* category. The scores for *animal based*, *vegetable based*, *oil & fats*, and *pharmaceuticals* remain relatively unchanged.

Meanwhile, deeper analysis on the product basis (Table 2 to 8) have shown some interesting findings:

- 1) While a product cluster does not appear to have comparative advantage as a whole, some of the products within the cluster may have comparative advantages. This is the case for *Animal Based*, *Vegetable Based*, *Foodstuff*, and *Others* product cluster.
- 2) Pharma cluster does not appear to have any comparative advantages at the 4 digit HS code level.
- 3) Among the products with comparative advantage ($RCA > 1$), few have shown a consistent increase in the RCA scores which may imply growing competitiveness in the product. These are:
 - a. Animal Based
 - (HS 301) Live fish
 - (HS 306) Crustaceans, whether in shell or not
 - b. Oil & fats
 - (HS 1516) Animal or vegetable fats and oils and their fractions, partly or wholly hydrogenated, inter-esterified, re-esterified or elaidinised
 - (HS 1513) Coconut, palm kernel, babassu oil, fractions, refined

- (HS 1518) Animal or vegetable fats and oils and their fractions, boiled, oxidised, dehydrated, sulphurised, blown, polymerised by heat in vacuum or in inert gas or otherwise chemically modified
- (HS 1521) Vegetable waxes (other than triglycerides), beeswax, other insect waxes and spermaceti, whether or not refined or coloured.
- c. Foodstuffs
 - (HS 1805) Cocoa powder, unsweetened
 - (HS 1901) Malt extract; food preparations of flour, groats, meal, starch or malt extract
 - (HS 1905) Bread, pastry, cakes, biscuits and other bakers' wares products
 - (HS 2101) Extracts, essences, concentrates of tea, coffee, mate
 - (HS 2103) Sauces and preparations therefor; mixed condiments and mixed seasonings; mustard flour and meal and prepared mustard.
 - (HS 2106) Food preparations not elsewhere specified or included.
 - (HS 2202) Waters, including mineral waters and aerated waters
- d. Organic Chemicals
 - (HS 2902) Cyclic hydrocarbons
 - (HS 2905) Acyclic alcohols and their derivatives
 - (HS 2915) Saturated acyclic monocarboxylic acids and their anhydrides, halides, peroxides and peroxyacids; their halogenated, sulphonated, nitrated or nitrosated derivatives.
 - (HS 2916) Unsaturated acyclic monocarboxylic acids, cyclic monocarboxylic acids, their anhydrides, halides, peroxides and peroxyacids; their halogenated, sulphonated, nitrated or nitrosated derivatives.
 - (HS 2938) Glycosides, natural or reproduced by synthesis, and their salts, ethers, esters and other derivatives.
- e. Rubber
 - (HS 4005) Compounded rubber, unvulcanised, in primary forms or in plates, sheets or strip.
 - (HS 4009) Tubes, pipes and hoses, of vulcanised rubber other than hard rubber

- (HS 4012) Retreaded or used pneumatic tyres of rubber; solid or cushion tyres, tyre treads and tyre flaps, of rubber.
- (HS 4014) Hygienic or pharmaceutical articles (including teats), of vulcanised rubber other than hard rubber
- (HS 4015) Rubber clothing and accessories, except hard rubber
- f. Others
 - (HS 4304) Artificial fur and articles thereof

Our analysis on the overall product mix have shown that the majority of the products with comparative advantage ($RCA > 1$) are mainly in the *basic product* category (there are 40 types of items at 4 digit HS code), while there are 11 and 15 types of products in the *raw* and *complex category* respectively. However, by value of the product³, *basic product* takes 60% of the share, while *raw* and *complex product* takes 10% and 30% share respectively.

Meanwhile, analysis on the products with rising RCA scores shown a slightly different trend. *Basic product* still takes the largest number at 12 types of items but there is only 1 items under *raw product* category and 10 items under *complex product* category. By share of export value, the complex product category took the largest share at 61%, while *basic product* at 39% and *raw product* at 0.3%.

These findings led us to conclude that the evolution of Malaysian bio-based exports is heading towards the right direction with complex products taking a significant and growing competitiveness in exports. This is in line with the aspiration of the Malaysian government to focus on the higher value added product through the implementation of various policies and agencies to spearhead the development and progress of Malaysian bio-based and biotechnology related products.

Another interesting finding is the prevalence of *oil & fats* and *rubber*. Among the items with comparative advantage ($RCA > 1$) we find that *Oil & Fats* and *Rubber* clusters take 41% and 20% of the share of items by value of exports respectively. For the *Oil & Fat*

³ Value of exports in year 2013

cluster, palm oil and its products remains a dominant share in the cluster. Given that Malaysia is strongly reliant on these two industrial crops as a source of revenue we find it logical that Malaysian comparative advantages largely lies in these two products.

Table 9: Share of Products with Comparative Advantages by Product Cluster

	Product with RCA>1		Product with RCA>1 and rising	
	Value (RM)	Share (%)	Value (RM)	Share (%)
Animal Based	770,896,754	2.0	406,300,537	2.7
Vegetable Based	108,065,850	0.3	-	0.0
Oil and Fats	15,697,219,785	41.1	2,912,883,894	19.4
Foodstuff	4,027,812,955	10.5	3,019,288,466	20.1
Organic Chemicals	5,505,691,475	14.4	3,514,257,460	23.4
Rubber	7,663,653,851	20.1	5,149,000,127	34.3
Others	4,420,171,313	11.6	2,412,533	0.0

On a policy perspective, given the prevalence of palm oil and rubber, it makes reasonable sense to have policies focusing on further promoting the growth and development of these clusters. The purpose is not only to maintain its competitiveness, but also any policy actions would result in the highest impact given that the clusters have the largest share in bio-based related exports with comparative advantage. In Malaysia, the Ministry of Science, Technology and Innovation (MOSTI) could emphasise on creating a comprehensive environment focusing on the creation of complete value-chain and promoting new technologies under these clusters. Meanwhile, BiotechCorp could serve as the promotional agencies spearheading the development in Malaysian biotechnology. Through taking advantage of established and competitive product space, the production of new technology would be easier as it requires similar knowledge requirements and endowments. As a result, the growth of these clusters could accelerate faster. Moreover, *Organic Chemicals* could capitalise on the improvement of the *Oil & Fats* and *Rubber* clusters. The relationship is straightforward, as these products undergo downstream processes and value additions, they get converted into other types of advanced products such as chemicals. In a way, the cluster can also grow in tandem with the development of the *Oil & Fats* and *Rubber* clusters.

Meanwhile, in analysing the *foodstuff* cluster, it appears that there is a considerable improvement in the RCA score (Table 1) although the cluster does not appear to have comparative advantage as a whole. This cluster may imply an avenue for opportunities for further improvement given the consistent and ongoing momentum. On a macro level, there has been clear policy direction by the government to promote the development of the food industry amid the need for food self-sustainability as well as food security, taking into advantage Malaysia large biodiversity and climate.

Nevertheless, one caveat remains when applying the RCA model. The model suffer in its inability to exclude the import content from the export data. It does account for transshipment trade whereby products are imported for storage or repackaging only to be exported back with little value add. Malaysia has been known to be among a few of the busiest transshipment hub in the world along with Singapore and Hong Kong. It is also a result of strategic planning by the government to position Malaysia as a regional transport corridor. As a result, the export share of a product can be artificially high and skew the RCA score as the share of exports includes products under transshipments. Typically Malaysian transshipment product involves mostly oil and minerals products such as petroleum, iron ore and copper, as well as electrical and electronic products such as semiconductors. While we did not exclude the possibility of some part of bio-based product involved in the transshipment activity, we are in the view that the share is negligible. Yet, the conclusions drawn from the RCA analysis should be taken with caution.

CONCLUSION



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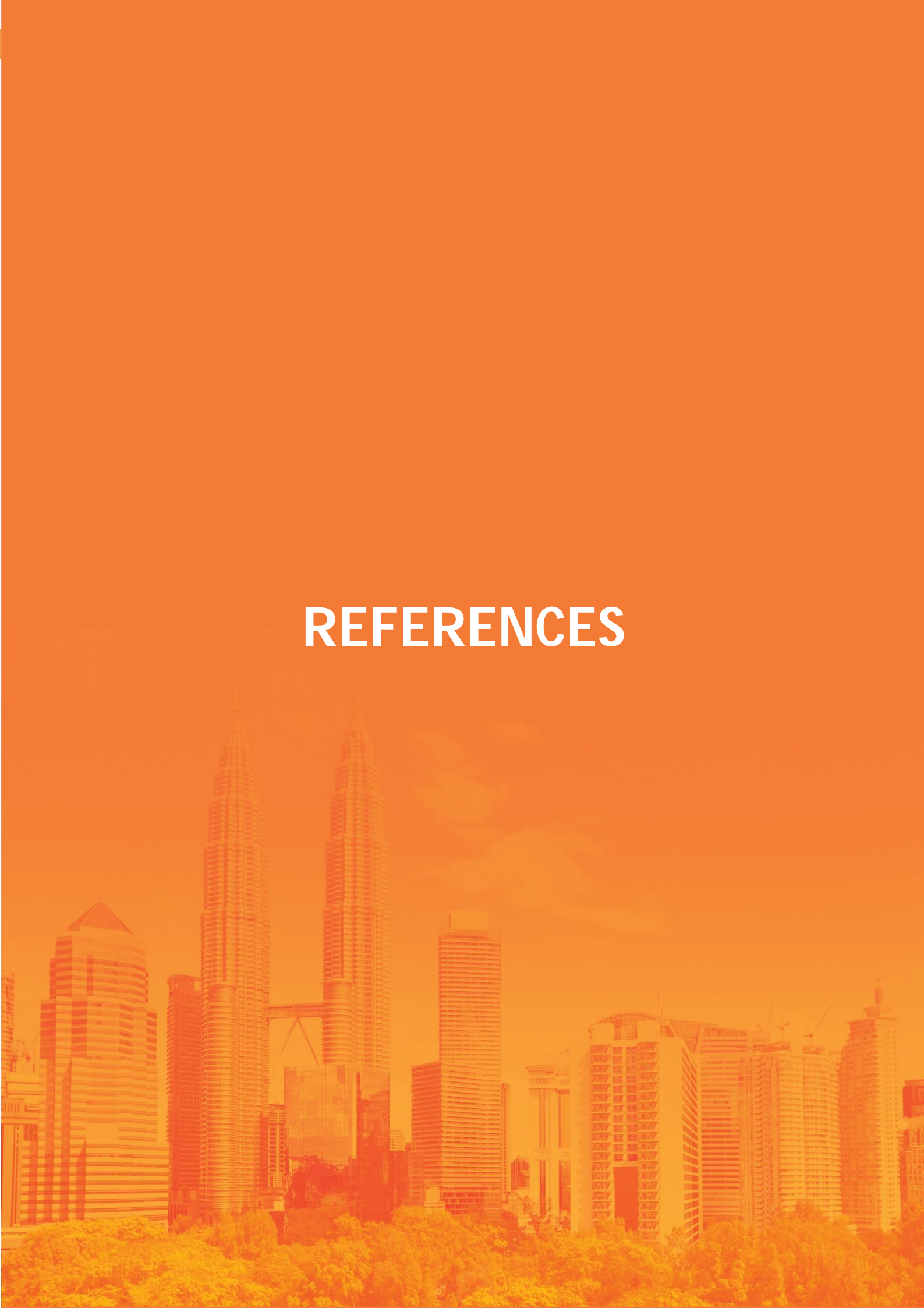
Our study aims to explore Malaysia's relative competitiveness in bio-based industry and compare the structure of its specialisation in trade vis-à-vis the rest of the world. By using bio-based exports as a proxy for biotechnology industry performance, we have measured the RCA through Balassa's model using annual data from 1995 to 2013. Our findings show that Malaysia has comparative advantage in *oil & fats*, *organic chemicals* and *rubber*, while a comparative disadvantage in *animal based*, *vegetable based*, *foodstuffs*, *pharmaceuticals* and *others*⁴ in 2013.

We also conclude that the evolution of Malaysian bio-based exports is heading towards the right direction with complex products taking a significant and growing comparative advantage in exports. By products, palm oil, rubber indicates a large and growing share and could serve as a potential industry to pursue for policymakers seeking to expand the use of biotechnology. We also pointed out the potential in organic chemicals and foodstuff industry. However, the nature of the model which takes into account transshipment of products does highlight some caution although the concern over its shortcoming have been addressed accordingly.

Overall, this study confirms our initial perception over the nature of Malaysian bio-based exports and serves as a proof that the country remains competitive in a lot of its products. It is hoped that through continuous value addition and adaptation of new technologies, the country would achieve its aspirations for a developed status by the year 2020.

⁴ Please refer to the appendix for a list of products under 'others' category

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APPENDIX



APPENDIX

Table of bio-based export in HS codes

Product cluster	HS Codes and description
ANIMAL BASED	<p>01 LIVE ANIMALS</p> <p>0101 horses, asses, mules and hinnies, live</p> <p>0102 bovine animals, live</p> <p>0103 swine, live</p> <p>0104 sheep and goats, live</p> <p>0105 chickens, ducks, geese, turkeys, and guineas, live</p> <p>0106 animals, live, nesoi Nesoi - not elsewhere specified of indicated.</p> <p>02 MEAT & EDIBLE MEAT OFFAL</p> <p>0201 meat of bovine animals, fresh or chilled</p> <p>0202 meat of bovine animals, frozen</p> <p>0203 meat of swine (pork), fresh, chilled or frozen</p> <p>0204 meat of sheep or goats, fresh, chilled or frozen</p> <p>0205 meat of horses, asses, mules, hinnies fr, chld, fz</p> <p>0206 ed offal, bovine, swine, sheep, goat, horse, etc.</p> <p>0207 meat & ed offal of poultry, fresh, chill or frozen</p> <p>0208 meat & edible offal nesoi, fresh, chilled or frozen</p> <p>0209 pig & poultry fat fresh chld frzn salted dried smkd</p> <p>0210 meat & ed offal salted, dried etc. & flour & meal</p> <p>03 FISH & CRUSTACEANS</p> <p>0301 fish, live</p> <p>0302 fish, fresh or chilled (no fillets or other meat)</p> <p>0303 fish, frozen (no fish fillets or other fish meat)</p> <p>0304 fish fillets & other fish meat, fresh, chill or froz</p> <p>0305 fish, dried, salted etc, smoked etc, ed fish meal</p> <p>0306 crustaceans, live, fresh etc, and cooked etc.</p> <p>0307 molluscs & aquatic invertebrates nesoi, live etc</p> <p>0308 aquatic invertebrates other than crustaceans and molluscs</p> <p>04 DAIRY, EGGS, HONEY, & ED. PRODUCTS</p> <p>0401 milk and cream, not concentrated or sweetened</p> <p>0402 milk and cream, concentrated or sweetened</p> <p>0403 buttermilk, yogurt, kephir etc, flavored etc or not</p> <p>0404 whey & milk products nesoi, flavored etc. or not</p> <p>0405 butter and other fats and oils derived from milk</p> <p>0406 cheese and curd</p> <p>0407 birds' eggs, in the shell, fresh, preserved or cooked</p> <p>0408 birds' eggs, not in shell & yolks, fresh, dry, etc</p> <p>0409 honey, natural</p> <p>0410 edible products of animal origin, nesoi</p>

05 PRODUCTS OF ANIMAL ORIGIN

- 0501 human hair, unworked and waste of human hair
- 0502 hogs' hair etc, badger hair etc, waste hair etc.
- 0503 horsehair and horsehair waste
- 0504 animal (not fish) guts, bladders, stomachs & parts
- 0505 bird skins & other feathered parts and down
- 0506 bones & horn cores, unworked etc, powder & waste
- 0507 ivory, tortoise-shell, whalebone, horns etc, unwrk
- 0508 coral, shell of molluscs etc unworked powder/waste
- 0509 natural sponges of animal origin
- 0510 ambergris, castoreum etc, glands etc for pharmacy
- 0511 animal products nesoi, dead animals, inedible etc.

VEGETABLE BASED

06 LIVE TREES & OTHER PLANTS

- 0601 bulbs, tubers etc, chicory plants & roots nesoi
- 0602 live plants nesoi, cuttings etc., mushroom spawn
- 0603 cut flowers & buds for bouquet etc., prepared
- 0604 foliage, grasses etc for bouquets etc, prepared

07 EDIBLE VEGETABLES

- 0701 potatoes (except sweet potatoes), fresh or chilled
- 0702 tomatoes, fresh or chilled
- 0703 onions, shallots, garlic, leeks etc, fr or chilled
- 0704 cabbages, cauliflower, kale etc, fresh or chilled
- 0705 lettuce and chicory, fresh or chilled
- 0706 carrots, turnips & other edible roots, fr or chill
- 0707 cucumbers and gherkins, fresh or chilled
- 0708 leguminous vegetables, shelled or not, fr or chill
- 0709 vegetables nesoi, fresh or chilled
- 0710 vegetables (raw or cooked by steam etc), frozen
- 0711 vegetables, temporarily preserved, not now edible
- 0712 vegetables, dried, whole, cut etc., no added prep
- 0713 leguminous vegetables, dried shelled
- 0714 cassava arrowroot etc fresh or dry: sago pith

08 ED. FRUITS & NUTS, PEEL OF CITRUS/MELONS

- 0801 coconuts, brazil nuts & cashew nuts, fresh or dry
- 0802 nuts nesoi, fresh or dried
- 0803 Bananas and plantains, fresh or dried
- 0804 dates, figs, pineapples, avocados etc, fr or dried
- 0805 citrus fruit, fresh or dried
- 0806 grapes, fresh or dried
- 0807 melons and papayas, fresh
- 0808 apples, pears and quinces, fresh
- 0809 apricots, cherries, peaches, plums & sloes, fresh
- 0810 fruit nesoi, fresh
- 0811 fruit & nuts (raw or cooked by steam etc), frozen
- 0812 fruit & nuts temporarily preserved, not now edible
- 0813 fruit dried nesoi, mixtures of nuts or dried fruit

0814 peel, citrus or melon, fresh, frzn, dried, provsl pres

09 COFFEE, TEA, MATE & SPICES

0901 coffee, coffee husks etc, substitutes with coffee

0902 tea

0903 mate

0904 pepper, genus piper, genus capsicum or pimenta

0905 vanilla beans

0906 cinnamon and cinnamon-tree flowers

0907 cloves (whole fruit, cloves and stems)

0908 nutmeg, mace and cardamoms

0909 seeds, anise, badian, fennel, coriander, cumin etc

0910 ginger, saffron, tumeric, thyme, bay leaves etc

10 CEREALS

1001 wheat and meslin

1002 rye in the grain

1003 barley

1004 oats

1005 corn (maize)

1006 rice

1007 grain sorghum

1008 buckwheat, millet & canary seed, cereals nesoi

11 MILLING INDUSTRY PRODUCTS

1101 wheat or meslin flour

1102 cereal flours, except of wheat or of meslin

1103 cereal groats, meal and pellets

1104 cereal grains, worked etc nesoi, cereal germs, wrk

1105 flour, meal and flakes of potatoes

1106 flour & meal of dry, legum vegs, sago, fruit etc.

1107 malt, whether or not roasted

1108 starches, inulin

1109 wheat gluten, whether or not dried

12 OIL SEEDS/MISC. GRAINS/MED. PLANTS/STRAW

1201 soybeans, whether or not broken

1202 peanuts (ground-nuts), raw

1203 copra

1204 flaxseed (linseed), whether or not broken

1205 rape or colza seeds, whether or not broken

1206 sunflower seeds, whether or not broken

1207 oil seeds & oleaginous fruits nesoi, broken or not

1208 flour & meal of oil seed & olea fruit (no mustard)

1209 seeds, fruit and spores, for sowing

1210 hop cones, fresh or dried, lupulin

1211 plants etc for pharmacy, perfume, insecticides etc

1212 locust beans, seaweed, s beet & cane: fruit pits etc.

1213 Cereal straw & husks unprep w/n chop etc or pellet

1214 rutabagas, hay, clover & other forage products

13 LAC, GUMS, RESINS, ETC.

1301 lac, natural gums, resins, gum-resins and balsams

1302 veg saps & extracts: pectates etc: agar-agar etc.

14 VEGETABLE PLAITING MATERIALS

1401 vegetable plaiting materials (bamboos, reeds etc.)

1402 veg materials (kapok etc) for stuffing or padding

1403 veg materials (broom corn etc) for brooms & brushes

1404 vegetable products nesoi

OIL & FATS

15 ANIMAL OR VEGETABLE FATS, OILS & WAXES

1501 lard, other pig fat and poultry fat, rendered

1502 fats, bovine, sheep or goat, raw or rendered

1503 lard stearin/lard oil/etc not emulsified or preprd

1504 fats & oils, their fractions, fish & marine mammal

1505 wool grease & fatty substances derived therefrom

1506 animal fat & oil & reaction nesoi not chem modified

1507 soybean oil & its fractions, not chemically modified

1508 peanut oil & its fractions, not chemically modified

1509 olive oil & its fractions, not chemically modified

1510 olive-residue oil & blends (1509 & 1510) not chem mod

1511 palm oil & its fractions, not chemically modified

1512 sunflower-seed, safflower or cottonseed oil, not ch mod

1513 coconut, palm kernel or babassu oil etc, not ch mod

1514 rapeseed, colza or mustard oil etc, not chem modif

1515 fixed veg fats & oils nesoi etc, not chem modified

1516 an or veg fats & oils, hydrogen etc, not fur prep

1517 margarine, edible mixtures etc an or veg fat & oil

1518 animal/veg fats & oils chem modified, inedbl mxt etc

1519 ind monocarb fat acids, acid oil, ref, ind fat alc

1520 glycerol (glycerine), glycerol waters and lyes

1521 veg waxes nesoi, beeswax etc and spermaceti

1522 degreas, residues from fatty substances/animal/veg waxes

FOODSTUFF

16 ED. PREP. OF MEAT, FISH, CRUSTACEANS, ETC

1601 sausages, similar prdt meat etc food prep of these

1602 prepared or preserved meat, meat offal & blood nesoi

1603 extracts etc. of meat, fish, crustaceans, etc.

1604 prep or pres fish, caviar & caviar substitutes

1605 crustaceans molluscs etc prepared or preserved

17 SUGARS & SUGAR CONFECTIONERY

1701 cane or beet sugar & chem pure sucrose, solid form

1702 sugars nesoi, incl chem pure lactose etc, caramel

1703 molasses from the extraction or refining of sugar

1704 sugar confection (incl white chocolate), no cocoa

18 COCOA & COCOA PREPARATIONS

- 1801 cocoa beans, whole or broken, raw or roasted
- 1802 cocoa shells, husks, skins and other cocoa waste
- 1803 cocoa paste, defatted or not
- 1804 cocoa butter, fat and oil
- 1805 cocoa powder, not sweetened
- 1806 chocolate & other food products containing cocoa

19 PREPS. OF CEREALS, FLOUR, STARCH OR MILK

- 1901 malt ext, food prep of flour etc un 50% cocoa etc
- 1902 pasta, prepared or not, couscous, prepared or not
- 1903 tapioca and substitutes from starch in flakes, etc
- 1904 foods prep by swell cereal, cereal nesoi, grain fm
- 1905 bread, pastry cakes etc: comm wafers, empty caps etc

20 PREPS OF VEGS, FRUITS, NUTS, ETC.

- 2001 veg, fruit, nuts etc, prep or pres by vinegar etc
- 2002 tomatoes prepared or preserved nesoi
- 2003 mushrooms and truffles prepared or preserved nesoi
- 2004 vegetables nesoi prepared or preserved nesoi, frozen
- 2005 vegetables nesoi prepared etc nesoi, not frozen
- 2006 fruit/nuts/fruit-peel etc, preserved by sugar
- 2007 jams, fruit jellies, marmalades etc, cooked
- 2008 fruit, nuts etc prepared or preserved nesoi
- 2009 fruit juices (& grape must) & veg juice, no spirit

21 MISC. EDIBLE PREPARATIONS

- 2101 extracts etc of coffee, tea or mate, roast chicory
- 2102 yeasts, dead sing-cell micro-org nesoi, baking powder
- 2103 sauces & prep, mixed condiments, mustard flour etc
- 2104 soups, broths & preps, homogenized comp food preps
- 2105 ice cream and other edible ice, with cocoa or not
- 2106 food preparations nesoi

22 BEVERAGES, SPIRITS & VINEGAR

- 2201 waters, natural etc, not sweetened etc, ice & snow
- 2202 waters, sweetened etc & other nonalc beverages nesoi
- 2203 beer made from malt
- 2204 wine of fresh grapes, grape must nesoi
- 2205 vermouth & other wine of fresh grapes spec flavored
- 2206 fermented beverages nesoi (cider, berry, mead etc)
- 2207 ethyl alcohol, undenat, n/un 80% alc, alcohol, denat
- 2208 ethyl alcohol, undenat, und 80% alc, spirit bev etc
- 2209 vinegar & substitutes for vinegar from acetic acid

23 RESIDUES FROM FOOD INDUSTRIES, ANIMAL FEED

- 2301 flour, meal etc of meat etc, not for human: greavs
- 2302 bran, sharps etc from working cereals & leg plants
- 2303 residues of starch mfr or sugar mfr or brewing etc

2304 soybean oilcake & other solid residue, wh/not ground
 2305 peanut oilcake & other solid residue, wh/not ground
 2306 oilcake etc nesoi, from veg fats & oils nesoi
 2307 wine lees, argol
 2308 veg material, waste etc for feeding animals nesoi
 2309 preparations used in animal feeding

24 TOBACCO & MANUF. TOBACCO SUBSTITUTES

2401 tobacco, unmanufactured, tobacco refuse
 2402 cigars, cigarettes etc., of tobacco or substitutes
 2403 tobacco & tobacco subst mfrs nesoi, tob proces etc

ORGANIC CHEMICALS

29 ORGANIC CHEMICALS

2901 acyclic hydrocarbons
 2902 cyclic hydrocarbons
 2903 halogenated derivatives of hydrocarbons
 2904 hydrocarbon derivatives, sulfonated, nitrated etc
 2905 acyclic alcohols & halogenat, sulfonatd etc derivs
 2906 cyclic alcohols & halogenatd, sulfonatd etc derivs
 2907 phenols, phenol-alcohols
 2908 phenol or phenol-alcohol deriv, halog, sulf etc
 2909 ethers, ether-alcohols, alcohol peroxides etc.
 2910 epoxides with a 3 memb ring & halog, sulfon etc
 2911 acetals and hemiacetals with or w/o other oxy func
 2912 aldehydes, its cyclic polymers, paraformaldehyde
 2913 halogenated, sulfonated etc der of aldehyde compounds
 2914 ketones & quinones & halogenatd, sulfonatd der etc
 2915 sat acyclic monocarbox acid & anhyd, halogen etc
 2916 unsat acyclic & cyclic monocarbox acid & anhyd etc
 2917 polycarboxylic acids & anhyd etc, halog, sulf etc
 2918 carboxylic acid, added oxygen & anhy etc, hal etc
 2919 phosphoric esters & salts, lactophosphates etc.
 2920 Esters of inorg acids & salts, their halog etc der
 2921 amine-function compounds
 2922 oxygen-function amino-compounds
 2923 quaternary ammonium salts etc, lecithins etc.
 2924 carboxamide-function comp, amide-function com etc
 2925 carboxyimide-function comp, imine-function com etc
 2926 nitrile-function compounds
 2927 diazo-, azo-, or azoxy-compounds
 2928 organic derivatives of hydrazine or hydroxylamine
 2929 nitrogen function compounds nesoi
 2930 organo-sulfur compounds
 2931 organo-inorganic compounds nesoi
 2932 heterocyclic compounds, oxygen hetero-atom(s) only
 2933 heterocyclic comp, nit hetero-atom, nucleic acids
 2934 heterocyclic compounds nesoi
 2935 sulfonamides

2936 provitamins and vitamins & derivatives & intermixs
 2937 hormones, derivatives & steroids used as hormones
 2938 glycosides, natural or synth & salts, ethers etc.
 2939 veg alkaloids, nat or synth & salts, ethers etc.
 2940 sugars, chem pure (except sucrose, lactose, fructose)
 2941 antibiotics
 2942 organic compounds nesoi

38 MISCELLANEOUS CHEMICAL PRODUCTS

3803 tall oil, whether or not refined
 3804 residual lyes from wood pulp mfr (except tall oil)
 3805 turpentine etc, crude dipentene, pine oil etc
 3806 rosin & resin acids etc, rosin spirit etc, run gum
 3807 wood tar, vegetable pitch etc & similar preps
 3821 prepared culture media for devel of microorganisms
 3823 Industrial monocarboxylic fatty acids; acid oils from refining; industrial fatty alcohols

PHARMACEUTICALS

30 PHARMACEUTICAL PRODUCTS

3001 glands etc dry & ext, heparin, hum etc subst nesoi
 3002 human blood, animal blood, antisera, vaccines etc
 3003 medicaments nesoi of mixtures, not dosage etc form
 3004 medicaments nesoi, mixed or not, in dosage etc fm
 3005 bandages etc coated etc or in retail medic etc fm
 3006 pharmaceutical goods (specified sterile prod etc.)

RUBBER

40 RUBBERS & ARTICLES THEREOF

4001 natural rubber, balata, gutta-percha, guayule, chicle and similar natural gums
 4003 reclaim rubber in primary forms/plates, sheets/strip
 4004 waste, parings and scrap of rubber (other than hard rubber)
 4005 compounded rubber, unvulcanised, primary forms etc
 4006 unvulc rubber forms nesoi & unvulc rubber articles
 4007 vulcanized rubber thread and cord
 4008 plates, sheets, profile shapes etc, soft vulc rubber
 4009 tubes, pipes & hoses of unhard vulcanized rubber
 4010 conveyor or transmiss belts of vulcanized rubber
 4011 new pneumatic tires, of rubber
 4012 retread or used pneu tires, solid tires etc, rubber
 4013 inner tubes for tires, of rubber
 4014 hygienic or pharm articles of unhard vulcan rubber
 4015 art of apparel & access of unhard vulcanized rubber
 4016 articles nesoi of unhardened vulcanized rubber
 4017 hard rubber in all forms: articles of hard rubber

OTHERS

41 RAW HIDES & SKINS & LEATHER

4101 raw hides & skins of bovine or equine animals
 4102 raw skins of sheep or lambs nesoi
 4103 raw hides and skins nesoi (fr or pres not tan etc)
 4104 bovine or equine leather, no hair nesoi
 4105 sheep or lamb skin leather, no wool nesoi

- 4106 goat or kidskin leather, no hair nesoi
- 4107 leather of animals nesoi, no hair nesoi
- 4108 chamois (including combination chamois) leather
- 4109 patent & patent laminated leather, metallized leather
- 4110 leather waste, leather dust, powder and flour
- 4111 composition lea, lea fiber in slabs, sheets, strip

42 ARTICLES OF LEATHER, SADDLERY & HARNESS, TRAVEL GOODS, HANDBAGS, ARTICLES OF GUT

- 4201 saddlery, harness, traces, leads etc, any material
- 4202 travel goods, handbags, wallets, jewelry cases etc
- 4203 articles of apparel & access, leather & comp leather
- 4204 articles of leather used in machinery/mech appliances
- 4205 articles of leather, nesoi
- 4206 articles of gut nesoi, of gold beater's skin etc.

43 FURSKINS & ARTIFICIAL FUR, MANUFACTURES

- 4301 raw furskins nesoi (incl pcs for fur use)
- 4302 tanned or dressed furskins (incl pcs etc)
- 4303 articles of apparel etc, of furskin
- 4304 artificial fur and articles thereof

44 WOOD & ARTICLES OF WOOD, WOOD CHARCOAL

- 4401 fuel wood in logs etc, wood in chips, etc.
- 4402 wood charcoal, whether or not agglomerated
- 4403 wood in the rough, stripped or not of sapwood etc
- 4404 hoopwood, split poles, pickets and stakes etc
- 4405 wood wool (excelsior), wood flour
- 4406 railway or tramway sleepers (cross-ties) of wood
- 4407 wood sawn or chipped length, sliced etc, ov6mm thick
- 4408 veneer sheets etc, not over 6 mm thick
- 4409 wood, continuously shaped (tongued, grooved etc.)
- 4410 particle board & similar board of wood etc.
- 4411 fiberboard of wood or other ligneous materials
- 4412 plywood, veneered panels & similar laminated wood
- 4413 densified wood blocks/plates/strips/profile shapes
- 4414 wooden frames paintings, photographs, mirrors, etc
- 4415 packing cases etc of wood, pallets etc of wood
- 4416 casks, barrels, vats, etc. and parts, of wood
- 4417 tools, tool & broom bodies etc shoe last/trees wood
- 4418 builders' joinery and carpentry of wood
- 4419 tableware and kitchenware, of wood
- 4420 wood marquetry etc, jewel case etc & wood furn nesoi
- 4421 articles of wood, nesoi

45 CORK & ARTICLES OF CORK

- 4501 natural cork, raw or simply prep, waste cork etc.
- 4502 natural cork deback/rgh sqd in blocks/sheets/strips
- 4503 articles of natural cork

4504 agglomerated cork and articles thereof

50 SILK, INC. YARNS & WOVEN FABRICS THEREOF

5001 silkworm cocoons suitable for reeling

5002 raw silk (not thrown)

5003 silk waste, including silk yarn waste etc.

5004 silk yarn, not spun from waste, not retail packed

5005 yarn spun from silk waste not put up for retail sale

5006 silk yarn & yarn from waste put up for ret, silkworm gut

5007 woven fabrics of silk or silk waste

51 WOOL & FINE OR COARSE ANIMAL HAIR, INC. YARNS & WOVEN FABRICS THEREOF

5101 wool, not carded or combed

5102 fine or coarse animal hair, not carded or combed

5103 waste of wool or of fine or coarse animal hair

5104 garnetted stock of wool/fine or coarse animal hair

5105 wool & fine or coarse animal hair, carded & combed

5106 yarn of carded wool, not put up for retail sale

5107 yarn of combed wool, not put up for retail sale

5108 yarn of fine animal hair, not for retail sale

5109 yarn of wool or fine animal hair, for retail sale

5110 yarn coarse animal hair put up or not retail sale

5111 woven fabrics of carded wool or fine animal hair

5112 woven fabrics of combed wool or fine animal hair

5113 woven fabrics of coarse animal hair or horsehair

52 COTTON, INC. YARNS & WOVEN FABRICS THEREOF

5201 cotton, not carded or combed

5202 cotton waste (including yarn waste etc.)

5203 cotton, carded or combed

5204 cotton sewing thread, retail packed or not

5205 cotton yarn (not sewing thread) nu 85% cot no retail

5206 cotton yarn (not sewing thread) un 85% cot no retail

5207 cotton yarn (not sewing thread) retail packed

5208 woven cotton fabrics, nu 85% cot, wt n/ov 200 g/m2

5209 woven cotton fabrics, nu 85% cot, wt ov 200 g/m2

5210 woven cotton fab, un 85% cot, mmfmix, n/ov 200g/m2

5211 woven cotton fabrics, un 85% cot, mmfmix, ov 200g/m2

5212 woven cotton fabrics nesoi

53 VEG. TEXTILE FIBERS NESOI, YARNS & WOVEN ETC.

5301 flax, raw etc but not spun, flax tow and waste

5302 true hemp, raw etc not spun, true hemp tow and waste

5303 jute & other text bast fibers nesoi, raw etc & tow etc

5304 sisal & other agave text fibers, raw etc & tow etc

5305 coconut, abaca, ramie etc nesoi, raw etc, tow etc

5306 flax yarn

5307 yarn of jute & other textile bast fibers nesoi

5308 yarn of vegetable textile fibers nesoi, paper yarn

5309 woven fabrics of flax

5310 woven fabrics of jute or other text bast fiber nesoi

5311 woven fab of veg textile fibers nesoi, wov fab of ppr yarn

Source: <https://www.foreign-trade.com/reference/hscod.htm>