Identifying Thailand's high-potential export opportunities in ASEAN+3 countries

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Abstract

Purpose – This paper aims to identify Thailand's realistic export opportunities (REOs) in the ASEAN+3 countries (i.e. ASEAN, Greater China, Japan and South Korea), which together constitute an economically dynamic region and a strategic export destination for Thailand. Furthermore, the paper seeks to determine the extent to which Thailand already has a share in ASEAN+3 countries and where new opportunities lie. This allows the formulation of appropriate export promotion strategies for Thailand.

Design/methodology/approach – The methodology used is a decision support model (DSM) which uses an extensive data-filtering system to systematically screen and eliminate less-promising product–country combinations to ultimately reveal high-potential REOs. Product–country combinations are screened on the basis of country risk; macro-economic country performance; market potential in terms of import growth and import market size; and market access conditions, including market concentration and the existence of trade barriers. The thus narrowed-down REOs are categorised according to Thailand's relative market share in, and the characteristics of, the identified import markets.

Findings – The study reveals that the ASEAN+3 countries account for about 40 per cent of the total potential export value of Thailand's REOs in the world, with China leading the way (12.45 per cent), followed by Japan (8.56 per cent) and South Korea (6.23 per cent). However, Thailand has a relatively small or intermediately small market share in the majority of these REOs, pointing to the need for more offensive and exploratory export promotion strategies.

Research limitations/implications – The ASEAN+3 countries – given that they are an abundant source of REOs for Thailand and are in Thailand's "backyard" – should receive more focused attention and resources in government export promotion efforts. The recent launch of the ASEAN Economic Community and the proposed establishment of an East Asia Free Trade Area lend weight to the idea of Thailand adopting a strong regional focus in its export activities.

Practical implications – The insights derived from the study are valuable for export promotion officials, industry representatives and practising exporters alike, as they constitute an easy-to-digest snapshot of high-potential REOs for Thailand in the ASEAN+3 region. This makes for more efficient planning and prioritising of export development activities, and a more streamlined approach to resource allocation.

Originality/value – Export promotion shows diminishing returns and requires sustainable strategies and interventions. The value in this paper lies in its description of an innovative market selection tool, the DSM, which is able to process and filter high volumes of information and arrive at a shortlist of high-potential REOs

for Thailand in the ASEAN+3 countries. The paper represents a concise case study of the DSM in practice, which should be of particular interest to export promotion agencies, industry associations and both new and more established exporting countries.

1. Introduction

The ASEAN+3 region, which consists of the ten ASEAN countries (Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam), Japan, China and South Korea, is rightly considered to be the most dynamic economic region in the world. (For a comparison between ASEAN and other systems of regional economic integration in the world, see Chen *et al.*, 2017) ASEAN+3 cooperation commenced in December 1997 and was formally institutionalised in 1999 when the ASEAN leaders issued a Joint Statement on East Asia Cooperation at their Third ASEAN+3 Summit in Manila. In November 2004, the ASEAN+3 leaders agreed on the establishment of an "East Asian Community" as a long-term objective and affirmed the role of ASEAN+3 as the main vehicle for such an entity. International trade and investment links between ASEAN countries, such as Thailand and China, have increased significantly since China joined the WTO in December 2001, and will be further strengthened under the China–ASEAN Free Trade Area (FTA), which came into being in January 2010. At the time of writing this paper, all tariff duties applying to products originating in the ASEAN–China FTA and exported from Thailand to China were zero (IE Singapore Go Global, 2016).

The ASEAN countries also have signed a free trade agreement with Japan and South Korea. The ASEAN–Japan Free Trade Agreement provides tariff duty elimination for many products originating in the Japan–ASEAN region. However, Japan's tariff schedule of this FTA also contains products where the base tariff duty applies (e.g. 50 per cent in case of HS020610 – edible offal of bovine animals, fresh or chilled, cheek meat and head meat!), or where the base duty is eliminated in a number of yearly instalments. Moreover, a number of products are excluded from any tariff commitment, such as some agricultural and fishery products and preparations (e.g. HS021020 – meat of bovine animals) (Ministry of Foreign Affairs of Japan, 2016). In turn, based on the ASEAN–Korean FTA, on 1 January 2010, South Korea completely eliminated tariff duties on products in the "Normal Track" of the FTA, and by 1 January 2016, the tariff duties were brought to 0-5 per cent of the products in the sensitive list of the "Sensitive Track" of the FTA (ASEAN, 2006)[1].

The ASEAN countries themselves have made great strides in terms of regional economic integration – as evidenced, *inter alia*, in the formation of the ASEAN FTA (AFTA) in 1992 and the ASEAN Economic Community (AEC) at the end of 2015, which together have created a market of approximately 622 million people. The commitments under AFTA have cleared the way for less-developed member countries, such as Vietnam, Laos and Cambodia, to forge international trade and investment relationships with the more-developed ASEAN countries, including Thailand. On 22 November 2015, the leaders of the ten ASEAN member countries signed a declaration establishing a formal economic, political, security and socio-cultural community. The AEC is collectively the third largest economy in Asia and the seventh largest in the world. Economic growth in the AEC countries is projected at 3.3 per cent in 2015, slightly lower than the previous year's growth rate of 3.4 per cent, but forecast to accelerate to 4.9 per cent in 2016 (ASEAN, 2015, p. 17). In 2014, after nearly 20 years of continuous liberalisation of trade in goods within ASEAN, 99.2 per cent of the tariff lines were duty-free in the ASEAN-6 (Brunei, Indonesia, Malaysia, the Philippines, Singapore,

Thailand) and 72.6 per cent were duty-free in the "CLMV" (Cambodia, Laos, Myanmar, Vietnam), with the latter share expected to increase to 90.8 per cent in 2015 (ASEAN, 2015, p. 18). Moreover, the many non-tariff barriers are continuously being reduced or harmonised, and intra-ASEAN trade in a number of services has been liberalised. Clearly, all these factors point to greater export opportunities within the ASEAN and the ASEAN+3[2].

In this paper, we endeavour to make a quantitative assessment of Thailand's export opportunities in the ASEAN+3 region, which represents Thailand's "backyard". Therefore, Thailand's export opportunities in the other ASEAN countries (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore and Vietnam), as well as in China, Hong Kong, Taiwan[3], Japan and South Korea, will be identified and investigated. This will be achieved through the application of the decision support model (DSM), an innovative market selection tool.

In Section 2, we discuss the more recent literature on the impact of the AEC on Thailand. In this section, also a literature contextualisation for the DSM is provided. Section 3 outlines the DSM methodology used to identify Thailand's realistic export opportunities (REOs), after which we show how this methodology was applied using macro-economic and international trade data up to 2013. In contrast to the previous "runs" of the DSM, we use averaged and weighted international trade data, allowing us to focus on the more sustainable REOs. In Section 4, we discuss the results based on the number of REOs identified. In a deviation from previous analyses of Thailand's export opportunities (Cuyvers, 1996, 2004), Section 5 briefly describes the methodology of the DSM used to quantify Thailand's REOs based on potential export values. In Section 6, we investigate the REOs at product level and then bring the paper to a close with a number of concluding comments.

2. Literature overview

2.1 The economic impact of the ASEAN Economic Community on Thailand

There is abundant literature on regional economic integration of the countries of Southeast Asia, in which also a quantitative assessment is made of its impact on international trade of the individual countries involved, among which is Thailand. It will lead us much too far to review this literature, which has been cumulated over three decades. Let it suffice to review some of the more recent studies.

To estimate the economic impact of the creation of the AEC, Lee and Plummer (2011) used a modified version of the LINKAGE model. They established a baseline scenario for 2004-2020, after which they simulated the impact on the ASEAN countries of the following scenarios:

- *Scenario 1*: The ASEAN members remove bilateral trade barriers by 2015.
- *Scenario 2*: A 2.5 per cent reduction in frictional trade costs among the ASEAN members over the period 2010-2015 under Scenario 1.
- *Scenario 3*: Scenario 2, but in contrast with Scenarios 1 and 2, with the sector-specific productivity factors related to the degree of openness endogenously determined.
- *Scenario 4*: Scenario 3, plus a 10 per cent reduction in the trade and transport margins among the ASEAN countries relative to the baseline over the period 2010-2015.

For the purpose of the present study, we are evidently only interested in the estimation results for the impact of their AEC scenarios on Thailand.

The welfare effects, measured by the percent deviations for Thailand in equivalent variations from the baseline in 2015, are for the respective scenarios 2.26 per cent (Scenario 1), 4.39 per cent (Scenario 2), 4.87 per cent (Scenario 3) and 9.38 per cent (Scenario 4) (Lee and

Plummer, 2011, Table 3). These are the highest proportionate welfare effects among the ASEAN countries. In addition, based on the simulations by Lee and Plummer (2011), Thailand seems also to benefit most, of all ASEAN countries of intra- and extra-regional trade flow adjustments resulting from the AEC under Scenario 4, with percent deviations from the baseline of its trade flows for the year 2015, to the importing ASEAN countries amounting to 29.5 per cent (Singapore), 159.0 per cent (Indonesia), 38.9 per cent (Malaysia), 61.2 per cent (Philippines), 138.8 per cent (other ASEAN) and 71.5 per cent (ASEAN-10) (Lee and Plummer, 2011, Table 4). Under Scenario 4, Thailand's sectoral output adjustments are the most important in transportation equipment (17.8 per cent deviation from the baseline), processed food (13 per cent from the baseline) and other agriculture (10 per cent from the baseline), followed by petroleum products (7.5 per cent from the baseline), rice (6.3 per cent from the baseline) and chemical products (5.6 per cent from the baseline) (Lee and Plummer, 2011, Table 5).

Further along these lines, Plummer *et al.* (2012, 2014) have simulated a global computable general equilibrium (CGE) model, allowing heterogeneous firm trade to identify the effect of a number of scenarios of further regional economic integration. Their calculations show that by 2015, the AFTA scenario will only increase the economic welfare in Thailand as compared with the baseline GDP with 0.6 per cent, as compared to 3.9 per cent and 4.9 per cent in case of the reduction of non-tariff measures in goods in ASEAN (AFTA+) and the AEC scenario (Plummer *et al.*, 2012, Table 6). This is, to a large extent, the effect of an increase in international trade, which is estimated for Thailand to be an increase from the baseline in exports of 8.8, 27.8 and 33.6 per cent according to the AFTA, the AFTA+ and the AEC scenarios, respectively, and to corresponding increases in Thailand's imports with 9.8, 31.5 and 34.7 per cent (Plummer *et al.*, 2012, Table 7). Later simulations by Plummer *et al.* (2014) show welfare gains in Thailand by 2025 as a percentage of the baseline GDP of 1.7 per cent (AFTA scenario), 7.6 per cent (AFTA+ scenario) and 9.7 per cent (AEC scenario) (Plummer *et al.*, 2014, Table 5). Similarly, by 2025, Thailand's exports would increase from the baseline with 6.7, 19.0 and 23.0 per cent, according to their AFTA, AFTA+ and AEC scenarios, respectively. The respective increase of Thailand's imports is estimated to be 6.9, 19.1 and 23.1 per cent (Plummer *et al.*, 2014, Table 6). These results imply that with further ASEAN regional integration, Thailand's international trade balance will deteriorate. If the country wants to avoid this, further efforts among others will have to be made for increasing competitiveness *vis-à-vis* the other ASEAN members and of improving its export promotion in the other ASEAN markets.

In a report for the National Economic and Social Development Board of Thailand, Jitsuchon and Pupphavesa (2013) estimated the impact of the creation of the AEC, under three scenarios of tariff reductions: no progress (Scenario a), half progress (Scenario b) and full progress (Scenario c). It reveals that based on their calculations, the average 2012-2015 GDP growth rate under Scenarios b and c is estimated to be the highest in Cambodia (5.1 and 5.5 per cent, respectively), followed by that in Thailand (3.5 and 3.7 per cent, respectively) (Jitsuchon and Pupphavesa, 2013, Figure 4.1.1). Their research team also listed per ASEAN country the products among the top 200 exported and/or imported items having potential trade creation effect in AEC integrating into a single market and production base. For Thailand, the highest number of such export products (at HS6-digit level) is found in the import market of Malaysia (57 products), followed by Vietnam (46 products), Singapore (45 products) and Indonesia (43 products) (Jitsuchon and Pupphavesa, 2013, Table 4.2.1). As the creation of the AEC also increases intra-regional competition and can lead to intra-regional relocation of investment, their analysis also indicates the export products of the ASEAN-6 that complement import demand by CLMV, as well as the products that CLMV could

out-compete those of ASEAN-6 and hence attract relocation of investment from ASEAN-6 to CLMV (Jitsuchon and Pupphavesa, 2013, Table 4.2.12 and 4.2.13). Going into all these results would evidently lead us much too far from the subject of the present paper.

With more detail, further extension of the regional economic integration towards other major Asia-Pacific trading partners and its impact on Thailand, was calculated by Pupphavesa (2012), considering the impact of ASEAN+3 and ASEAN+6[4] using Global Trade Analysis Project (GTAP) simulations. For our purpose, the most important scenario investigated is their Scenario 1, with all import duties removed between the ASEAN+1 countries (ASEAN + China, Japan, Korea, Australia, New Zealand and India, respectively), and their Scenario 2, with all import duties removed by all ASEAN+3 countries (Scenario 2a) or by Thailand alone (Scenario 2b). As is well known from the international economics literature, regional integration leads to both trade creation and trade diversion. As a result of ASEAN+3 Scenario 2a, Thailand will experience favourable trade creation effects for an estimated US$28,903m, as well as trade diversion effects in favour of Thai exports of US$16,154m (Pupphavesa, 2012, Table 11.1.1). ASEAN+3 also holds important intra-industry trade potential of US$28,351m for Thailand (Pupphavesa, 2012, Table 11.1.1). However, unfavourable trade diversion is also reported.

Based on Scenario 2a, Thailand's GDP will increase with 3.87 per cent, the value of Thailand's exports will drop however with -3.86 per cent and the trade balance will become more negative with US$$-13,559$m (Pupphavesa, 2012; Table 10.6 and 10.36). Under Scenario 2a, the value of Thailand's trade balance will particularly improve because of export increases (in declining order) of chemical–plastic–rubber products, metals n.e.s., food products n.e.s., sugar, plant-based fibres, vegetables–fruit–nuts, meat products n.e.s., oil, paddy rice, etc., but the balance will drop in machinery and equipment n.e.s., electronic equipment, motor vehicles and parts, textiles, apparel, wood products and ferrous metals (Table 10.20). These results are somewhat attenuated under Scenario 2b (Table 10.22). Unfortunately, Pupphavesa (2012) has not estimated the changes in intra-regional trade flows.

It will be clear from recent estimations, which we briefly reviewed above, that the impact of regional economic integration in ASEAN and ASEAN+3 on Thailand is considerable. Therefore, a detailed investigation of the REOs of Thailand at product and importing country levels within ASEAN, as well as in China, Japan and Korea, is a logical step from the point of view of updating Thailand's export promotion policy and to take advantage of a more focused approach in their government export promotion efforts. Supporting factors include the recent launch of the AEC and the proposed establishment of an East Asia FTA, which lend weight to the idea of Thailand adopting a more streamlined approach to resource allocation and a strong regional focus in its export activities.

2.2 Overview of international market selection methods

A small but growing body of literature addresses the question of how to identify opportunities for exporters. Papadopoulos and Denis (1988, pp. 38-51) provided the first summary and categorisation of the literature on international market selection. Steenkamp et al. (2012) extended this study by adding more recent studies and distinguishing between firm- and country-level quantitative market selection methods. Firm-level studies typically focus on identifying markets with high export potential for the products of a particular firm. These analyses usually include the firm's objectives, profitability, managers' experience and knowledge, customer standards and attitudes and product adaptation requirements which are not applicable in the country-level analyses. Country-level international market selection methods, on the other hand, are designed to identify opportunities for all the exporters of a country and are not limited to only a few

products. The DSM that is applied in this paper can be classified as a country-level international market selection model. See Steenkamp *et al.* (2012) for a detailed discussion and comparison of the specific firm- and country-level studies.

When compared to other country-level market selection methods, the DSM is unique, in that it considers all possible worldwide product–country combinations as a starting point, while other methods base their analyses on the exporting country's existing export products and/or destinations (Steenkamp *et al.*, 2012).

Since the publication of the book *Export Promotion: a Decision Support Approach* in 2012[5], the DSM has been applied to more exporting countries including the Netherlands (Viviers *et al.*, 2014), Zimbabwe (Mzumara *et al.*, 2014, 2015), Greece (Kanellopoulos and Skintzi, 2014) and the Czech Republic (Urban and Mejstřik, 2014). It is therefore evident that this unique approach to international market selection is gaining prevalence in the literature.

In the next section, the methodology of the DSM is explained.

3. Methodology: the DSM approach

The DSM methodology (Cuyvers *et al.*, 1995; Cuyvers, 1996, 2004; Cuyvers *et al.*, 2012b; Viviers *et al.*, 2014) consists of consecutive steps aimed at selecting markets and products in such a way that it eventually produces a list of product–country combinations of REOs. The methodology used in this paper is summarised in Figure 1.

Each filter is described in detail in Sections 3.1 to 3.4.

It should be stressed that although we investigate Thailand's REOs in ASEAN+3, these are derived from the list of Thailand's REOs worldwide. Therefore, the filtering process starts with all countries and HS6-digit products in the world for which data are available, and the selection criteria in the different filters are derived from the relevant statistical distributions over all countries or product–country combinations included in the analysis (remaining product–country combinations in the relevant filter).

For Filter 1, country-level data on political and commercial risk are sourced from the *Office National du Ducroire* (ONDD, 2014), and macro-economic data (GDP, GDP per capita levels and growth) sourced from the World Bank Development indicators are used. In Filters 2, 3 and 4, bilateral trade values from the United Nation's Comtrade database (as adjusted by the French International Economics Research Centre [CEPII] in their BACI World Trade database) are used. Because of a lag in capturing and auditing international trade data, the most recent available trade data at the time the analysis started were for 2013. The period from 2009 to 2013 is therefore covered in this study.

3.1 Filter 1

In Filter 1 of the DSM, countries that pose too high a political and/or commercial risk to the exporting country, and do not show adequate macroeconomic size or growth, are eliminated. The rationale for Filter 1 is that the researchers are able to eliminate uninteresting countries early in the filtering process to focus attention on a more limited set of product–country combinations in the subsequent filters. Countries that lack general potential are therefore eliminated in this filter.

As indicated above, Filter 1 of the DSM assesses importing countries against two sets of criteria. We first analysed the country risk, and followed this with an assessment of the macro-economic performance of such countries.

The ONDD rates countries on a scale of 1 to 7 for political risk, where 1 indicates a low political risk and 7 indicates a high political risk. Political risk ratings for each country are provided for the short-, medium- and long-term, and the simple average of the three is used as the political risk rating. The commercial risk rating is presented as an "A", "B" or "C",
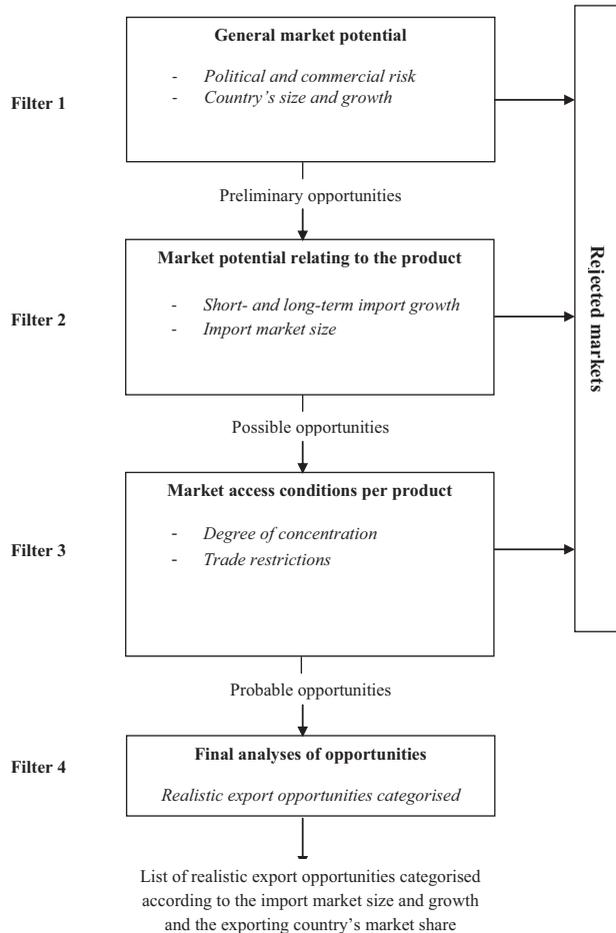
Figure 1.
The basic
methodology of the
DSM

where "A" indicates low commercial risk and "C" indicates high commercial risk. A country is considered to be too risky as a target for public export promotion efforts if its ONDD rating is 6C, 7A, 7B or 7C. A total of 176 countries out of the 209 (excluding Thailand) for which ONDD data are available were selected based on these criteria. Specifically, for the application in this study to the ASEAN+3 countries, both Laos and Myanmar had an ONDD score of 6C for the period of analysis and therefore were not given further consideration.

The second set of criteria applied include the macroeconomic size and growth of all the remaining countries selected based on country risk. GDP and GDP per capita and GDP growth and GDP per capita growth values are used as indicators. There were no macroeconomic data available for three of the 176 remaining countries (namely Monaco, Curacao and Saint Maarten), and therefore, 173 countries were included in this analysis.

In terms of macroeconomic size, the 20th percentile over the GDP and GDP per capita values of the 173 remaining countries are used as cut-off values (Viviers *et al.*, 2014). A

country is selected based on its macro-economic size when its GDP and GDP per capita values are higher than the cut-off values for at least two of the three years 2011, 2012 and 2013 (Cuyvers *et al.*, 2012b).

For macroeconomic growth, the average GDP growth and GDP per capita growth values for the 173 countries are used as cut-off values. Countries are selected if their GDP and GDP per capita growth values are higher than the cut-off values for all three years 2011, 2012 and 2013 (Cuyvers *et al.*, 2012b).

Countries can be selected for either macro-economic size (GDP and GDP per capita) and/or growth (GDP growth and GDP per capita growth) to continue to Filter 2.

After this first round of filtering, we retained 166 countries that had met the two sets of criteria.

3.2 Filter 2

In *Filter 2*, the various product categories for the remaining 166 countries are assessed to identify product–country combinations that show adequate import size and growth.

As mentioned earlier, there were no data available from the CEPII BACI World Trade database[6], for the Faeroe Islands, Puerto Rico and the Virgin Islands. Also, Luxembourg's trade values are added to Belgium's trade values and therefore these form one country, Belgium-Luxembourg, in the data set[7]. Therefore, in Filter 2, we investigated the import size and growth for specific HS6-digit level products in 162 countries. The necessary trade data were available for a total of 693,137 product–country combinations which were analysed in Filter 2.

A given country's imports for a specific product were seen as offering interesting export potential to Thailand if they showed either sufficiently large and/or positively[8] growing import demand.

The import demand in a market (product–country combination) is regarded sufficiently large if a country i's total imports (in value) of a particular product j is greater than or equal to 2 per cent of total world imports of the product. This applies for products in which the exporting country n (Thailand in this case) specialises in exporting ("revealed comparative advantage [RCA]" $\geq$ 1). For lower levels of export specialisation ($0 <$ RCA < 1), these criteria become increasingly strict (and up to 3 per cent of total world imports)[9].

The short- and long-term growth in import demand in different markets is assessed by comparing it with the world import growth rate per product. Short-term growth is defined as the simple, most recent one-year growth rate in import value (in this case between 2012 and 2013). The long-term growth rate is a compounded annual average growth rate in the import value over a period of five years (in this case, 2009 to 2013).

The selection criteria for both short- and long-term import growth are defined as follows. If the exporting country n (Thailand in this case) does not export a particular product j at all (RCA = 0), the import growth rate in a particular import market (product–country combination) must be almost two times (198.8 per cent) the world import growth rate for the product under consideration. The import growth rate should be at least higher than the world import growth rate if the exporting country n exports the product, but not with an RCA ($0 <$ RCA < 1), depending on the degree of specialisation. For products in which the exporting country n specialises in exporting a product j (RCA $\geq$ 1), the import growth rate is allowed to be below (and down to 80 per cent) the world import growth rate of the product in question (Cuyvers *et al.*, 2012b). These selection criteria are defined by means of a scaling factor[10]. In this study, we added an additional criterion in Filter 2. To be selected as a growing market in the short and/or longer term, growth rates needed to be positive and above the cut-off values in this filter. This was done to avoid declining (negative growth) markets to be classified as "growing in the short or long term" even though this negative growth rate might be above the negative world growth rate for the product.

For the size, short- and long-term growth in import demand, a "1" is allocated in the relevant column of Table I if the selection criteria described above are met and a "0" is allocated if not. This is used to categorise each product–country combination into one of eight categories indicated in the Table I.

Only product–country combinations that fall into Categories 3 to 7 are selected to enter Filter 3 (Cuyvers, 2004, p. 261; Cuyvers et al., 2012b). Consequently, only markets that are considered to be sufficiently large (even though not showing promising growth), growing in both the short- and long-term (not necessarily large markets) or growing in the short- and/or long-term and are sufficiently large, are selected to enter Filter 3.

Based on the abovementioned criteria, we selected 275,541 product–country combinations in the world market as possible REOs for Thailand. For a more detailed account of the process, the reader is referred to Cuyvers et al. (2012b).

3.3 Filter 3: market concentration and access
According to Cuyvers et al. (1995, p. 180), being selected on the basis of size and growth does not necessarily mean that the markets in question can easily be penetrated. In *Filter 3*, trade restrictions and other barriers to entry are considered to further screen the remaining possible export opportunities. Two categories of barriers are considered in this filter, namely, the *degree of concentration* (Filter 3.1) and *trade restrictions* (Filter 3.2) (Cuyvers, 2004, p. 261).

3.3.1 Filter 3.1: import market concentration. A concentrated market in this application can be defined as an import market with only a few suppliers of which, in most cases, one supplier dominates the market for a particular product. This means that these suppliers hold a large market share with a lot of market experience and knowledge and are well-known by the local market, making it very difficult for new entrants to penetrate such a market. Cuyvers et al. (1995, p. 180) confirmed this by finding a negative correlation between export performance and market concentration and concluded that it would be largely inefficient for export promotion organisations to use limited resources on such markets.

In this study, the Herfindahl–Hirschman Index (HHI) (Hirschman, 1964) is used to measure the degree of market concentration in each market. The index is calculated as[11]:

$$HHI_{ij} = \sum \left(\frac{X_{k,ij}}{M_{tot,ij}} \right)^2$$

Category	Short-term import market growth	Long-term import market growth	Relative import market size
0	0	0	0
1	1	0	0
2	0	1	0
3	0	0	1
4	1	1	0
5	1	0	1
6	0	1	1
7	1	1	1

Source: Cuyvers et al. (2012b, p. 65)

Table I.
Categorisation of product-country combinations as per Filter 2 criteria

where:

$X_{k,ij}$ = represents country i's imports of product j from different exporting countries k; and

$M_{tot,ij}$ = country i's total imports of product j.

An HHI-value equal to one indicates that the import market is supplied by only one exporting country, while an HHI value closer to 0 indicates lower market concentration (many supplying countries, each with a relatively small market share). It would consequently be very difficult for an export country to penetrate a market with an HHI value closer to 1 (Cuyvers *et al.*, 1995, p. 180; Cuyvers, 2004, p. 261).

The selection criterion for this filter is defined in light of the fact that market concentration can be amplified in a market that is not growing, as few suppliers control the market and no market growth implies limited new opportunity to grow your market share or to enter into these markets (Cuyvers *et al.*, 1995, p. 180). As a result, the cut-off values for market concentration are dependent on the Filter 2 category to which the specific import market was allocated (Table I). For relatively large, but not growing, markets (Category 3), a concentration of up to 40 per cent (HHI ≤ 0.4) is allowed[12]. Markets growing in both the short and long term (Category 4), as well as large markets that are growing in either the short or long term (Categories 5 and 6), are allowed a concentration of no more than 50 per cent (HHI ≤ 0.5)[13]. Finally, large markets that are growing in both the short and long term (Category 7) are allowed a concentration of no more than 60 per cent[14] (Viviers *et al.*, 2014).

This process leads to the selection of 159,798 product–country combinations that showed import market concentration ratios that were smaller than the respective cut-off values.

3.3.2 Filter 3.2: import market access restrictions. Various factors can be listed that restrict import market access, such as transportation costs, time and expenses related to import and/or transit procedures, import duties, quantitative import restrictions, various non-tariff barriers, etc. For Thailand as an exporting country to the other countries of the ASEAN+3 region, it can be assumed that transportation costs, as often conveniently proxied by distance, are approximately the same between the ASEAN-6 countries and between ASEAN-6 and China, Japan and South Korea. As for the other market access restrictions, it should be stressed that in spite of the ASEAN FTA and the FTAs between ASEAN and China, Japan and South Korea, a number of import products in the respective countries are excluded from the tariff duty commitments in their partner countries, or are not yet completely liberalised. Moreover, various non-tariff measures still apply which restrict market access for Thailand in both the other ASEAN countries and in China, Japan and South Korea.

As in our previous research on the REOs for Belgium and Thailand (Cuyvers, 1996, 2004; Cuyvers *et al.*, 1995), we refrained from attempting a quantification of market access barriers, and instead used an index of "revealed absence of barriers to trade" as proxy. The hypothesis is that if the neighbours of the exporting country for which the model is applied could establish a relatively strong market position in a particular market, then it would not be too difficult for the exporting country to overcome trade barriers in this market (Cuyvers *et al.*, 1995, p. 181; Cuyvers, 1996, p. 7, 2004, p. 262). The revealed absence of barriers to trade $M_{i,j}$ is calculated as follows:

$$M_{i,j} = \frac{\dfrac{X_{Neighbour1,i,j}}{X_{Neighbour1,i}} + \dfrac{X_{Neighbour2,i,j}}{X_{Neighbour2,i}} + \dfrac{X_{Neighbour3,i,j}}{X_{Neighbour3,i}} + \cdots}{\dfrac{X_{World,i,j}}{X_{World,i}}}$$

with $X_{\text{Neighbour},i,j}$ being each neighbouring country's exports of product j to country i; $X_{\text{Neighbour},i}$ is the total exports of each the neighbouring country to country i; $X_{\text{World},i,j}$ is the total world exports of product j to country i; and $X_{\text{World},i}$ is total world exports to country i.

The selection criterion, namely that $M_{i,j}$ should be larger than or equal to 0.95, is defined with the assumption that a higher relative share $M_{i,j}$ reflects a relative lack or a revealed absence of barriers to trade (Cuyvers *et al.*, 1995, p. 181). This implies that, with a margin of error of 5 per cent, if at least one of Thailand's fellow ASEAN-5[15] countries has an "RCA" in exporting to a particular market, it is assumed that there are no "revealed barriers to trade" for the exporting country for which the model is applied in that market (Cuyvers, 2004, p. 263).

Applying this criterion led to the selection of 67,260 product–country combinations, with an apparent market accessibility that was similar to that which at least one of Thailand's neighbouring countries was experiencing for the same product group in the same importing country.

For export opportunities to be REOs, we require that the respective import markets are both reasonably competitive (less concentrated) and sufficiently accessible. Mathematically, this means that we take the intersection of the product–country combinations selected on the basis of import market concentration and market accessibility. The intersection thus constructed in this case yielded 51,620 REOs.

3.4 Filter 4: categorisation of Thailand's REOs according to import market characteristics and import market share
In the fourth and last stage of the analysis, the REOs that were identified in Filters 1 to 3 are categorised (Tables IV-VII)[16] and no further elimination is done.

For each of the markets that entered Filter 4, the relative market share of the exporting country (country n, in this case, Thailand) of product category j in importing country i is calculated as follows:

$$\mu_{n,i,j} = \left(\frac{X_{n,i,j}}{X_{six,i,j}} \right)$$

where $X_{n,i,j}$ is country n's exports of product category j to country i; and $X_{six,i,j}$ is the top six countries' total exports of product category j to country i. A comparison is therefore made between the relative market share of country n in each market that entered Filter 4 and the relative market share of the six largest competitors in these markets.

If country n's exports to a particular market (product–country combination) are lower than or equal to 5 per cent ($\mu_{n,i,j} \leq 0.05$) of the total exports of the top six competitors in that market, it is considered a relatively small market share. If this value is between 5 and 25 per cent, country n's relative market share is considered intermediately small; between 25 and 50 per cent, intermediately high; and above 50 per cent relatively high (see columns of Table II) (Viviers *et al.*, 2014).

The entire filtering process leads to the categorisation of REOs in Table II (identified in Filters 1 to 3) into 20 cells according to the size and growth in demand (determined in Filter 2) and the exporting country's relative market share (determined in Filter 4) in these markets. The classification in the rows of Table II is obtained from the categories of Filter 2 (Table I), which indicate the size and growth of import demand, while the columns are based on the relative market share of the exporting country calculated in Filter 4.

After categorising each REO in Filter 4, we also take into account Thailand's present export capacity by considering Thailand's "RCA" and "revealed trade advantage". Therefore, we distinguished between "potential" REOs (all REOs that came out of Filter 3)

Import demand size and growth	Market share of Thailand relatively small	Market share of Thailand intermediately small	Market share of Thailand intermediately high	Market share of Thailand relatively high
Large market	Cell 1	Cell 6	Cell 11	Cell 16
Growing (long- and short-term) market	Cell 2	Cell 7	Cell 12	Cell 17
Large market with short-term growth	Cell 3	Cell 8	Cell 13	Cell 18
Large market with long-term growth)	Cell 4	Cell 9	Cell 14	Cell 19
Large market (short- and long-term growth)	Cell 5	Cell 10	Cell 15	Cell 20

Table II.
Categorisation of
realistic export
opportunities based on
import market size
and growth and the
exporting country's
relative market share

and "actual" REOs (only those REOs for which Thailand's "RCA index[17]" was sufficiently high, e.g. 0.7 (Balassa, 1965), as well as the cases where Thailand was a net exporter of the product with an "revealed trade advantage (RTA) index[18]" above zero (Vollrath, 1991). These criteria are specifically chosen for the following reasons. An RCA index above one indicates that the exporting country n (Thailand in this case) is specialised in exporting product j (Balassa, 1965). We however follow Cuyvers et al. (2012c) in considering an RCA above 0.7, an indication that the exporting country is already successfully exporting the product and is close to export specialisation. An RTA larger than zero discloses positive comparative trade advantage or trade competitiveness. It can be assumed that it indicates that the product exported is produced domestically, as it corrects for re-exports (Vollrath, 1991). See also Section 4.2.

Finally, we follow Viviers et al. (2014) by equating the potential export values associated with REOs of product j in country i as the average imported from the top six countries that supply these imports. It is then assumed that this "average" gives an indication of the size of each REO relative to the others to rank and prioritise among product–country combinations. See Section 5.

3.5 Unique addition to the DSM method in this study
For the first time, and in contrast to the previous "runs" of the DSM, instead of using the international trade data for only the latest year available, we calculate five-year weighted averages[19] for the size of the import market (Filter 2), the degree of concentration (HHI in Filter 3.1), the revealed absence of trade barriers proxy (Filter 3.2), Thailand's exports to each market (Filter 4) and Thailand's RCA and RTA values when determining "actual" versus "potential" REOs (Section 4.2). Using the weighted average import and export values has the effect of smoothing out years with unprecedentedly high or low values, gives larger weight to more recent trade figures and allows a stronger focus on the more sustained REOs.

Figure 2 summarises the results of the filtering process followed.

4. Thailand's realistic export opportunities in the ASEAN+3 countries
4.1 ASEAN+3's share in Thailand's export opportunities
Table III depicts the distribution of the number of REOs for Thailand in the ASEAN+3 countries.

Of the 51,620 REOs in the world at large, 10,338 are situated in the ASEAN+3 countries, which represents 20 per cent of Thailand's worldwide REOs[20]. The REOs to Greater China (China, Hong Kong, Macao) and South Korea constitute 22 and 7.82 per cent, respectively, of the total REOs of ASEAN+3, with China showing the highest number of REOs (1,342), constituting 12.98 per cent of the total REOs. Vietnam comes a close second with 1,264 REOs, representing 12.23 per cent of the total REOs. Japan is in third place with 979 REOs, or 9.27 per cent of the total REOs. More details on the specific products that have REOs in all individual ASEAN+3 countries can be obtained from the authors. However, if we take into account the potential export values involved[21], the picture is very different from that based on the number of REOs, with the ASEAN+3 countries accounting for as much as 40.23 per cent of the value of Thailand's potential exports in the world. Of Thailand's total potential export value in the ASEAN+3 countries, Greater China (China, Hong Kong, Macao) represents 44 per cent, followed by Japan (21.35 per cent) and South Korea (15.47 per cent). The ASEAN market constitutes 19.15 per cent of Thailand's potential export value in ASEAN+3.
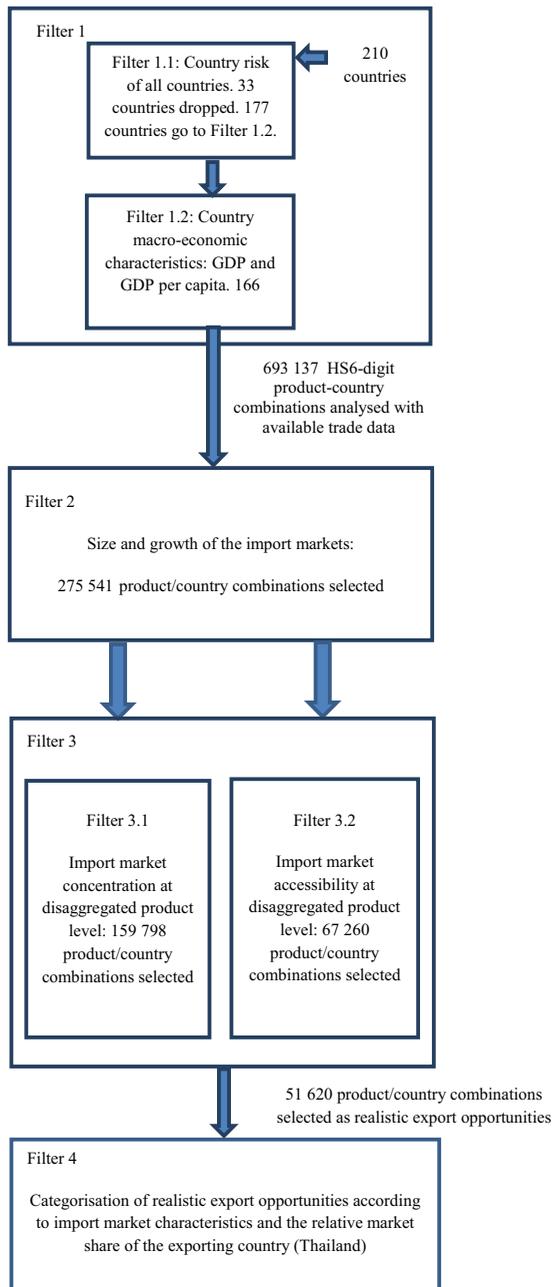
Country	No. of REOs 2013	(%)	Potential export value (US$ thousand)	(%)
Brunei	783	7.57	158,700	0.06
Cambodia	675	6.53	309,114	0.12
China	1342	12.98	77,787,211	30.94
The Philippines	881	8.52	2,336,692	0.93
Hong Kong	795	7.69	32,791,765	13.04
Indonesia	931	9.01	10,587,097	4.21
Japan	979	9.47	53,667,651	21.35
Macao	138	1.33	127,381	0.05
Malaysia	854	8.26	9,798,223	3.90
Singapore	888	8.59	19,021,870	7.57
Taiwan	–	–	–	–
South Korea	808	7.82	38,905,783	15.47
Vietnam	1264	12.23	5,928,019	2.36
Total ASEAN+3	10,338	100.00	251,419,506	100.00
World vs ASEAN+3	51,620	20.03	624,937,728	40.23

Table III.
Thailand's realistic export opportunities in ASEAN+3: 2013

4.2 Thailand's REOs in ASEAN+3 according to Thailand's market share and import market characteristics
To further analyse Thailand's REOs in ASEAN+3, we categorised (in Filter 4) these REOs according to Thailand's relative market share and the import market characteristics into a matrix, consisting of 20 cells (see Section 3.4 and Table II).

We also took into account Thailand's present export capacity by considering, for each REO, Thailand's "RCA". Therefore, we distinguished between "potential" REOs (all REOs that came out of Filter 3) and "actual" REOs (RCA $\geq$ 0.7 and RTA > 0; see Section 3.4). Table IV shows the distribution of Thailand's 10,338 "potential" REOs in ASEAN+3, whereas Table V shows the distribution of the "actual" REOs in ASEAN+3 and therefore where RCA $\geq$ 0.7 and the RTA > 0[22].

In Table IV, Cell 2 shows the highest number of REOs, followed by Cell 7. Cell 1 ranks third. From Table IV, it can also be concluded that 70.38 per cent of Thailand's "potential" REOs are in markets where Thailand's market share is negligible or very small (Cells 1 to 5), whereas 11.17 per cent are in markets where Thailand's market share is high or moderately high (Cells 11 to 20), thereby offering immediate export potential. The situation improves with Thailand's "actual" REOs, where 22 per cent of the export opportunities are in markets where Thailand enjoys a high or intermediately high market share (Table V).

The largest number of REOs, both "potential" and "actual", is found in markets that are growing in the short and long term (Cells 2, 7, 12 and 17), i.e. 67.94 and 62.46 per cent, respectively, and of these, in the markets where Thailand's market share is small (i.e. Cell 2), 47.08 and 31.24 per cent, respectively, are situated in growing import markets. In other words, almost 70 per cent of "potential" REOs are in growing markets, and 50 per cent of "actual" REOs have a small market share (if any at all). If Thailand wants to develop suitable offensive market exploration export promotion strategies involving "taking advantage of a growing market" (Cuyvers *et al.*, 2012a), special attention will have to be devoted to exploiting its competitive advantage in terms of price, quality and service/delivery, and to creating awareness of Thai products in these markets. However, as will be seen in Section 5, the picture changes markedly when the potential export values involved are considered.

Import demand size and growth	Relative market share of Thailand				
	Market share of Thailand relatively small	Market share of Thailand intermediately small	Market share of Thailand intermediately high	Market share of Thailand relatively High	Total
Large market	Cell 1 920 8.90%	Cell 6 227 2.20%	Cell 11 60 0.58%	Cell 16 43 0.42%	1,250 12.09%
Growing (long- and short-term) market	Cell 2 4,867 47.08%	Cell 7 1,290 12.48%	Cell 12 388 3.75%	Cell 17 479 4.63%	7,024 67.94%
Large market (short-term growth)	Cell 3 114 1.10%	Cell 8 21 0.20%	Cell 13 4 0.04%	Cell 18 2 0.02%	141 1.36%
Large market (long-term growth)	Cell 4 372 3.60%	Cell 9 90 0.87%	Cell 14 33 0.32%	Cell 19 22 0.21%	517 5.00%
Large market (short- and long-term growth)	Cell 5 1,003 9.70%	Cell 10 279 2.70%	Cell 15 57 0.55%	Cell 20 67 0.65%	1,406 13.60%
Total	7,276 70.38%	1,907 18.45%	542 5.24%	613 5.93%	10,338 100.00%

Table IV.
Distribution of
Thailand's "potential"
realistic export
opportunities in
ASEAN+3, according
to relative market
position and market
characteristics
(number of
opportunities)

Import demand size and growth	Market share of Thailand relatively small	Market share of Thailand intermediately small	Relative market share of Thailand Market share of Thailand intermediately high	Market share of Thailand relatively high	Total
Large market	Cell 1	Cell 6	Cell 11	Cell 16	452
	222	136	55	39	13.36%
	6.56%	4.02%	1.63%	1.15%	
Growing (long- and short-term) market	Cell 2	Cell 7	Cell 12	Cell 17	2,113
	1,057	566	218	272	62.46%
	31.24%	16.73%	6.44%	8.04%	
Large market (short-term growth)	Cell 3	Cell 8	Cell 13	Cell 18	43
	23	15	4	1	1.27%
	0.68%	0.44%	0.12%	0.03%	
Large market (long-term growth)	Cell 4	Cell 9	Cell 14	Cell 19	186
	88	54	27	17	5.50%
	2.60%	1.60%	0.80%	0.50%	
Large market (short- and long-term growth)	Cell 5	Cell 10	Cell 15	Cell 20	589
	291	187	50	61	17.41%
	8.60%	5.53%	1.48%	1.80%	
Total	1 681	958	354	390	3 383
	49.69%	28.32%	10.46%	11.53%	100.00%

5. Thailand's export potential in ASEAN+3

This section attempts to provide an estimate of the export values associated with the given REOs. As described in Section 3.4, we equate the potential export values associated with REOs of product j in country i as the weighted average imported over the period between 2009 and 2013 from the top six countries that supply these imports, measured in US dollars. The potential export values of the REOs that share common characteristics, e.g. they belong to the same cell in Tables IV or V, can then be added up.

5.1 Thailand's potential exports in ASEAN+3 according to Thailand's market share and import market characteristics

In Tables VI and VII, the distribution of these total potential export values for Thailand is shown, according to import market characteristics and Thailand's relative market share in the import markets concerned.

From Tables VI and VII it appears that Thailand's total potential export value in ASEAN+3 amounts to US\$251.42bn (Table VI), of which US\$101.98bn is related to products that Thailand is already successfully exporting to other markets (Table VII considering RCA ≥ 0.7 and RTA > 0; Section 3.4). However, these values should rather be considered as a means to weight each REO against the others. Weighting each REO by the assumed US dollar value of its export potential makes quite a difference in the distribution of the REOs over the cells of the categorisation matrix. When Thailand's potential REOs in ASEAN+3 [in which Thailand has already achieved a high or moderately high market share (Cells 11 to 20)], are weighted by potential export values as defined above, they account for only 3.5 per cent of the potential export value in ASEAN+3 of the "potential" REOs, and only 7.55 per cent of the potential export value in ASEAN+3 of the "actual" REOs.

Accordingly, the "potential" REOs in ASEAN+3, in which Thailand has a small or negligible market share (Cells 1 to 10), assume much more importance, representing 96.52 per cent of the potential export value in US dollars. When considering only the "actual" REOs (Table VII), the share of the total potential export value of the REOs in which Thailand has acquired a small or negligible market share is 92.45 per cent. The reduction in the share of Cells 1 to 5 from 83.45 to 67.45 per cent is largely due to the impact on Cell 2 of weighting by potential export values. Thus, Cell 2 represents only 6.02 per cent of the "potential" export value and 3.35 per cent of the value of "actual" REOs, compared with 47.08 and 31.24 per cent, respectively, if unweighted (Tables IV and V). In contrast, of the export value of Thailand's actual REOs in ASEAN+3, 15.89 per cent is found in Cell 1, 24.13 per cent in Cell 4 and 17.99 per cent in Cell 5 in Table VII. Again, for many REOs, offensive export promotion strategies of market exploration seem to be appropriate (Cuyvers *et al.*, 2012a), catering, in particular, to the specific market characteristics (large market, large market showing growth in the short and/or longer run).

5.2 Thailand's export potential in ASEAN+3 per broad product category and some policy implications

Tables VIII and XI show Thailand's "potential" and "actual" REOs in ASEAN+3 per broad product category.

Machinery represents the largest share of the "potential" REOs, i.e. 35.56 per cent, as compared to 33.32 per cent in Thailand's worldwide (excluding ASEAN+3) REOs, followed by mineral products (32.23 per cent) and chemicals (5.87 per cent).

Restricting our analysis to the "actual" REOs (Table XI), we see that machinery – when weighted with potential export values – represents an even larger share (52.66 per cent, as compared to 33.49 per cent in the worldwide REOs). Mineral products (22.03 per cent, as compared to 21.76 per cent worldwide) and chemicals (4.39 per cent, as compared to 1.98 per

Import demand size and growth	Market share of Thailand relatively small	Market share of Thailand intermediately small	Relative market share of Thailand Market share of Thailand intermediately high	Market share of Thailand relatively high	Total
Large market	Cell 1 84,636,073 33.66%	Cell 6 13,049,530 5.19%	Cell 11 1,163,896 0.46%	Cell 16 1,584,279 0.63%	100,433,778 39.95%
Growing (long- and short-term) market	Cell 2 15,135,886 6.02%	Cell 7 6,284,036 2.50%	Cell 12 931,426 0.37%	Cell 17 706,609 0.28%	23,057,956 9.17%
Large market (short-term growth)	Cell 3 14,441,257 5.74%	Cell 8 517,035 0.21%	Cell 13 39,125 0.02%	Cell 18 198 0.00%	14,997,615 5.97%
Large market (long-term growth)	Cell 4 37,332,329 14.85%	Cell 9 2,837,227 1.13%	Cell 14 1,787,716 0.71%	Cell 19 194,278 0.08%	42,151,550 16.77%
Large market (short- and long-term growth)	Cell 5 58,260,979 23.17%	Cell 10 10,161,269 4.04%	Cell 15 1,091,200 0.43%	Cell 20 1,265,159 0.50%	70,778,607 28.15%
Total	209,806,523 83.45%	32,849,097 13.07%	5,013,363 1.99%	3,750,524 1.49%	251,419,506 100.00%

Table VI.
Distribution of
Thailand's "potential"
realistic export
opportunities in US$
thousands in
ASEAN+3, according
to relative market
position and market
characteristics

Import demand size and growth	Market share of Thailand relatively small	Market share of Thailand intermediately small	Relative market share of Thailand Market share of Thailand intermediately high	Market share of Thailand relatively high	Total
Large market	Cell 1 16,205,353 15.89%	Cell 6 10,028,586 9.83%	Cell 11 1,050,103 1.03%	Cell 16 1,486,415 1.46%	28,770,457 28.21%
Growing (long- and short-term) market	Cell 2 3,413,818 3.35%	Cell 7 4,314,058 4.23%	Cell 12 642,837 0.63%	Cell 17 438,935 0.43%	8,809,648 8.64%
Large market (short-term growth)	Cell 3 6,310,340 6.19%	Cell 8 444,829 0.44%	Cell 13 39,125 0.04%	Cell 18 194 0.00%	6,794,489 6.66%
Large market (long-term growth)	Cell 4 24,607,337 24.13%	Cell 9 2,336,131 2.29%	Cell 14 1,699,976 1.67%	Cell 19 184,461 0.18%	28,827,905 28.27%
Large market (short- and long-term growth)	Cell 5 18,342,894 17.99%	Cell 10 8,277,105 8.12%	Cell 15 900,399 0.88%	Cell 20 1,255,563 1.23%	28,775,960 28.22%
Total	68,879,742 67.54%	25,400,708 24.91%	4,332,440 4.25%	3,365,569 3.30%	101,978,459 100.00%

Table VII.
Distribution of Thailand's "actual" realistic export opportunities in US$ thousands in ASEAN+3 with RCA ≥ 0.7 and RTA > 0, according to relative market position and market characteristics

Product category (SITC2-digits)	Potential export value (US$ thousands) in ASEAN+3	% of total potential export value in ASEAN+3	Potential export value (US$ thousands) worldwide	% of total potential export value worldwide
01-05 Animal and animal products	2,249,898	0.89	3,507,949	0.94
06-15 Vegetable products	924,557	0.37	5,578,611	1.49
16-24 Foodstuffs	3,607,195	1.43	10,370,128	2.78
25-27 Mineral products	81,036,654	32.23	38,606,074	10.34
28-38 Chemicals and allied industries	14,746,223	5.87	38,553,481	10.32
39-40 Plastic/Rubbers	13,362,100	5.31	19,920,984	5.33
41-43 Raw hides, skins, leather, and furs	945,710	0.38	1,913,770	0.51
44-49 Wood and wood products	2,914,025	1.16	8,653,674	2.32
50-63 Textiles	4,027,272	1.60	30,787,740	8.24
64-71 Stone/Glass	12,636,586	5.03	18,542,661	4.96
72-83 Metals	12,637,209	5.03	17,686,954	4.74
84-85 Machinery/Electrical	89,400,982	35.56	124,474,722	33.32
86-89 Transportation	2,654,400	1.06	19,692,040	5.27
90-97 Miscellaneous	10,276,694	4.09	35,229,432	9.43
Grand total	251,419,506	100.00	373,518,221	100

Table VIII.
Thailand's "potential"
REOs per broad
product category

Product category (SITC2-digits)	Total potential export value (US$ thousands) in ASEAN+3	% of total potential export value in ASEAN+3	Potential export value (US$ thousands) worldwide (excluding ASEAN+3)	% of total potential export value worldwide (excluding ASEAN+3)
01-05 Animal and animal products	1,068,053	1.05	1,463,303	0.97
06-15 Vegetable products	379,733	0.37	1,497,472	0.99
16-24 Foodstuffs	1,782,444	1.75	6,619,680	4.39
25-27 Mineral products	22,461,242	22.03	32,803,691	21.76
28-38 Chemicals and allied industries	4,477,904	4.39	2,981,140	1.98
39-40 Plastic/Rubbers	8,041,065	7.89	13,310,475	8.83
41-43 Raw hides, skins, leather, and furs	498,146	0.49	945,214	0.63
44-49 Wood and wood products	527,552	0.52	1,617,824	1.07
50-63 Textiles	1,959,427	1.92	11,573,204	7.68
64-71 Stone / Glass	1,271,320	1.25	9,666,134	6.41
72-83 Metals	2,556,345	2.51	4,464,622	2.96
84-85 Machinery / Electrical	53,703,769	52.66	50,472,397	33.49
86-89 Transportation	876,189	0.86	5,061,086	3.36
90-97 Miscellaneous	2,375,270	2.33	8,252,455	5.48
Grand total	101,978,459	100.00	150,728,696	100

Table IX.
Thailand's "actual" REOs per broad product category with RCA ≥ 0.7 and RTA > 0

cent worldwide) show a somewhat smaller share, to the benefit of plastics/rubbers (7.89 per cent, as compared to 8.83 per cent worldwide).

Table X depicts at the HS6-digit level the 30 products with the highest export potential for Thailand in ASEAN+3. Thirteen products belong to the category machinery and equipment (HS84-85), and another three belong to mineral products (HS25-27). HS854221 – cards incorporating an electronic integrated circuit (smart cards) rank first, and are good for a potential export value of approximately US$33.1bn in seven countries. Petroleum oils, oils from bituminous minerals (HS271000) rank second and third, respectively, followed by HS847330 – parts and accessories (excluding covers, carrying cases and the like) in six countries with an estimated total potential export value of US$4.88bn. In the fifth place is HS847170 – analogue/hybrid automatic data-processing machines in eight countries with a total potential export value of US$2.86bn.

Table X can be compared with Table XI which shows Thailand's top 30 REOs in the world (excluding ASEAN+3) based on export potential. Seventeen products now belong to the category machinery and equipment (HS84-85) but only one belongs to mineral products (HS27). Strikingly, nine products in the top 30 "actual" REOs in ASEAN+3, which belong to the chemical products of HS28-39 (six belong only to HS39), do not feature in Thailand's top 30 REOs in the world, thus requiring a regional public export promotion effort. There are also some notable changes in the rankings of the products. HS271000 – petroleum oils and oils obtained from bituminous minerals, other than crude, rank first in the world, but second in the top 30 in ASEAN+3. The reverse holds for HS854221 – cards incorporating an electronic-integrated circuit (smart cards), which rank first in the ASEAN+3 top 30 and fourth in the world's top 30. Apparatus for carrier-current line systems/digital line systems (HS851750) ranks second in the world's top 30 (representing a potential export value of US$6.98bn) but only fifth in the ASEAN+3 top 30 (representing US$2.05bn). Also, some more labour-intensive-produced export products are in demand in the world, but are absent in the top 30 of ASEAN+3, i.e. HS640399 – footwear (excluding waterproof) incorporating a protective metal toe-cap (ranked 9th); HS940360 – furniture made of materials other than metal/wood/plastics, including cane/osier/bamboo (ranked 12th); HS611030 – jerseys, pullovers, cardigans, waistcoats and similar articles, knitted or crochet (ranked 15th); and HS 610910 – T-shirts, singlets and other vests, knitted or crocheted, of cotton (ranked 27th). The ASEAN+3 countries probably reflect similar comparative advantages.

While Thailand considers itself an agro-business centre, only one of the products in the HS01 to 24 group is in the top 30 worldwide, and the REOs in this category represent, in the country's "backyard" (which ASEAN+3 is), hardly 2.7 per cent of Thailand's total potential export value in the region and 11.3 per cent of the total number of REOs in the region. This, however, might be because of the high levels of protection frequently found in the world of agriculture and agricultural trade[23].

5.3 Thailand's export potential in ASEAN+3 per country and some policy implications
Because ASEAN+3 is Thailand's "backyard" and represents 40.23 per cent of the potential export value for Thailand in the world (Table III), it is interesting to take a closer look at the REOs at HS6-digit level per target market. In Table XII, some major products from the top five are listed, offering promising export potential, together with the actual and potential export values per country.

Again, it can be seen that many of these high-potential exports involve products and target markets, in which Thailand's market share is either small or intermediately small (Cells 1 to 10). For instance, for HS854221 – cards incorporating an electronic-integrated circuit (smart cards), which rank highest in the top 30 (Tables X and XI), all REOs are

HS6-digit product category	Rank	Potential export value (US$ thousands)	No. of opportunities
HS854221 – Cards incorporating an electronic integrated circuit (smart cards)	1	33,103,712	7
HS271000 – Petroleum oils and oils obtained from bituminous minerals, other than crude	2	21,377,218	6
HS847330 – Parts and accessories (excluding covers, carrying cases and the like)	3	4,884,729	6
HS847170 – Analogue/hybrid automatic data processing machines	4	2,860,485	8
HS851790 – Apparatus for carrier-current line systems/digital line systems	5	2,048,274	3
HS290243 – Benzene	6	1,538,067	2
HS740400 – Copper waste and scrap	7	1,430,722	3
HS390120 – Ethylene-vinyl acetate copolymers, in primary forms	8	859,142	7
HS390210 – Polyisobutylene, in primary forms	9	851,299	6
HS850440 – Ballasts for discharge lamps/tubes	10	830,614	7
HS852540 – Still image video cameras and other video camera recorders; digital cameras	11	823,070	5
HS851750 – Apparatus for carrier-current line systems/digital line systems	12	711,872	2
HS854430 – Co-axial cable and other co-axial electronic conductors	13	648,481	4
HS390740 – Alkyd resins, in primary forms	14	639,135	8
HS400122 – Balata, gutta-percha, guayule, chicle and similar natural gums	15	619,026	3
HS330499 – Beauty/make-up preparations and preparations for the care of the skin	16	573,518	6
HS390110 – Ethylene-vinyl acetate copolymers, in primary forms	17	548,664	9
HS854121 – Diodes (excluding photosensitive/light emitting diodes)	18	530,957	6
HS290122 – Buta-1,3-diene and isoprene	19	527,849	4
HS854160 – Diodes (excluding photosensitive/light emitting diodes)	20	476,376	6
HS711319 – Articles of jewellery and parts there of	21	464,944	4
HS850490 – Ballasts for discharge lamps/tubes	22	464,081	7
HS030613 – Crabs, whether or not in shell, frozen	23	461,548	9
HS390190 – Ethylene-vinyl acetate copolymers, in primary forms	24	452,403	4
HS854390 – Machines and apparatus for electroplating/electrolysis/electrophoresis	25	447,408	9
HS270750 – Aromatic hydrocarbon mixtures of which 65% or more by volume	26	428,369	5
HS210690 – Food preparations, not elsewhere specified	27	422,616	8
HS390230 – Polyisobutylene, in primary forms	28	418,212	5
HS271320 – Petroleum bitumen	29	405,418	4
HS847160 – Analogue/hybrid automatic data processing machines	30	401,147	4
Total potential value for the top 30 within ASEAN+3		80,249,354	

Table X.
Thailand's top 30 products in potential export value within ASEAN+3, RCA ≥ 0.7 and RTA > 0

HS6-digit product category	Product ranking by potential export values (US\$ thousands)	Potential export value (US\$ thousands)	No. of opportunities
HS271000 – Petroleum oils and oils obtained from bituminous minerals, other than crude	1	32,035,421	21
HS851750 – Apparatus for carrier-current line systems/digital line systems	2	6,975,350	23
HS847330 – Parts and accessories (excluding covers, carrying cases and the like)	3	5,411,393	48
HS854221 – Cards incorporating an electronic integrated circuit (smart cards)	4	4,597,467	5
HS711319 – Articles of jewellery and parts there of	5	4,271,734	16
HS401110 – New pneumatic tyres, of rubber (excluding those with herring-bone)	6	3,567,704	68
HS847170 – Analogue/hybrid automatic data processing machines	7	3,004,963	64
HS850440 – Ballasts for discharge lamps/tubes	8	2,919,195	61
HS640399 – Footwear (excluding waterproof) incorporating a protective metal toe-cap	9	2,531,154	43
HS847160 – Analogue/hybrid automatic data processing machines	10	2,374,373	31
HS852812 – Reception apparatus for television, whether or not incorporating radio-broadcast receivers	11	2,154,222	55
HS940360 – Furniture of materials other than metal/wood/plastics, including cane/osier/bamboo	12	1,994,388	58
HS851790 – Apparatus for carrier-current line systems/digital line systems	13	1,800,104	36
HS870323 – Vehicles (excluding of 87.02 and 8703.10) principally designed for the transportation of persons	14	1,789,264	13
HS611030 – Jerseys, pullovers, cardigans, waist-coats and similar articles, knitted or crochet	15	1,613,061	32
HS210690 – Food preparations, not elsewhere specified	16	1,390,855	44
HS940161 – Parts of the seats of 94.01	17	1,388,566	43
HS852540 – Still image video cameras and other video camera recorders; digital cameras	18	1,354,927	37
HS847180 – Analogue/hybrid automatic data processing machines	19	1,279,913	46
HS853650 – Apparatus for protecting electrical circuits (excl. of 8536.10 and 8536.20)	20	1,089,074	44
HS852691 – Radar apparatus	21	1,018,553	28
HS190590 – Bread, pastry, cakes, biscuits and other bakers' wares	22	998,516	31
HS841590 – Air-conditioning machines	23	963,519	37
HS940350 – Furniture of materials other than metal/wood/plastics, incl. cane/osier/bamboo	24	916,857	62
HS848210 – Ball bearings	25	891,527	42
			(*continued*)

Table XI.
Thailand's top 30
products in potential
export value in the
rest of the world
(excluding
ASEAN+3), RCA ≥
0.7 and RTA > 0

HS6-digit product category	Product ranking by potential export values (US$ thousands)	Potential export value (US$ thousands)	No. of opportunities
HS030613 – Crabs, whether or not in shell, frozen	26	887,234	23
HS610990 – T-shirts, singlets and other vests, knitted or crocheted, of cotton	27	799,803	53
HS852821 – Reception apparatus for television, whether or not incorp. radio-broadcast receivers	28	799,257	43
HS841430 – Air compressors mounted on a wheeled chassis for towing	29	772,561	30
HS850110 – AC generators (alternators), of an output >375 kVA but not >750 kVA	30	739,492	35
Total potential export value for the top 30 products outside ASEAN+3		92,330,448	

located in Cells 1 to 5 in Tables IV and V and show a large difference between what potentially could be exported by Thailand and what is actually exported. When it comes to public export promotion, it could be difficult to tap this large export potential because the production and export of smart cards are under the control of foreign companies operating in Thailand, which could be relatively immune to national export promotion policies and efforts.

Petroleum oils (HS271000 – petroleum oils and oils obtained from bituminous minerals, other than crude) would be less susceptible to the above problem. However, Thailand has limited domestic oil production and reserves. With a view to promoting petroleum exploration and production and attracting investors, the government enacted the Petroleum Act (Thailand) and Petroleum Income Tax Act (Thailand) in 1971. The country has seven oil refineries, five of which belong to PTT (Petroleum Authority of Thailand). It follows that there is scope for export promotion of the mentioned petroleum oils in Japan, South Korea and Indonesia. Bearing in mind that Thailand's market share in these petroleum oils in the ASEAN+3 countries is small, the strategies to be developed should be offensive but exploratory. What also needs to be taken into account is that large markets for this product, such as Japan and South Korea (Cell 1), need to be approached differently from Indonesia (Cell 2: not a sufficiently large market; growing in the short and long term).

Similarly, there is a need for offensive exploratory export promotion strategies to be developed and adopted to promote HS847330 – parts and accessories (excluding covers, carrying cases and the like) in ASEAN+3 target markets, such as Hong Kong, Japan, South Korea and Vietnam (but not in Malaysia where Thailand's market share is intermediately high), and to promote HS847170 – analogue/hybrid automatic data-processing machines in countries such as South Korea, Indonesia and Brunei. However, with respect to HS847170, offensive export promotion strategies involving market expansion could be developed and applied for China, Hong Kong, Singapore and Vietnam, where Thailand already has an established presence (evidenced by Cells 11 to 15 in Tables IV and V).

Within ASEAN, tariff duties on the products listed in Tables X-XII are zero, but a number of national trade restrictions related to various health and safety regulations still apply, and norms and standards are often not mutually recognized yet in spite of much progress made

Country	Cell	Potential export value (US$ thousands)	Actual export value (US$ thousands) Thailand (2013)
HS854221 – Cards incorporating an electronic integrated circuit (smart cards)			
China	Cell 4	15,415,433	1,170,297
Hong Kong (SARC)	Cell 5	6,669,135	939,942
Singapore	Cell 3	4,738,873	419,706
South Korea	Cell 4	3,032,502	301,557
Japan	Cell 3	1,365,625	185,279
Malaysia	Cell 5	1,239,186	143,070
Vietnam	Cell 2	642,957	48,573
HS271000 – Petroleum oils and oils obtained from bituminous minerals, other than crude			
Singapore	Cell 6	6,042,598	3,384,751
Indonesia	Cell 1	3,945,859	112,360
China	Cell 1	3,713,460	845,352
Japan	Cell 1	2,915,142	303,699
Malaysia	Cell 7	2,454,074	1,071,217
South Korea	Cell 5	2,306,083	36,701
HS847330 – Parts and accessories (excl. covers, carrying cases and the like)			
Hong Kong (SARC)	Cell 4	2,913,532	654,947
Singapore	Cell 6	770,442	253,705
Japan	Cell 1	454,123	35,163
Malaysia	Cell 11	361,619	736,508
South Korea	Cell 2	274,326	8,823
Vietnam	Cell 2	110,688	2,092
HS847170 – Analogue/hybrid automatic data processing machines			
Hong Kong (SARC)	Cell 14	1,251,979	2,025,147
China	Cell 16	1,167,103	4,058 215
Singapore	Cell 15	250,254	428,868
South Korea	Cell 7	137,445	186,737
Indonesia	Cell 7	33,901	27,790
Vietnam	Cell 12	18,720	34,180
Brunei Darussalam	Cell 2	770	48
Cambodia	Cell 7	315	426
HS851790 – Apparatus for carrier-current line systems/digital line systems			
China	Cell 5	1,550850	149,591
South Korea	Cell 5	496,553	46,781
Brunei Darussalam	Cell 2	871	11

Table XII.
Examples of product – country combinations with large export potential for Thailand in ASEAN+3

during the last couple of years. As to China, Japan and South Korea, many of the top-30 products listed in Tables X-XII have zero tariff duties when originating in and imported from Thailand, but not all. For instance, to imports of frozen crabs (belonging to HS030613) from ASEAN, Japan applies a 4 per cent tariff duty, and to red ginseng tea and other products of red ginseng (belonging to HS210690), the tariff duty in Korea is even 603.4 per cent. In China, Japan and Korea, many imports are still subject to regulations. Further, in-depth further market research on the individual REOs is required if suitable detailed export promotion strategies can be evolved.

For the sake of brevity, we have opted to restrict ourselves to these few REOs in the ASEAN+3 countries discussed above. They are helpful, in that they are illustrative but are

far from exhaustive in terms of where the analysis and discussion of REOs could potentially go.

6. Conclusions and some policy implications

By applying the latest DSM methodology using international macro-economic data and detailed international trade data for Thailand up to 2013, we have identified 51,620 REOs in the world at large, of which 10,338 (20 per cent) are in ASEAN+3. Of these 10,338 REOs, the greatest number of REOs can be traced to China (1,342, representing 13 per cent of the total REOs in ASEAN+3) and Vietnam (1,264, representing 12.23 per cent of the total REOs in ASEAN+3). The other REOs in ASEAN+3 are more or less evenly spread over the remaining countries of the region. Somewhat disconcerting is that Thailand's neighbours, Laos and Myanmar, had to be excluded because of political and commercial risks being above the threshold level.

In earlier research, a headcount was taken of the REOs identified per importing country or per product, whereas in the present research (following Cuyvers *et al.*, 2012c), an attempt has been made to weight each individual REO by an (admittedly rough) estimate of its potential export value in US dollars. We demonstrate that such weighting allows the focus to be placed on the more important REOs (in terms of export value), rather than on the REOs that are more readily detected but could lead to focused export promotion efforts being diluted if attention were given to too many import markets. Based on our estimations, the ASEAN+3 markets represent US$251.4bn or as much as 40.23 per cent of the total potential export value in the world, with China topping the list (30.9 per cent of the total potential export value within ASEAN+3), followed by Japan (21.35 per cent of the total potential export value within ASEAN+3) and South Korea (15.47 per cent of the total potential export value within ASEAN+3). Strikingly, Vietnam, which represents 12.23 per cent of Thailand's REOs in ASEAN+3, accounts for only 2.36 per cent of potential export value.

It is important to make a further distinction between "actual" REOs (in which Thailand has already acquired a sizable comparative advantage in international trade) and "potential" REOs (which constitute all REOs, irrespective of Thailand's comparative advantage). The distinction is of particular significance, as it enables Thailand's export promotion agency to focus on the promotion of exports of products that are already successfully exported by the country.

Although 40.23 per cent of Thailand's potential export value in the world can be found in the ASEAN+3 countries, Thailand has a relatively small or intermediately small market share in the vast majority of these REOs. Of the total export value of the "actual" REOs, only 22 per cent relate to product/country combinations in which Thailand has a high or intermediately high market share. This has important implications for the design and implementation of export promotion strategies, which should more often than not be of an offensive and exploratory nature rather than be aimed at immediate market expansion. This conclusion is also justified if one considers the top 15 REOs in ASEAN+3.

Based on the product composition of Thailand's "actual" REOs in ASEAN+3, the product category machinery and equipment takes the lion's share (52.66 per cent), thereby offering relatively quick export potential in the ASEAN+3 markets. This proportion is even better than in of the world at large, as the share of this product category in the "actual" REOs worldwide stands at only 22.5 per cent.

Furthermore, the export potential of the top 30 REOs in ASEAN+3 is almost as large as Thailand's top 30 REOs worldwide (excluding ASEAN+3), which builds a strong case for Thailand to introduce a strong regional focus in its export promotion efforts. For example, it is striking that in the former list, a number of products considered to be the traditional

"playground" of multinational business are less prominent, thereby offering scope for the promotion of Thai export products, such as various machines, parts and components and electrical appliances and parts, etc. This is not to say that the export potential of multinational corporations' offerings should be neglected, as a number of products in the top 30 REOs in ASEAN+3 can be outsourced to, and supplied by, Thai producers (such as various products belonging to HS84-85). However, promoting the export of products that are mainly, if not completely, produced and marketed by multinational companies, is somewhat problematic.

Finally, as previously mentioned, nine products of the chemical industry (HS28-39) that are in Thailand's top 30 "actual" REOs in ASEAN+3 (representing 8 per cent of the potential export value of these "actual" REOs) do not feature in the country's top 30 REOs worldwide, which similarly highlights the need for a regional focus in Thailand's public export promotion activities.

Although it seems unwise to advocate that Thailand's export promotion efforts should focus solely on the region, our conclusions point to the fact that relatively more of the country's scarce public export promotion resources should be directed at ASEAN+3. As economic integration in the region deepens – and taking into account the recent launch of the AEC and the plans to establish an East Asia FTA – an enhanced regional focus is likely to deliver the greatest successes on the export front. To this end, the specific REOs for Thailand as depicted in Table XII of this paper will help to direct Thailand's export promotion policies and strategies, and make the desired outcome of elevated competitiveness and enhanced exports all that more attainable.

Notes

1. The Korean–ASEAN FTA also contains a list of "highly sensitive" products, which can account for maximum 200 HS6-digits tariff lines and maximum 3 per cent of the 2004 value of Korea's total imports.

2. For the most recent assessment of the progress made in economic integration in ASEAN, see ASEAN (2015).

3. Taiwan is not a member of ASEAN+3. Moreover, because of the absence of international trade data for Taiwan in the Comtrade database, this country will be analysed in terms of macro-economic performance, but then not given further consideration.

4. ASEAN+6 is ASEAN+3, plus Australia, New Zealand and India.

5. In which the DSM was applied and results compared for Belgium, South Africa and Thailand

6. For purposes of consistency, a single consolidated source of international trade data was used.

7. The SACU countries' (South Africa, Botswana, Lesotho, Namibia and Swaziland) data are also reported together in the BACI database. However, customs data from the SACU countries were gathered for these countries and trade values were split accordingly.

8. In this study, we added an additional criterion in Filter 2. To be considered a growing market in the short and/or longer term, growth rates needed to be positive and above the cut-off values in this filter.

9. $M_{i,j} = 0.02 M_{w,j}$ if $RCA_{n,j} \geq 1$; or $M_{i,j} = [(3 - RCA_{n,j}))/100] M_{w,j}$ if $RCA_{n,j} < 1$; with $M_{i,j}$ being country i's total import value of product j and $M_{w,j}$ being total world imports of product j. Also with $RCA_{n,j} = (X_{n,j}/X_{W,j})/(X_{n,tot}/X_{W,tot})$ and $X_{n,j}$ being the exports for country n (Thailand) of product j; $X_{W,j}$ is world exports of product j; $X_{n,tot}$ is total exports of country n; $X_{W,tot}$ is total world exports (all categories). An RCA closer to zero indicates that country n does not have a comparative advantage in exporting product j, while an RCA value greater than or equal to one indicates that the exporting country n is specialised in exporting product j (Balassa, 1965).

10. The scaling factor $s_{n,j}$ is defined as (Cuyvers, 2004, p. 260): $s_{n,j} - 0.8 + 1/(RCA_{n,j} + 0.85)\exp^{(RCA_{n,j}-0.01)}$; and cut-off values for short- and long-term import growth are then calculated by: $g_{ij} \geq g_{W,j} \cdot s_{n,j}$, where $g_{i,j}$ represents the import growth rate of product category j by country I, and $g_{w,j}$ is the world import growth rate for product j.

11. Thailand is excluded in the numerator of the equation to still select markets where Thailand causes the concentration. Therefore, if Thailand has a large/dominant presence in a particular market, only the market shares of the other suppliers in that market will be considered in the HHI calculation resulting in a low concentration value from Thailand's perspective.

12. For example, the HHI for a market in which one supplier holds a 60 per cent market share and four other suppliers a 10 per cent market share each, would be 0.4, whereas a market with two suppliers, the one holding 60 per cent and the other 40 per cent would have an HHI of 0.52.

13. For example, the HHI for a market with two suppliers each with a 50 per cent market share would be 0.5. Also, a market with one supplier holding a 70 per cent market share and three others holding 10 per cent each, would have an HHI of 0.52.

14. For example, the HHI for a market in which one supplier holds a 75 per cent market share, another 15 per cent and the last 10 per cent market share, would be 0.595, whereas a market with two suppliers, one holding a 75 per cent market share and the other 25 per cent, would have an HHI of 0.625.

15. ASEAN-5 is ASEAN-6, excluding Brunei. ASEAN-5 thus consists of Thailand, Indonesia, Malaysia, the Philippines and Singapore.

16. For a more detailed explanation of the DSM methodology and the determination of cut-off values in each filter, see Cuyvers *et al.* (1995, pp. 173-186), Cuyvers *et al.* (2012a, pp. 58-84), and Viviers *et al.* (2014).

17. $RCA_{n,j} = (M_{n,j}/M_{W,j})/(M_{n,tot}/M_{W,tot})$, with $X_{n,j}$ being the exports for country n (Thailand) of product j; $X_{W,j}$ is world exports of product j; $X_{n,tot}$ is total exports of country n; $X_{W,tot}$ is total world exports (all categories). An RCA closer to zero indicates that country n does not have a comparative advantage in exporting product j, while an RCA value greater than or equal to one indicates that the exporting country n is specialised in exporting product j (Balassa, 1965).

18. $RTA_{nj} = RCA_{nj} - RMA_{nj}$. $RMA_{nj} = (M_{n,j}/M_{W,j})/(M_{n,tot}/M_{W,tot})$, with $M_{n,j}$ being the imports of country n (Thailand) of product j; $M_{W,j}$ is world imports of product j; $M_{n,tot}$ is total imports of country n; $X_{W,tot}$ is total world imports (all categories). Therefore, this measure implies a relative import advantage (RMA).

19. In this weighted five-year average, the most recent year weights the most and each year before approximately half the preceding one. Therefore, Year 5 weights 51.61 per cent, Year 4 weights 25.81 per cent, Year 3 weights 12.9 per cent, Year 2 weights 6.45 per cent and Year 1 weights 3.23 per cent.

20. Including Myanmar and Laos, which were dropped from the list of countries to be considered further in Filter 1 due to extremely high political and commercial risk, would add 933 REOs for Myanmar and 103 REOs for Laos.

21. For the way in which potential export values are calculated, see Section 3.4.

22. Myanmar, which was dropped from the list of countries in Filter 1, shows 933 REOs for Thailand, of which 407 have RCAs ≥ 0.7, and 302 if the condition RCA ≥0.7 and the RTA > 0 is applied. As for Laos, which fared much like Myanmar, it presents 103 REOs, of which 51 have RCAs ≥ 0.7, and 39 if the conditions RCA ≥ 0.7 and the RTA > 0 are applied.

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