Identifying export opportunities for China in the 'Belt and Road Initiative' group of countries: a decision support model approach

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Abstract

Purpose – This paper aims to identify China's realistic export opportunities (REOs) among the "Belt and Road Initiative" (BRI) group of countries.

Design/methodology/approach – The methodology used is a decision support model (DSM) that filters data based on country risk; macro-economic country performance; market potential in terms of import growth and import market size; and market access conditions. The high-potential REOs are revealed.

Findings – Out of the 84 BRI countries, 79 countries represent 42.5% of China's REOs globally and 26.9% of China's globally untapped potential value. Interestingly, 17.9% of this untapped potential is in the BRI countries Poland, Austria and the Czech Republic, thus providing a potentially important route into the European Union.

Research limitations/implications – If China wants to develop additional or new markets, focus should be put on the BRI markets outside of the top 20. China should also invest in the development of most BRI economies, to ensure their future growth and increased demand for import of products and services from China.

JEL classification – F13, F145, F15, F17, O50

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Practical implications – The shortlist of China's REOs in the individual BRI countries makes for more efficient planning and prioritising of export development activities. It also highlights the need for policymakers to look beyond international trade and focus on how to also improve the domestic economies of the BRI partners.

Originality/value – To the best of authors' knowledge, this paper is the first to use the DSM to identify China's REOs at HS6-digit level within the BRI group. The findings have important implications for China's export promotion agencies, industry associations and individual companies.

Keywords China, Export promotion, Comparative advantage, BRI, Decision support model, International market research, Realistic export opportunities, DSM

Paper type Research paper

1. Introduction

The Chinese President Xi Jinping called for the establishment of a new regional cooperation model through the construction of the "Silk Road Economic Belt" during his visit to Kazakhstan in September 2013. While visiting Indonesia in October 2013, he called for the creation of the Asian Infrastructure Investment Bank and the construction of the "21st Century Maritime Silk Road". These two initiatives together are officially named the "Belt and Road Initiative" (BRI).

The BRI aims to enhance trade ties, mutual trust and greater policy coordination among those countries that link China's ancient land and maritime silk routes to Europe, the Middle East, Africa and the rest of Asia (Johnston, 2019). Among the BRI's priorities are to rigorously research and identify optimal investment and trade facilitation solutions, eliminate barriers to trade and investment and create a free trade zone among participating countries[1]. The BRI also aims to strengthen bilateral investment ties and facilitate the formation of cross-country industry value chains. To this end, China aims to reduce its own trade barriers, increase internal market efficiency and strengthen its regional economic integration efforts.

The BRI has provided a stimulus to China's efforts to deepen trade, investment and infrastructure links with the associated countries. Although the BRI could help foster a trade revival for China, it also affords BRI countries access to China's overseas direct investment, thereby assisting them in the development and/or upgrading of their infrastructure. Such developments create important export opportunities for China. However, the BRI countries are very diverse in terms of their development status, political system, market size, consumption characteristics and transport infrastructure. As a result, Chinese companies are exposed to a range of opportunities in different countries. Owing to resource limitations, though, relatively few of China's potential export opportunities have a good chance of being successfully and sustainably exploited. Yet, a key component of a successful export promotion drive is the ability to identify the "most realistic" foreign markets for specific products or groups of products, using comprehensive and reliable data.

The main purpose of this paper is to reveal China's most realistic export opportunities (REOs) in the BRI countries using the decision support model (DSM) approach. This will add rigour to China's export promotion efforts. There are many models available for choosing international markets: the Green and Allaway shift-share model, trade-off model of Papadopulous *et al.*, the International Trade Centre's (ITC) multi-criteria method, the gravity model, the product space network methodology, Canada's Trade Opportunity Matrix and the TRADE-DSM are but a few (Steenkamp *et al.*, 2012). For this paper, the TRADE-DSM was selected as it was specifically designed for international market selection purposes and has been widely used (Cuyvers and Viviers, 2012). For example, since 1995, the TRADE-DSM has been applied in various countries, including Belgium, Thailand, Rwanda, the

Czech Republic, Greece, Thailand and the USA (at state level – Louisiana), in addition to South Africa (Cameron and Viviers, 2017; Oluwade, 2018; Jansen van Rensburg *et al.*, 2019). It has also received favourable reviews from the ITC (ITC, 2017) and the World Trade Organization (Steenkamp *et al.*, 2012). There is an extensive body of literature on the DSM methodology and its applications in various countries (Cuyvers *et al.*, 1995, 2004; Cuyvers *et al.*, 2012a; Cameron *et al.*, 2017; Jansen van Rensburg *et al.*, 2019).

In a nutshell, the DSM is a market selection method that screens large quantities of data that would be too voluminous to analyse using more conventional techniques. From a specific home market's perspective (for current purposes, China), the DSM systematically analyses markets against criteria such as political and commercial risk and macroeconomic stability, market size, market accessibility and growth prospects. It then creates a list of the most realistic markets for various product categories.

To our knowledge, this paper reveals the first attempt to use the DSM to identify China's export opportunities at the country–product (HS6-digit) level within the BRI group of countries. The findings therefore have important implications for China's export promotion agencies, industry associations and individual companies. In Section 2, we review the literature on China's BRI and its economic impact. In Section 3, we summarise the DSM methodology and in Section 4, we present and discuss the results of the DSM application for China, revealing the most REOs in the BRI countries. We provide concluding remarks in Section 5[2].

2. Literature review

Since China's announcement of the BRI in 2013, a growing body of literature and research outputs on the BRI has been produced.

A first strand of the literature examines the motivation behind, possible frameworks for and implications of regional economic integration among the BRI countries. For instance, Huang (2016) argued that the BRI represents an important attempt by China to sustain its economic growth momentum by exploring new forms of international economic cooperation with new partners. China also intends to exert greater influence in the world and contribute to the evolving global economic architecture. The author argued, however, that it is too early to assess the impact of the BRI. Cheng (2016) said that the BRI offers great potential for economic cooperation, but its success depends on many factors beyond China's control. Wang (2016) argued that the China-led BRI has more of a defensive than an offensive nature and could present tremendous opportunities for international economic cooperation. Gorbunova and Komarov (2017), in turn, stressed that the BRI has a clear developmental purpose, focusing on industrialisation in those countries lacking in infrastructure.

A second strand of the literature analyses the impact of the BRI on China and other BRI countries. Several papers focus on its trade and FDI effects. For example, Wang *et al.* (2018) examined the impact of the BRI on Chinese exports. They asserted that since the Initiative was launched, the expanded infrastructure and improvements in logistics performance have had a positive effect on China's exports. Cinar *et al.* (2016), using a gravity model, examined the extent to which countries in the former Silk Road regions were either meeting or falling short of their trading potential with China. The results of their study suggest that China's former Silk Road trading partners have yet to fully realise the benefits of China's economic growth, but that the gap may be narrowing. Du and Zhang (2018) showed that China's overseas direct investment has risen significantly in the BRI countries. Zhai (2018) investigated the macroeconomic impact of the BRI, using a global computable general equilibrium model. The author found sizeable welfare and trade benefits for the global

economy, even when conservative assumptions were made about the magnitude of the total investment under the initiative.

The BRI also affects partner countries. For instance, Fardella and Prodi (2017) analysed the impact of the BRI on Europe, with a specific focus on Italy. Their analysis suggests that the development of new railway connections will benefit the northern and central European countries the most, and that Italy needs to coordinate its ports with its railway network to take advantage of the BRI's opportunities. Jabin (2017) reviewed the respective responses of India and Pakistan to the BRI, showing that China's BRI is often simplistically understood to be opposed by India and supported by Pakistan. García-Herrero and Xu (2017) estimated how much trade might be created among BRI countries and found that European Union (EU) member countries, especially those that are landlocked, would benefit considerably. This is also true for Eastern Europe and Central Asia and, to a lesser extent, South East Asia. Timofeev *et al.* (2017) examined the possible opportunities and challenges associated with the co-development of the Eurasian Economic Union and the BRI, arguing that the success of Russia–China collaboration in Eurasia would depend crucially on strong dynamics in a future Eurasia–China partnership.

Although the number of countries joining the BRI is increasing and the BRI is generally positively perceived, it has also created concerns globally. Sachdeva (2018) investigated Indian perceptions of the BRI and found that developments in the broader India–China relationship have affected Indian perceptions. The Indian government considers the BRI primarily a Chinese initiative. It is therefore difficult for New Delhi to endorse the China–Pakistan Economic Corridor. Banerjee (2016) argued that the success of the BRI depends on India's participation. In addition to geopolitical tensions, there are global concerns about China-initiated BRI projects that lack regulation and market coordination. García-Herrero and Xu (2019) conducted a big-data analysis of countries' perceptions of China's BRI and found that all regions, except South Asia, have a positive view of the BRI. However, some individual countries have a very negative view. Interestingly, Rahman and Rahman (2019) have argued that the BRI will create gravity between China and Eurasia through a land corridor and to transport and logistics costs minimisation for all the countries involved.

From the literature review, it can be concluded that the BRI offers great export potential for China and constitutes a means of stimulating economic growth and increased wealth for both China and associated countries. However, gravity model or computable general equilibrium model estimations of this export potential are at an aggregate level and offer few policy insights for companies and export promotion agencies. Until this paper was written, no attempt had been made to identify China's export opportunities in the BRI countries at a level of disaggregation that was sufficiently detailed to be useful to individual companies.

3. Decision support model methodology

A small but expanding body of literature addresses the question of how to identify opportunities for exporters. Country-level international market selection methods are designed to identify opportunities for all exporters in a country; they are not confined simply to a few products, as in firm-level studies. The DSM used in this paper can be classified as a country-level international market selection method (Steenkamp *et al.*, 2012; Cuyvers *et al.*, 2017; Cameron *et al.*, 2017).

The DSM is derived from international marketing research and is used to identify, for an exporting country (the home market), the REOs in a target economy (or target economies) or the world at large. It uses macroeconomic performance data and international trade data for those countries where data is available and filters out less-interesting countries and export

products. The DSM was originally designed to help export promotion agencies identify promising export opportunities and formulate suitable export promotion strategies (Cuyvers *et al.*, 1995). The method has been applied for countries as diverse as Belgium (Cuyvers *et al.*, 1995; Cuyvers *et al.*, 2012a, Cuyvers and Viviers, 2012), Thailand (Cuyvers, 2004; Cuyvers *et al.*, 2017), South Africa (Pearson *et al.*, 2010), Greece (Kanellopoulos and Skintzi, 2016), the Czech Republic (Urban *et al.*, 2014), Namibia (Teweldemedhin and Chiripanhura, 2015) and the USA (specifically Louisiana) (Oluwade, 2018), Furthermore, the TRADE-DSM has also been recognised as an important information source used by companies in their international market selection decisions as well as to develop a multi-phase, big data analytics model for international market selection (Calof and Viviers, 2020).

As summarised in Figure 1, the DSM methodology uses filters that sequentially eliminate less realistic/interesting product–country combinations with a view to categorising and prioritising REOs in different positions on a grid, for the country/firm for which the analysis is applied.

3.1 Filter 1: general market potential

The first filter eliminates countries that pose too high a political and/or commercial risk to the exporting country and indicate inadequate size or economic growth. In this context, the definition of political risk means to include any event in the importing country that assumes the nature of a force majeure incident (including wars, revolutions, natural disasters, currency shortages and unanticipated government actions) (Office National Du Ducroire [ONDD], 2014). Commercial risk is the risk of the importer's financial situation deteriorating to the point that payment for a consignment becomes impossible (Office National Du Ducroire [ONDD], 2014). The political and/or commercial risk evaluations applied in the modelling supporting this paper makes use of evaluations for all countries as on October 2018 (Credendo, 2018).

Countries that pose a high political and/or commercial risk to the exporting country are eliminated from the screening process. This filter also considers the macroeconomic size and growth of the importing country measured by gross domestic product (GDP) and GDP per capita and GDP growth and GDP growth per capita, respectively. Macroeconomic data is sourced from the National Accounts Estimates of Main Aggregates of the United Nations Statistics Division (United Nations [UN], 2017). Countries that do not meet the relevant cut-off values are eliminated from the screening process.

In order not to reduce the list of countries (and BRI countries) based on political and commercial risk assessments, it was decided in this paper, not to apply the political and commercial risks filtering procedure, in contrast to previous DSM research. Consequently, only countries are eliminated that show inadequate preliminary potential based on economic size and/or purchasing potential, as well as economic growth performance (using the World Bank's GDP and GDP per capita data, respectively, up to 2018)[3]. In this context, "inadequate" means that a country's GDP or GDP per capita and economic growth rates are below statistically determined "cut-off" values. For GDP and GDP per capita, these cut-off values are determined at the 20th percentile of the values for the countries for which all data necessary to run the DSM are available, and for GDP and GDP per capita growth rates, the cut-off values are determined at the world averages for each year. The application of Filter 1 allows the researcher to further focus in the subsequent filters on the product imports of a smaller list of importing countries. Of the 253 countries in the world (excluding China), macroeconomic data were available for only 219 countries. Because of lacking data and after applying Filter 1, 50 countries were not considered for further investigation.

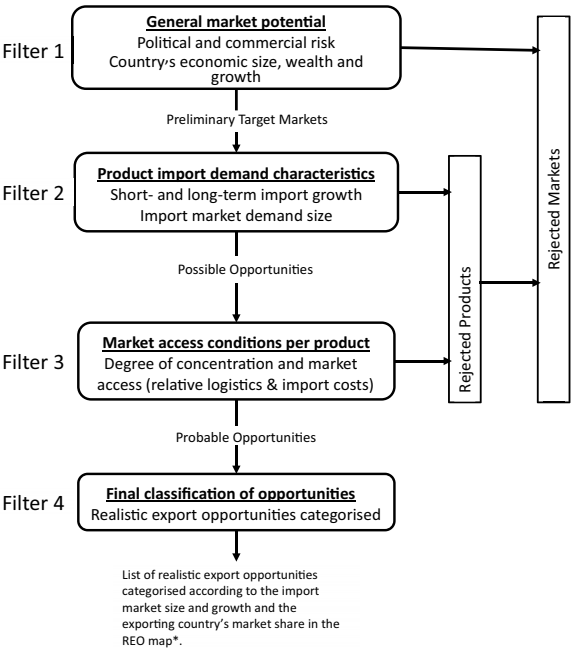


Figure 1.
Summary of the basic methodology of the DSM

Source: Adapted from Cuyvers *et al*. (2017)

3.2 Filter 2: product import demand characteristics

The aim of this filter is to identify the product–country combinations with a satisfactory import market size and short- and long-term import market growth rate (relative to global trends for the product).

The international trade data is obtained from the *Base Analytique du Commerce International* (BACI) data set (Gaulier and Zignago, 2010), which is a reconciled version of the UN COMTRADE database provided by *Centre d'Études Prospectives et d'Informations Internationales* (CEPII) (CEPII, 2017). The data is reconciled for more than 200 countries and makes use of the 2007 HS revision data (at the six-digit level, which is the most detailed level comparable on an international basis across all reporting countries[4]). The modelling supporting this paper also makes use of the latest (2016) trade data from the ITC's Trade Map database for the period 2012–2016.

Revealed comparative advantage (RCA) index of Balassa (1964) is used to define cut-off points for each of the criteria. The degree to which the exporting country is specialised in exporting the product is a deciding factor when determining the import market size and import market growth cut-off points.

An assessment is made of the potential 1,333,002 import figures for the 209 countries[5] for which there exist imports data at the HS 6-digit level in the BACI database of CEPII (209 countries × 6378 HS 6-digit products). In practice 879,198 combinations have actual trade reported on 5,052 products for the period of investigation in the CEPII data set[6]. For each product–country combination, *short-term import growth*, *long-term import growth* and *import market size* are calculated. *Short-term import growth* is the most recent available

simple annual growth rate in imports. *Long-term growth* is calculated as the weighted compounded annual percentage growth rate of imports over the most recent five-year period. Finally, the relative *import market size* is proxied by the ratio of imports of country *i* for product category *j* and the total world imports of product category *j*. Next, "cut-off" values are calculated for short- and long-term import growth and for import market size, using formulas that per product category, consider the degree of specialisation (as proxied by Balassa's RCA) of the home market (exporting country, in this case China). The cut-off points thus calculated are more restrictive, the lower the degree of specialisation of the exporting country in the respective products (Cuyvers, 2004, pp. 259–261; Cuyvers *et al.*, 2012a, pp. 60–64). Of the product–country combinations thus selected, only these are considered for further analysis that are at least growing adequately in the short or long term and/or be of adequate size. The product–country combinations thus identified are the PEOs that subsequently enter Filter 3.

3.3 Filter 3: product–country market access conditions

A target market selected on the basis of only size and growth is not necessarily easily accessed. Therefore, trade barriers such as the degree of market concentration (Filter 3.1) and trade restrictions (Filter 3.2) are considered, thereby screening the remaining possible export opportunities (Cuyvers *et al.*, 1995, p. 180; Cuyvers, 2004, p. 261).

3.3.1 Filter 3.1: target market concentration. A target market whose import supply patterns are highly concentrated is more difficult to enter than a less concentrated market. It might therefore be inefficient for an exporting country to focus on a concentrated target market as the chances of success are likely to be reduced. The Herfindahl–Hirschman index (HHI) (Hirschman, 1964) (adjusted), which excludes the influence (if any) of the "home market", is calculated as a measure of target market concentration.

An HHI of 1 indicates that only one exporting country supplies the importing market and an HHI closer to 0 indicates that many exporting countries are supplying the importing market. Cut-off values for importing market concentration are set heuristically at 0.4, 0.5 and 0.6, respectively, depending on the importing market characteristics (large market, large and short- or long-term growing market, large and growing market in the short and the long term). At the world level (of the 879,198 combinations), application of Filter 3.1 (in isolation of the rest of the filters) leads to an HHI-adjusted subset of 386,348 product-country combinations (so only 44% of the product-country combinations meet the cut-off values).

3.3.2 Filter 3.2: target market access, relative logistics and import costs. The methodology considers trade cost as a measure of trade barriers, but it also includes tariffs, international shipping-cost approximations and both domestic and international transit times, as well as transit country–border cost approximations and the domestic cost to import in the various target markets. Each of these is calculated as an *ad valorem* equivalent (percentage) of the value of the goods and added together to arrive at the total *ad valorem* equivalent of trade cost per product–country combination MAI_{ij} (Cameron *et al.*, 2017). The zero tariffs in existing free trade agreements between China and individual BRI countries are taken into consideration in the calculation of the *ad valorem* equivalent of the trade cost per product–country combinations.

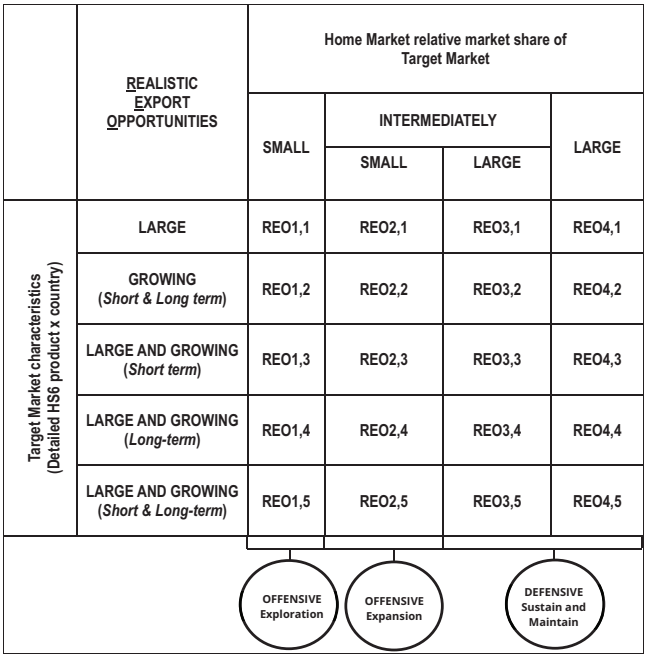
This allows us to construct a relative cost index that not only considers the international (marine) shipping cost and domestic cost to import (World Bank, 2016) but also other costs relating to trade time, infrastructure and logistics (allowing for some differentiation between road freight and marine freight), as part of the filtering process to ensure that the most realistic opportunities are identified.

The data sources are ITC's Market Access Map (MacMap), online sources such as World Freight Rates[7], Searates.com[8], Mediterranean Shipping Company[9], Maersk, CMA CGM [10], Pacific International Lines[11], the Logistics Cluster[12] and Google Maps[13] and the World Bank's Doing Business Report. As MAI_{ij} cut-off point, Pareto's "eighty-twenty rule" was applied, such that only the product/country combinations that passed Filter 2 with a MAI_{ij} of less than or equal to the 80th percentile of the total *ad valorem* equivalent trade costs are allowed as elements of the set MAI. For China, Filter 3.2 (applied in isolation) leads to a MAI-adjusted subset of 700,692 product-country combinations (so 80% of the world total of 879,198 combinations remains).

3.4 Filter 4: categorisation of realistic export opportunities

In the last stage of the analysis, the REOs identified are categorised and prioritised. The filtering process leads to an REO matrix providing a consolidated picture of a market's demand potential as reflected in its imports' size and growth, concentration and accessibility (i.e. in the face of potential trade barriers) (Figure 2).

For the purpose of short-term export promotion activities, an additional criterion that is applied is the exporting country's production capacity for exports, as measured by its RCA and revealed trade advantage (RTA) (Vollrath, 1991). This ensures that only those product–country combinations in which the exporting country has developed a significant level of capacity are selected as export opportunities. Thus, the final categorisation of outcomes is based on the RCA, RTA and "home market" and "target market" product-level trade characteristics (Cameron *et al.*, 2017; Jansen van Rensburg *et al.*, 2019).



Source: Cameron *et al.* (2017), based on Cuyvers *et al.* (1995)

Figure 2.
REO map

The value of "untapped" export potential is categorised according to the home market's (in this case, China's) current export performance in such markets, compared to the performance of the top six competitors in each market (measured in terms of the value of imports from each of these competitors). The "untapped" potential US dollar export value for a product in a target market is defined as the average import market value of the top six competitors in each market, excluding imports from the home market (if the home market happens to be one of the top six sources of imports for the target market for a given product) (Cameron *et al.*, 2017).

This measure therefore provides an indication of the potential "additional" size of different export opportunities in relation to one another from the perspective of the home market, relative to existing exports to the target market. If the share of total imports into a target market, from one of the main exporters to that market, exceeds the average market value of the same product supplied to the market by the top six competitors, it is possible that the actual export value from the home market is higher than this indicative untapped potential export value. In this way, we provide a realistic indication (assuming all other factors remain constant) of the potential market value that the home market could "target" to obtain, in addition to its existing exports to the target market. Using the "all else constant" assumption, it would imply that the home market would need to take market share away from the group of other countries already supplying this product into the target market in question.

For ease of reference and interpretation, the outcomes are translated into a matrix that depicts the characteristics of each REO (combination of a single market × single product), as depicted in Figure 2.

REO characteristics can inform appropriate, though still broadly defined, export promotion or marketing strategies, as follows (Cuyvers *et al.*, 1995; Cuyvers *et al.*, 2012b; Cuyvers *et al.*, 2017; Cameron *et al.*, 2017; Jansen van Rensburg *et al.*, 2019):

- *REO1,1 to REO1,5*: The home market has a nonexistent to low market share and an offensive market exploration strategy is appropriate for products in which a comparative advantage already exists or can be developed.
- *REO2,1 to REO2,5*: The home market has a moderate to large market share and REOs are situated in large and/or growing markets; therefore, an offensive market expansion strategy can be advised.
- *REO3,1 to REO4,5*: The home market has already achieved an important relative market share; therefore, a defensive market support/sustain and maintain strategy seems most appropriate.

4. Results and discussion

4.1 Realistic export opportunities in the Belt and Road Initiative-associated countries

Of the 209 countries for which sufficient data was available, only the 84 BRI countries were selected[14]. This number dropped further to 83 because of insufficient data for Niue. Figure 3 provides an overview of the process and the outcomes obtained for the subset of BRI countries.

At the end of the process, 57,999 product–country combinations remained (covering 79 countries and 2,174 products). Market access-related factors in Filter 3 served to exclude Afghanistan, Kyrgyzstan, Tajikistan and Uzbekistan and a total of 72 products. If we assume that the BRI will remove logistical constraints, resulting in these countries not passing the DSM filtering process (by relaxing the Filter 3.2 requirement for these four

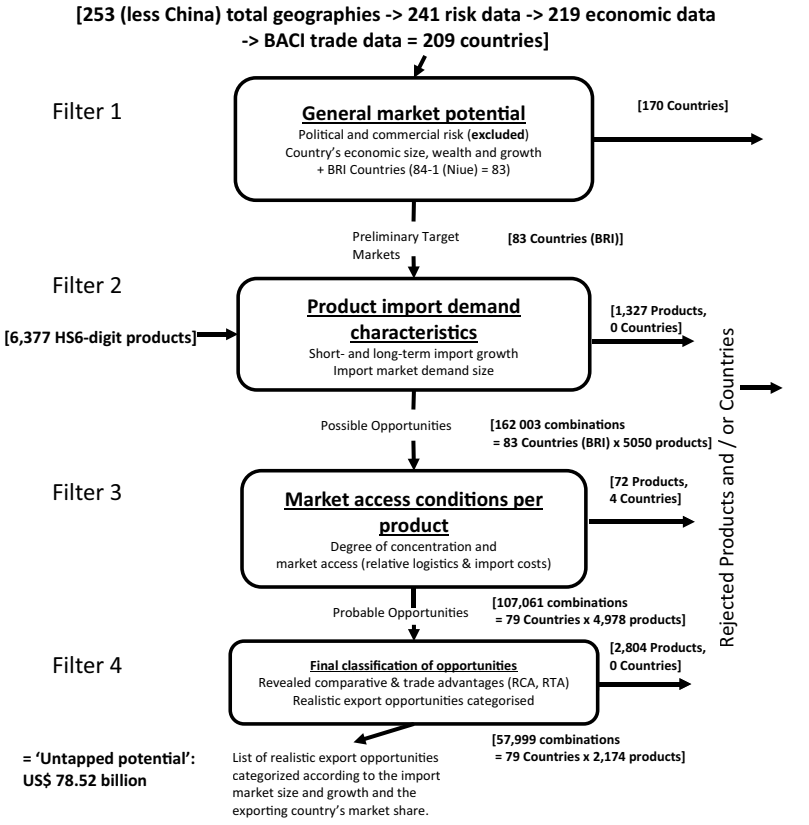


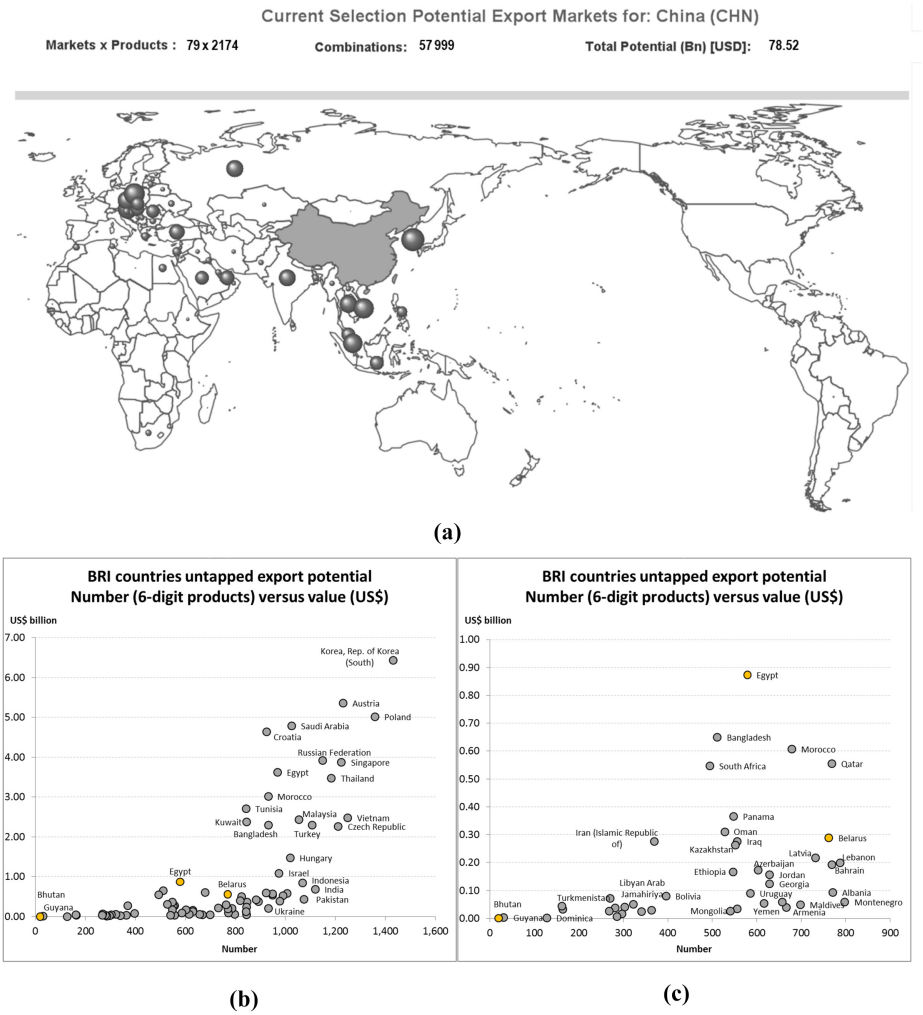
Figure 3.
Filtering process applied to China for the subset of BRI countries (summarised)

Source: Authors' calculations

countries), an additional 2,135 opportunities (4 countries × 1,255) with an untapped potential value of US$182.4m become accessible to Chinese exporters. Although this may seem negligible in the larger context, for the individual countries and exporting companies, these opportunities may be significant. Nevertheless, we decided to exclude these markets from our analysis because they are currently relatively inaccessible. Future research can probe the export opportunities for China presented by these four markets.

The geographical spread and untapped potential in the BRI group, representing a significant US$78.52bn, are depicted in Figure 4. Interestingly, at first glance, the untapped potential seems to be spread quite well within the geographical area of the old "silk routes", whereas African countries and distant locations such as New Zealand and Panama offer, in relative terms, significantly less potential.

Evident from Panel B in Figure 4 is that South Korea presents the largest "untapped" potential in terms of both monetary value and number of six-digit product codes (8.2% of value and 2.5% of number –Table 2). On the opposite side of the scale, countries like Bhutan and Guyana appear. More detail within the range of countries with a number of opportunities between 0 and 900 can be seen in Panel C of Figure 4.



Source: Authors' calculations, the size of the bubbles reflects total realistic export potential of the target market(s) in US$bn. Panel C provides more resolution of lower opportunity countries indicated in Panel A, with Egypt, Belarus and Bhutan indicated as points of orientation between the two charts

Figure 4. Geographical representation of untapped export potential (in US$bn) of BRI countries for China

It is important not to jump to the hasty conclusion that these markets do not offer any potential. It could very well be that they have potential, although relatively small – not only because of the small size of their economies and thus limited demand, but also because China may already be a dominant supplier to such markets. A more detailed analysis would give a clearer picture of these potential target markets. However, this is beyond the scope of this paper, which is to demonstrate how the DSM approach can provide China's export promotion agencies with high-level strategic

insights and some of the core facts needed to take informed decisions and prioritise markets for development. From previous studies, it is clear that although the DSM results provide well-structured and quantitative inputs into the process of concrete strategy formulation, a variety of further information, such as field research, marketing intelligence and geopolitical and diplomatic relations, etc. is required for designing an appropriate export promotion strategy (Cuyvers *et al.*, 2012a, 2012b).

4.2 China's realistic export opportunity matrix for Belt and Road Initiative countries

An analysis of China's worldwide REOs based on the DSM revealed that there are 105,439 global opportunities, representing US$303.34bn. It is interesting to compare the results for the BRI group, as summarised in Table I, with these global REOs.

It is evident that the untapped potential value in the BRI group of countries represents 25.9% of China's global opportunities (i.e. US$78.52bn out of US$303.34bn) and 55% (57,999) of the 105,439 opportunities globally.

Most of the untapped opportunity in the BRI countries is in markets that are relatively small but growing, both in the short and long term (49.1% – Table I). Yet, this group of markets represents the smallest share of untapped imports globally (20.9%). Within this set, 16% of the value of untapped potential is associated with opportunities where China already supplies some of the imports (19.7% of the opportunities) but has only an intermediately small share, whereas 15.6% of the value is associated with opportunities where China is already the dominant supplier (41.1% of the opportunities).

In terms of policy implications, the group of REOs in cell REO2,2, for example, may be prioritised for an offensive expansion strategy (Section 3.4.1).

4.3 China's realistic export opportunity results for the top 20 Belt and Road Initiative countries

In terms of both untapped potential and number of REOs for China, South Korea ranks first. Total exports from China relative to the untapped potential (Column D in Table 2) reflect a ratio of 734.8%, indicating that China already exports more than seven times the remaining untapped potential in South Korea.

In terms of untapped potential, South Korea is followed by Poland, Vietnam, Austria and Singapore, whereas China's existing exports are lower than the untapped potential in Austria and Romania only. Therefore, although the top 20 countries present around 82% of the untapped potential in value terms, China is already a large supplier of most of the imports into these markets. The BRI has tended to be overlooked by the European Commission, which has resulted in some of the smaller EU countries forging bilateral trade ties with China. It is striking that, when taken together, the results show that 17.9% of the value of China's export potential in the BRI countries is associated with Poland, Austria and the Czech Republic (although in number of REOs these represent only 5.9% of China's REOs), thus indicating a potentially important eastern European gateway for China.

Furthermore, most opportunities (63.4%) are associated with BRI countries outside of the top 20, but these represent only 18% of the associated untapped potential value. Hence, when it comes to spending resources on the extensive margin (i.e. developing additional or new markets), it would be sensible for China to focus on the BRI markets outside of the top 20, i.e. the smaller but growing markets. China's top 20 HS 4-digit product opportunities are listed in Table 3.

As can be seen, many of these opportunities belong to HS84 (nuclear reactors, boilers, machinery and mechanical appliances; parts thereof) and HS85 (electrical machinery and

Table I.
China's REO matrix for BRI countries (summarised)

Map of realistic export opportunities (REOs) Number (percentage of total) Untapped potential Billions (Bn) United States Dollar (USD) (percentage of total)	Relative market share of Home Market (China) into Target Market(s)				
	Small (1) <5% (×1)	Intermediate Small (2) 5%-25% (×2)	Intermediate Large (3) 25%-50% (×3)	Large (4) >50% (×4)	Row totals
Target market × product demand characteristics					
Large (1)	1,1 138 (0.2%) 1.00 Bn (1.3%)	2,1 363 (0.6%) 2.69 Bn (3.4%)	3,1 329 (0.6%) 2.97 Bn (3.8%)	4,1 1 122 (1.9%) 6.21 Bn (7.9%)	×,1 1 952 (3.4%) 12.87 Bn (16.4%)
Growing (2) (Short and long term)	1,2 7,717 (13.3%) 6.42 billion (8.2%)	2,2 11,407 (19.7%) 12.58 billion (16.0%)	3,2 8,045 (13.9%) 7.25 billion (9.2%)	4,2 23,844 (41.1%) 12.26 billion (15.6%)	×,2 51,013 (88.0%) 38.51 billion (49.1%)
Large and growing (3) (Short term)	1,3 38 (0.1%) 0.37 billion (0.5%)	2,3 83 (0.1%) 0.65 billion (0.8%)	3,3 70 (0.1%) 0.47 billion (0.6%)	4,3 196 (0.3%) 0.95 billion (1.2%)	x,3 387 (0.7%) 2.44 billion (3.1%)
Large and growing (4) (Long term)	1,4 98 (0.2%) 0.67 billion (0.9%)	2,4 195 (0.3%) 1.12 billion (1.4%)	3,4 166 (0.3%) 1.13 billion (1.4%)	4,4 729 (1.3%) 2.86 illion (3.6%)	x,4 1,188 (2.0%) 5.79 billion (7.4%)

(*continued*)

Table I.

Map of realistic export opportunities (REOs) Number (percentage of total) Untapped potential Billions (Bn) United States Dollar (USD) (percentage of total)	Relative market share of Home Market (China) into Target Market(s)				
	Small (1) <5% (×1)	Intermediate Small (2) 5%-25% (×2)	Intermediate Large (3) 25%-50% (×3)	Large (4) >50% (×4)	Row totals
Large and growing (5) (Short and long term)	1,5 418 (0.7%) 2.83 billion (3.6%)	2,5 583 (1.0%) 4.78 billion (6.1%)	3,5 487 (0.8%) 4.02 billion (5.1%)	4,5 1,971 (3.4%) 7.28 billion (9.3%)	x,5 3,459 (6.0%) 18.90 billion (24.1%)
Column Totals	1,y 8,409 (14.5%) 11.30 billion (14.4%)	2,y 12,631 (21.8%) 21.82 billion (27.8%)	3,y 9,097 (15.7%) 15.84 billion (20.2%)	4,y 27,862 (48.0%) 29.56 billion (37.6%)	x,y 57,999 (100.0%) 78.52 billion (100.0%)

Source: Authors' calculations

Table 2. China's REO results for the top 20 BRI countries

	Country	Number	[A]* Total realistic export potential target market (s) (US$bn)	[B] Total exports from CHN to target market(s) (US$bn)	[C] Total exports from CHN/ target market(s) Total imports (%)	[D] Total exports from CHN/ realistic export potential (%)	[E] Relative contribution to total realistic export potential value (%)	[F] Cumulative contribution to total realistic export potential value (%)	[G] Relative contribution to total realistic export potential number (%)	[H] Cumulative contribution to total realistic export potential number (%)
1	Korea, Rep. of Korea (South)	1,431	6.43	47.23	51.6	734.8	8.2	8.2	2.5	2.5
2	Poland	1,230	5.35	12.94	24.2	241.7	6.8	15.0	2.1	4.6
3	Vietnam	1,358	5.02	33.79	51.5	673.7	6.4	21.4	2.3	6.9
4	Austria	1,024	4.78	4.37	11.5	91.2	6.1	27.5	1.8	8.7
5	Singapore	925	4.63	15.83	32.4	341.7	5.9	33.4	1.6	10.3
6	Czech Republic	1,148	3.91	8.68	22.9	221.7	5.0	38.4	2.0	12.3
7	Thailand	1,224	3.87	21.49	44.8	555.4	4.9	43.3	2.1	14.4
8	Russian Federation	968	3.62	18.16	39.1	501.8	4.6	47.9	1.7	16.0
9	India	1,184	3.47	28.09	52.8	808.8	4.4	52.3	2.0	18.1
10	Turkey	931	3.01	10.84	33.1	359.8	3.8	56.2	1.6	19.7
11	United Arab Emirates	843	2.70	13.54	39.8	500.9	3.4	59.6	1.5	21.1
12	Indonesia	1,249	2.48	15.53	48.3	626.2	3.2	62.8	2.2	23.3
13	Malaysia	1,053	2.43	14.09	45.0	579.1	3.1	65.9	1.8	25.1
14	Saudi Arabia	844	2.37	8.24	32.4	347.3	3.0	68.9	1.5	26.6
15	Hungary	1,107	2.30	2.43	12.5	105.9	2.9	71.8	1.9	28.5
16	Slovakia	932	2.29	2.89	15.6	126.3	2.9	74.7	1.6	30.1
17	Romania	1,211	2.26	1.95	10.7	86.5	2.9	77.6	2.1	32.2
18	Philippines	1,020	1.47	14.96	60.9	1 016.4	1.9	79.5	1.8	33.9
19	Israel	974	1.09	2.78	25.6	255.3	1.4	80.9	1.7	35.6
20	Egypt	579	0.87	2.58	29.9	295.3	1.1	82.0	1.0	36.6
21	Rest	36,764	14.15	54.59	35.8	385.8	18.0	100.0	63.4	100.0
	Total	57,999	78.52	334.99	37.6	426.6	100.0		100.0	

Source: Authors' calculations; *Results sorted in descending order based on Column A. Outcomes based on modelled data from CEPII and other sources for 2017 and 2018

Table 3.
China's REO results for the top 20 BRI-associated products

	HS 4 group	HS4 description	Number	[A]* Total realistic export potential target market(s) (US$bn)	[B] Total exports from CHN to target market(s) (US$bn)	[C] Total exports from CHN/ target market(s) Total imports (%)	[D] Total exports from CHN/ realistic export potential (%)	[E] Relative contribution to total realistic export potential value (%)	[F] Cumulative contribution to total realistic export potential value (%)	[G] Cumulative contribution to total realistic export potential number	[H] Cumulative contribution to total realistic export potential number (%)
1	HS8517	Apparatus for carrier-current line systems/ digital line systems	238	5.77	35.91	46.8	621.9	7.4	7.4	0.4	0.4
2	HS8471	Analogue/hybrid auto. data processing machines	276	2.30	11.26	40.3	490.2	2.9	10.3	0.5	0.9
3	HS8473	Parts and accessories (excl. covers, carrying cases and the like)	143	1.92	8.06	37.4	420.1	2.4	12.7	0.2	1.1
4	HS8481	Check (non-return) valves for pipes/boiler shells/ tanks/vats, etc.	127	1.61	2.99	18.5	184.9	2.1	14.8	0.2	1.4
5	HS8901	Cruise ships, excursion boats and sim. vessels princ. designed for passengers	24	1.41	2.87	22.6	202.9	1.8	16.6	0.0	1.4
6	HS8529	Aerials and reflectors of all kinds suit. for use solely/princ. with television	65	1.27	6.33	41.7	498.9	1.6	18.2	0.1	1.5
7	HS8443	Flexographic printing mach.	213	1.20	3.07	26.7	255.2	1.5	19.7	0.4	1.9

(*continued*)

Table 3.

	HS 4 group	HS4 description	Number	[A]* Total realistic export potential target market(s) (US$bn)	[B] Total exports from CHN to target market(s) (US$bn)	[C] Total exports from CHN/ target market(s) Total imports (%)	[D] Total exports from CHN/ realistic export potential (%)	[E] Relative contribution to total realistic export potential value (%)	[F] Cumulative contribution to total realistic export potential value (%)	[G] Cumulative contribution to total realistic export potential number	[H] Cumulative contribution to total realistic export potential number (%)
8	HS7210	Flat-rolled prods. of iron/ non-alloy steel, of a width of 600 mm/more, clad/ [. . .]	196	1.14	3.91	33.9	344.4	1.4	21.2	0.3	2.2
9	HS8528	Reception app. for television, whether or not incorp. radio-broadcast receivers	272	1.05	5.18	42.4	492.0	1.3	22.5	0.5	2.7
10	HS3926	Articles of apparel and clothing access (incl. gloves, mittens and mitts) [. . .]	161	1.05	2.32	21.7	220.6	1.3	23.9	0.3	3.0
11	HS8541	Diodes (excl. photosensitive/light emitting diodes)	110	1.04	6.41	48.2	614.0	1.3	25.2	0.2	3.1
12	HS7308	Bridges and bridge-sections of iron/steel	175	1.03	3.11	28.1	301.2	1.3	26.5	0.3	3.4
13	HS8544	Co-axial cable and oth. co-axial elec. conductors	160	1.00	3.21	29.0	320.2	1.3	27.8	0.3	3.7
14	HS8534	Printed circuits	40	0.96	3.62	35.5	376.1	1.2	29.0	0.1	3.8
15	HS7326	Articles of iron/steel wire	92	0.96	1.71	17.9	178.2	1.2	30.2	0.2	4.0

(*continued*)

Table 3.

	HS 4 group	HS4 description	Number	[A]* Total realistic export potential target market(s) (US$bn)	[B] Total exports from CHN to target market(s) (US$bn)	[C] Total exports from CHN/ target market(s) Total imports (%)	[D] Total exports from CHN/ realistic export potential (%)	[E] Relative contribution to total realistic export potential value (%)	[F] Cumulative contribution to total realistic export potential value (%)	[G] Cumulative contribution to total realistic export potential number	[H] Cumulative contribution to total realistic export potential number (%)
16	HS8708	Brakes and servo-brakes and parts thereof (excl. mounted brake linings) [. . .]	111	0.90	1.46	17.5	161.9	1.1	31.4	0.2	4.1
17	HS8504	Ballasts for discharge lamps/tubes	236	0.89	4.22	36.0	471.4	1.1	32.5	0.4	4.6
18	HS8415	Air-conditioning machines (excl. of 8415.10–8415.81), incorp. a refrigeration[. . .]	157	0.81	3.38	37.8	420.0	1.0	33.5	0.3	4.8
19	HS7207	Semi-finished prods. of iron/non-alloy steel, cont. by wt. <0.25% of carbon [. . .]	60	0.80	2.25	30.5	281.4	1.0	34.6	0.1	4.9
20	HS8536	Apparatus for protecting electrical circuits (excl. of 8536.10 and 8536.20)	193	0.79	1.45	19.3	183.9	1.0	35.6	0.3	5.3
21		Rest	54,950	50.59	222.26	38.6	439.3	64.4	100.0	94.7	100.0
	Total		**57,999**	**78.52**	**334.99**	**37.6**	**426.6**	**100.0**		**100.0**	

Source: Authors' calculations. *Results sorted in descending order based on Column A. Outcomes based on modelled data from CEPII and other sources for 2017 and 2018

equipment and parts thereof; sound recorders and reproducers; television image and sound recorders; and reproducers, parts and accessories of such articles).

In terms of groups of products, HS8517 (apparatus for carrier-current line systems/digital line systems) represents the single largest potential in value terms at 7.4% of the total potential but only 0.4% of the number of products. From a volume of opportunities perspective, HS5407 (Woven fabrics (excl. of 5407.10–5407.30), cont. <85% by wt. of synthetic filaments) represent the largest number at 665 (not shown in Table 3).

5. Implications

Gravity model or computable general equilibrium model estimations of a country's export potential are at an aggregate level and offer few policy insights for companies and export promotion agencies. In contrast, the DSM results are a list of detailed product–country combinations, which allow both government export promotion agencies and/or exporters to follow these REOs involved. However, although the DSM approach can provide crucial information for China's export promotion activities, real-world logistics may need to be better understood before specific recommendations can be made. This is clearly illustrated by four key BRI countries (Afghanistan, Kyrgyzstan, Tajikistan and Uzbekistan) that, using the DSM, were eliminated on the basis of market access challenges and current logistics assumptions since the routing of most goods to these markets is via sea rather than road and rail – the latter transport modes being exactly what the BRI aims to unlock.

Our analysis shows that the BRI consists mainly of emerging and developing economies, with 70 of the 82[15] countries being classified as such, according to the International Monetary Fund. Of these 70 countries, 11 are further classified by the United Nations as least-developed countries. Therefore, only 12 of the BRI countries can be considered to be "advanced" economies.

China should aim to facilitate the upliftment of the emerging and developing economies within the BRI. To yield mutually beneficial economic outcomes, China would also need to consider investing in growth- and wealth-creating activities in these economies to ensure their future growth and increased demand for Chinese (and other countries') export products and services. Therefore, more than simply logistics connectivity will be required to connect the current major demand centres.

Comparing all of China's REOs in the world with the untapped potential associated with its REOs in the BRI countries only, we found the following:

- Of the total of 84 BRI countries, Niue was eliminated because of information deficiencies, whereas another four BRI countries (Afghanistan, Kyrgyzstan, Tajikistan and Uzbekistan) were eliminated because of market access challenges.
- The remaining 79 BRI countries represent 42.5% of all 186 potential target markets globally and 26.9% of China's globally untapped potential in US dollar value terms.
- Most markets (more than 85%) are considered emerging and developing economies, which signals (in relative terms) constrained future potential as significant demand centres for Chinese exports.
- However, 17.9% of the untapped potential value is associated with the BRI countries of Poland, Austria and the Czech Republic, providing China with a potentially important eastern European route into the EU.

- Although a necessary condition, increased logistics will not, in isolation, necessarily lead to the creation of sufficient future demand centres in the BRI countries that will significantly boost Chinese trade with such countries – unless Chinese policymakers and economic planners also consider effective ways of enhancing domestic economic growth and wealth creation in these countries.

6. Conclusions and some policy implications

Chinese companies and export promotion agencies may find it difficult to identify export markets that have potential in terms of demand, growth and sustainability. Although China's announcement of the BRI heralded great export opportunities for China's business sector, no specific attempts appear to have been made to identify REOs among the BRI countries at the detailed product level.

We have demonstrated how the DSM approach can be applied to identify China's REOs in the BRI countries. Importantly, the results show that one quarter of China's untapped REOs in the world are in the BRI region, with South Korea, Poland and Vietnam ranking as the top three markets. A relatively large share of the total untapped value associated with the identified REOs is attributed to relatively small but growing markets for which China either has an intermediately small market share or a very large market share. The product categories "machinery and electrical products (HS chapter 84 and 85)" enjoy a particularly strong comparative advantage.

It is important to consider the details of specific product–country combinations as different approaches may be required for such alternative combinations. In this regard, the DSM methodology provides structured and well-researched guidelines to assist export promotion specialists and policymakers in their strategic planning. For example, since 17.9% of the untapped potential is associated with Poland, Austria and the Czech Republic, such markets could be useful entry points for China into the greater EU region. Because of the relatively small size of the economies of many of the BRI countries, regional "hubs" of similar REOs could be investigated to aggregate for scale. In addition, offensive expansion opportunities should be unpacked in more detail so that the deployment of resources is more focused and makes sense from an export and investment promotion perspective. Furthermore, a pre-emptive analysis of mature markets, where Chinese exports already dominate, may be warranted.

Clearly, the opportunities associated with the relatively small but growing markets need to be prioritised and leveraged by way of an offensive expansion strategy. However, also evident from the analysis is that most of the countries associated with the BRI are emerging and developing economies that will not be able to absorb large volumes of Chinese exports unless the BRI implements a deliberate policy of enhancing these countries' domestic economies and income levels. This would help to boost demand and these countries' ability to pay for exports from the rest of the world, including China.

Our findings, although demonstrating how to build strong, fact-based foundations for company export strategies and government-driven export promotion policies, also highlight the need for policymakers to look beyond international trade and focus on how to also improve the domestic economies of the partners in the BRI. This will induce higher levels of wealth and growth, which in turn will stimulate increased trade potential for China. The possible mechanisms to realise this goal of increased and more diversified domestic growth might include targeted bilateral investment, development assistance (aid) and trade agreements between China and individual BRI countries (or regional agreements with

groups of countries). However, care needs to be taken when sorting out the mechanics of such initiatives or agreements, as there is already a perception that China is aiming to "exploit" and "re-colonise" these countries.

Notes

1. The BRI has five main pillars for regional cooperation: policy dialogue, infrastructure connectivity, unimpeded trade, financial support and people-to-people exchanges (Huang, 2016).
2. Since the analysis that is reported in this paper was conducted, the COVID-19 pandemic wreaked havoc in the international economy. It follows that the results of our analysis overstate reality for a post COVID-19 global trade environment. Taking into account the lacking data and the many uncertainties involved, it is evidently beyond the scope of the present investigation to attempt to rectify this.
3. http://databank.worldbank.org/data/views/variableselection/selectvariables.aspx
4. The World Customs Organisation (WCO) requires 6-digit reporting as the maximum detail for international comparative purposes. However, some countries can report up to 10-digit, e.g. the USA.
5. Including China as the home market.
6. Not all countries trade on exactly all possible HS codes in the given period.
7. See www.worldfreightrates.com/en/freight
8. See www.searates.com/
9. See www.msc.com/routefinder
10. See www.cma-cgm.com
11. See www.pilship.com/en-pil-pacific-international-lines/1.html
12. See www.logcluster.org/
13. See www.google.co.za/maps
14. A list of BRI countries we selected according to the Belt and Road Portal is available from Appendix 1.
15. Although there are 84 countries associated with the BRI, the IMF has data and classifications for only 82. Since 2011 Syria has been excluded due to the ongoing conflict in the country. Niue is not included either because of a lack of data.

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Appendix 1

Belt and Road Initiative group of countries and reasons for some countries' exclusion from the analysis

Although the island of Niue is listed as being part of the BRI group of countries (according to the Belt and Road Portal of the Office of the Leading Group for the BRI, which is hosted by the State Information Center), the island did not have the required economic and international trade data for modelling purposes. Furthermore, for Filter 1, only the sub-filter for economic size and growth was applied, whereas political and commercial risk elements were ignored for the BRI analysis. However, the treatment of Filter 1 in the BRI analysis did not exclude any of the BRI countries specifically. Table A1 lists the BRI countries that were excluded from the rest of the analysis based on the sub-filters of Filter 3.2 (market access) of the DSM methodology.

Table A1. BRI group of countries and reasons for some countries' exclusion

No.	Country	Least-developed countries (based on the UN*)	(A)dvanced and (E)merging and developing economies (based on the IMF**)	Excluded because of data constraints	Excluded because of Filter 3.2 (market access and logistics)
1	Afghanistan	X	E		X
2	Albania		E		
3	Antigua and Barbuda		E		
4	Armenia		E		
5	Austria		A		
6	Azerbaijan		E		
7	Bahrain		E		
8	Bangladesh	X	E		
9	Belarus		E		
10	Bhutan	X	E		
11	Bolivia		E		
12	Bosnia and Herzegovina		E		
13	Brunei Darussalam		E		
14	Bulgaria		E		
15	Cambodia	X	E		
16	Croatia		E		
17	Czech Republic		A		
18	Dominica		E		
19	East Timor (Timor-Leste)	X	E		
20	Egypt		E		
21	Estonia		A		
22	Ethiopia	X	E		
23	Georgia		E		
24	Greece		A		
25	Guyana		E		
26	Hungary		E		
27	India		E		
28	Indonesia		E		

(*continued*)

No.	Country	Least-developed countries (based on the UN*)	(A)dvanced and (E)merging and developing economies (based on the IMF**)	Excluded because of data constraints	Excluded because of Filter 3.2 (market access and logistics)
29	Iran		E		
30	Iraq		E		
31	Israel		A		
32	Jordan		E		
33	Kazakhstan		E		
34	Republic of Korea		A		
35	Kuwait		E		
36	Kyrgyz Republic (Kyrgyzstan)		E		X
37	Lao People's Democratic Republic	X	E		
38	Latvia		A		
39	Lebanon		E		
40	Libya		E		
41	Lithuania		A		
42	Macedonia		E		
43	Madagascar		E		
44	Malaysia		E		
45	Maldives		E		
46	Moldova		E		
47	Mongolia		E		
48	Montenegro		E		
49	Morocco		E		
50	Myanmar	X	E		
51	Nepal	X	E		
52	New Zealand		A		
53	Niue		N/A	X	
54	Palestine		N/A		
55	Oman		E		
56	Pakistan		E		
57	Panama		E		
58	Papua New Guinea		E		
59	Philippines		E		
60	Poland		E		
61	Qatar		E		
62	Romania		E		
63	Russia		E		
64	Saudi Arabia		E		
65	Senegal	X	E		
66	Serbia		E		
67	Singapore		A		
68	Slovak Republic (Slovakia)		A		
69	Slovenia		A		
70	South Africa		E		
71	Sri Lanka		E		

(*continued*)

Table A1.

No.	Country	Least-developed countries (based on the UN*)	(A)dvanced and (E)merging and developing economies (based on the IMF**)	Excluded because of data constraints	Excluded because of Filter 3.2 (market access and logistics)
72	Syria		E		
73	Tajikistan		E		X
74	Thailand		E		
75	Trinidad and Tobago		E		
76	Tunisia		E		
77	Turkey		E		
78	Turkmenistan		E		
79	Ukraine		E		
80	United Arab Emirates		E		
81	Uruguay		E		
82	Uzbekistan		E		X
83	Vietnam		E		
84	Yemen	X	E		

Source: Compiled by authors. *According to the United Nations Department of Economic and Social Affairs, least-developed countries (LDCs) are low-income countries faced with severe structural impediments to sustainable development. They are highly vulnerable to economic and environmental shocks and have low levels of human assets, see www.un.org/development/desa/dpad/least-developed-country-category.htmlformoreinformation. **The IMF's World Economic Outlook classifies, see www.imf.org/external/pubs/ft/weo/2018/02/weodata/groups.htmformoreinformation, countries as advanced, emerging or developing, depending on the per capita income level; the extent of export diversification, implying that oil-exporting countries that have a high per capita GDP would not make the advanced classification because around 70% of their exports are oil; and the degree of integration into the global financial system. Authors' calculations

Table A1.

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