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Export-Led Growth after COVID-19:
The Case of Portugal

Crescimento com Base nas Exportações depois da COVID-19:
O Caso Português

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ABSTRACT

The COVID-19 pandemic has disrupted trade and global value chains. Small open economies such as Portugal are particularly vulnerable. In this paper we consider the impact of the pandemic on the country's exports, arguing that an export-led recovery is possible. The challenge is to identify viable export opportunities: one of the consequences of the COVID-19 pandemic is to have closed and narrowed export opportunities globally. Despite this we show that there are still significant under-utilized export opportunities for Portugal. We use the large UN-COMTRADE and CEPII BACI data sets to which we apply four sets of filters to identify 42,593 realistic export opportunities. These opportunities are worth €286,6 billion in untapped revenue potential. The major markets for these products are countries such as United States, Germany, China, United Kingdom, France and Japan. We discuss the trade facilitation and industrial policy implications for utilizing these opportunities in the context of the relevant literature on trade and development.
Keywords: COVID-19; trade; exports; economic growth; Portugal.

JEL Classifications: F17; F14; I15; L52

RESUMO

A pandemia COVID-19 foi disruptiva para o comércio internacional e as cadeias de valor globais. Pequenas economias abertas como a Portuguesa são particularmente vulneráveis. Neste artigo consideramos o impacto da pandemia nas exportações do país, argumentando que uma recuperação liderada pelas exportações é possível. O desafio é o de identificar oportunidades de exportação viáveis, uma vez que uma das consequências da pandemia COVID-19 é a de ter fechado e restringido as oportunidades de exportação globalmente. Não obstante, nós mostramos que ainda há oportunidades de exportação subutilizadas em Portugal. Usamos as grandes bases de dados UN_COMTRADE e CEPII BACI às quais aplicámos 4 filtros

para identificar 45.593 oportunidades de exportação realistas. Estas oportunidades foram avaliadas em €286,6 mil milhões de euros em receitas potenciais inexploradas. Os maiores mercados para estes produtos estão em países como os Estados Unidos, Alemanha, China, Reino Unido, França e Japão. Discutem-se ainda implicações para políticas de facilitação do comércio e industriais que possam utilizar estas oportunidades no contexto da literatura relevante em comércio e desenvolvimento.

Palavras-chave: COVID-19; comércio; exportações; crescimento económico; Portugal.

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1. Introduction

The COVID-19 disease was declared a global pandemic by the World Health Organization (WHO) on 11th March 2020. Worldwide, countries responded with non-pharmaceutical interventions (NPIs) – "lockdown measures" – to limit the spread of the disease. As a result of these and its own NPIs, the Portuguese economy contracted by 3,8% in the first quarter of 2020 (Trypsteen, 2020). Estimates are that it would contract by 9,4% in 2020 if there is no second wave of infections (OECD, 2020). Moreover, the world economy is expected to contract by 6% in 2020 (Boone, 2020), that of the Eurozone by 9,1% (World Bank, 2020) and the economies of its largest trading partners, Spain and Germany, by respectively 12,8% and 7,8% (IMF, 2020). Unemployment is expected to increase from 6,5% to between 14,6% and 17,6% by the end of 2020[1].

To mitigate these economic impacts, the Portuguese government provided fiscal stimulus measures announced during April and May and valued at a (modest) 2,5% of GDP. Whereas the stimulus package provides an important temporary role in mitigation, the ultimate recovery from COVID-19 will require a recovery in aggregate demand. In this respect, there is substantial uncertainty more generally in Europe, but particularly in Portugal. Private consumption is projected to fall by 8% in 2020, investment spending by 11% (Trypsteen, 2020). Private consumption over the longer run is likely to me muted due to the ageing demographics of Portuguese society: its old-age dependency ratio is at 40% already 10% higher than the OECD average (OECD, 2019). Furthermore, apart from the fiscal stimulus, further contributions to aggregate demand stimulation from the government is restricted, given that government debt was before the crisis already amongst the highest of OECD countries, and likely to exceed 130% of GDP by the end of 2020 (OECD, 2019; Trypsteen, 2020).

This leaves foreign demand as a potential source of aggregate demand. Indeed, as we show in section 3 of the paper, exports have been a significant driver of economic growth in Portugal over the past decade, contributing 44% to GDP in 2019. The question that we try to answer in this paper is, can exports continue to be a driver of growth in Portugal, and in particular, can exports contribute to recovery from the COVID-19 crisis?

The challenge to an export-led growth path out of the current crisis is the fact that economic activity has contracted across the globe, particularly in Portugal's most important trading partners - as was mentioned in the preceding paragraphs. Thus, across the globe, export demand has declined significantly. This is clear for instance in the World Bank's estimation that global trade will contract by 13,4% in 2020, the worst decline since the 2nd World War, and more than the 10,4% decline during the global financial crisis in 2009[2] (World Bank, 2020). On the face of it, it would seem that recommending that Portugal export its way out of the crisis is unrealistic.

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[1] From the OECD's country scenario's at: http://www.oecd.org/economic-outlook/june-2020/#Country-scenarios.

[2] Global trade tends to contract by more than global GDP during a major international crisis. Eaton et al. (2016), with reference to the 2009 global financial crisis, ascribes this to shifts in expenditure away from tradeable to non--tradable and non-durable goods. However, in the 2020 COVID-19 crisis, there has not been a similar relative shift in expenditures towards services, as services sectors were generally worst affected by lockdown measures (Brinca et al., 2020). One might thus a priori expect trade to recover faster than during the 2009 crisis.

In this paper we make a case that not only is it not unrealistic but may in fact be the best way forward for a small open economy with an ageing population, such as Portugal. We make the case, based on a decision-support model that we apply to the "big data" from UN-COMTRADE, that there is, despite the COVID-19 pandemic, scope for Portugal to diversify its exports towards new products and new trading partners. COVID-19 has certainly resulted in a large decline in global trade but has still left a huge volume of trade intact. Moreover, it may be the case that trade, especially in goods, as opposed to services, is more resilient and quicker to recover. We see this already in indicators of goods trade such as the RWI/ISL Container-Throughput Index[3]. This index makes use of data from 51 ports. As can be seen in Figure 1, this indicator declined significantly in 2020, by 8,6% between January and February 2020, and again by 4% between March and May 2020. However, what is clear is that according to this indicator, world trade in goods have made a substantial recovery by July 2020, with the index value exceeding that reached in 2019. According to the Institute of Shipping Economics and Logistics[4], "Cargo handling in Chinese ports again reached an all-time high".

Figure 1: Recovery in World Trade as measured by the RWI/ISL Container-Throughput Index, January 2019 to July 2020 (2015 =100)
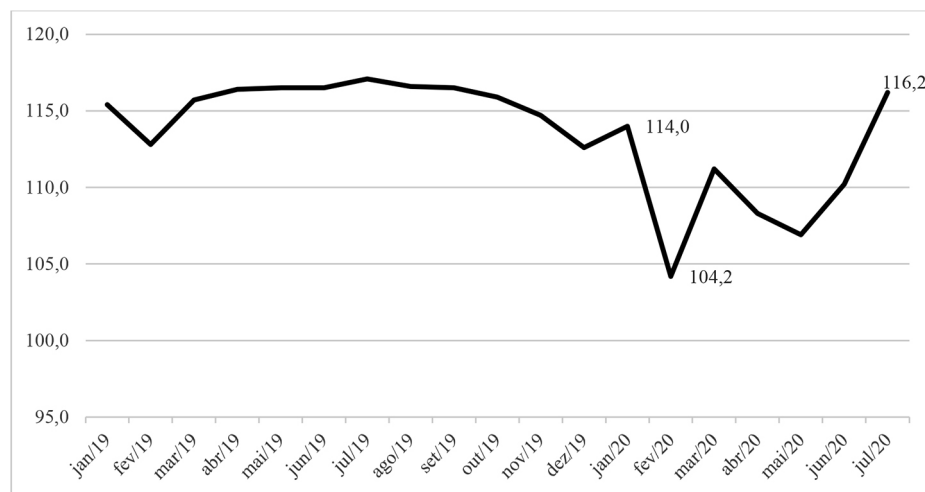
Source: Authors' compilation on data from the Institute of Shipping Economics and Logistics.

Thus, we are arguing that despite the recessionary conditions in the world economy and in particular in Portugal' s main trading partners in the EU, that the country, being dependent on exports, should make use of the fact that world trade in goods at least, seem to be recovering.

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[3] Available at: https://www.isl.org/en/containerindex/july-2020

[4] See: https://www.isl.org/en/containerindex/july-2020

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There are also further reasons why we argue here for a recovery led by promotion of exports and in particular on the identification and pursuit of new and alternative (but realistic[5]) export opportunities (REOs). The first is that in addition to providing a shorter-term demand stimulus to an economy that has suffered a large demand-side shock, the promotion of exports in order to make use of new/ alternative export opportunities offers further benefits, also over the longer-run, that will help Portuguese recovery after the pandemic. These benefits are due to the positive association that exists between exports on the one hand, and productivity and innovation on the other (Melitz, 2003; Aghion et al., 2018). Both market-size and learning-by-doing effects have been noted to be responsible for this positive association (Atkin et al., 2017). Note that in the case of COVID-19, there is not only a need to find new export opportunities, but that the improved access to imports will benefit the utilisation of any new or alternative exports to the extent that sourcing cheaper inputs is a source of competitive advantage for export firms. As concluded by Shu and Steinwender (2018, p. 6) from a survey of the literature in this regard, "export opportunities and access to imported intermediates are generally found to have positive effects on firm productivity and innovation across different countries."

A second reason for arguing for an export-led recovery is that expansion of export opportunities affects not only the productivity and innovation of firms that export (through the market-size effect) but has a general effect of enhancing domestic firm entry and entrepreneurship. This is known as an "induced" competition effect and is due to the fact that the existence of better export opportunities signals a larger market available to Portuguese firms and hence stimulate market entry (Shu and Steinwender, 2018).

A third reason is that diversification into new export products and markets can help improve the resilience of the Portuguese economy and provide insurance against future shocks, including future pandemics, given that these are more likely due to continued changes in land-use patterns and climate change (Gibb et al., 2020). The association between greater trade diversification and reduced trade volatility has been confirmed in the literature (e.g., Bennett et al., 2019; Cadot et al., 2013). Moreover, given that the COVID-19 pandemic will likely exacerbate the stagnating growth of the main trading partners of Portugal since the global financial crisis (Jean, 2020), a diversification into new export markets may reduce the risk or exposure to further demand shocks in future.

The rest of the paper is structured as follows. Section 2 details the impact of COVID-19 in Portugal, discusses the policy responses and the impacts of the pandemic on the country's exports. Section 3 contains a survey of the relevant strands of literature. In section 4 we first explain our methodology and then present the export opportunities for Portugal that we derive from it. Section 5 concludes.

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[5] Realistic in this context refers to opportunities that are deemed feasible subject to constraints applied through the TRADE-DSM methodology such as described in section 4 of this paper.

2. Covid-19 in Portugal: extent, policy responses and impact on exports

2.1. Extent and policy responses

The COVID-19 disease originated in China in November 2019 and was declared a global pandemic by the World Health Organization (WHO) on 11th March 2020. Portugal registered its first cases on 2nd March 2020. Six months later, by 1 September 2020, it had 58,012 confirmed cases and 1,849 deaths[6]. The government responded fairly rapidly by declaring a state of emergency on 18th March 2020. Within this state of emergency, it resorted to various nonpharmaceutical interventions (NPIs) aimed at containing the spread of the virus and avoiding overburdening the capacity of hospitals. These NPIs included social-distancing, quarantines and lockdowns.

To mitigate the adverse economic consequences of the lockdown, the Portuguese government provided fiscal stimulus measures announced during April and May and valued at a (modest) 2,5% of GDP[7], which includes an immediate fiscal impulse of €5,2 billion mainly aimed at distressed firms and protecting jobs, deferrals on payments worth €23,3 billion and €11,7 billion in other liquidity measures and guarantees[8]. A moratorium (until March 2021) has been put on repayment of bank loans[9].

The NPIs imposed by Portugal following the outbreak of its first COVID-19 cases were fairly stringent. Figure 9 in Appendix A compares the lockdown stringency in Portugal with that of Spain, France and Germany, showing that in general, Portugal's lockdown was more stringent than that of its close neighbours and major trading partners. The lockdown measures were most stringent in the first two weeks of April 2020, when the peak of new infections was reached. By 14 April 2020 some measures were relaxed, however, as a second wave started in mid-September 2020 more stringent measures were introduced. By the first week of December 2020 Portugal's lockdown measures were more stringent than that of either Spain, France or Germany.

Figure 2 depicts the confirmed daily fatalities per million population, as well as the stringency of the government's response as measured by the Oxford University's *Stringency Index*. It also shows that the number of new cases peaked on 11 April 2020 then declined until around the middle of September, after which a second wave started, which resulted in daily fatalities even exceeding that of the first wave – by the first week of December 2020 the daily fatality rate was double that experienced during the peak of the first wave – and hence the need for more stringent lockdown measures was clear.

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[6] Data on COVID-19 and the lockdown response by the government is sourced from the *Our World in Data* COVID-19 dataset, available on GitHub at: https://github.com/owid/covid-19-data/tree/master/public/data.

[7] The fiscal stimuli in Portugal's main trading partners, Spain, Germany and the UK have been much higher, respectively 3,7%, 8,3% and 8,0%; see Bruegel at: https://www.bruegel.org/publications/datasets/covid-national--dataset/.

[8] See the analysis of the Bruegel think tank at: https://www.bruegel.org/publications/datasets/covid-national--dataset/#portugal.

[9] See the IMF's Policy Tracker at: https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID--19#P.

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Figure 2: Two Waves: Confirmed daily fatalities (per million population) from COVID-19 and the Stringency Index in Portugal, 23 January – 6 December 2020
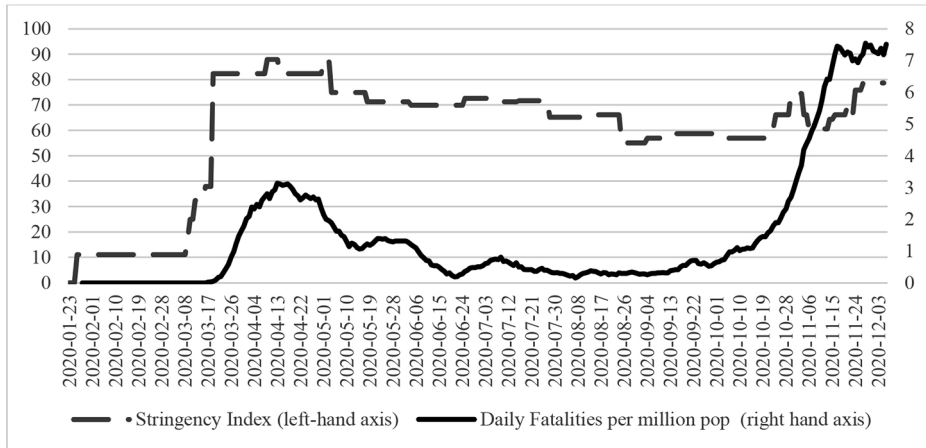
Source: Authors' compilation based on data from Our World in Data, available on GitHub.

2.2. Impact on Portugal's exports

From a health-disaster point of view, the impact of COVID-19 on trade in general and countries' export in particular is likely to be small, if not negligible. While there have not been many empirical studies, to the best of our knowledge, that have investigated the health impacts, in terms of deaths, on exports, the related literature on the relationship between natural disasters and exports, have seen a number of attempts to do this. This literature is surveyed in El Hadri et al. (2019, p. 2669) who conclude that "When pooling all countries, all products and all types of disasters, we do not find any statistical impact on exports, whichever the database at hand." Given the relative low proportion of deaths per country as percentage of the total labor force, it is therefore clear that the impact of the COVID-19 pandemic on exports is through the non-pharmaceutical measures (lockdown measures) taken to curb the spread of the pandemic.

COVID-19 thus represents a significant shock to Portugal's trade. The extent and nature of this shock on domestic firms can be analysed along the conceptual model set out in Shu and Steinwender (2018, p. 3) depicted in Figure 3.

Figure 3: Channels of Impact of the COVID-19 Shock on Trade

Source: Based on Shu and Steinwender, 2018, p. 3.

In Figure 3, domestic Portuguese firms will be affected in both their sales markets (domestic and international) as well as in their input markets (from domestic and international sources). The top two blocks indicate that both the nature of import competition that Portuguese firms will face in the domestic market will change, as well as the export opportunities that they face in international markets. The bottom two blocks indicate that as far as their access to inputs are concerned, they will face changes in the domestic market to the extent that foreign firms will compete with them for domestically sources inputs (other firms' exports) and that their access to imported intermediate goods will be affected.

Consider for instance that as a result of the economic impacts of the measures taken against COVID-19 that domestic firms in Portugal will face possible higher import competition, as foreign firms try to increase their sales in Portugal due to a reduction in demand elsewhere. Likewise, Portuguese firms will find that export opportunities will shrink. The immediate impact of measures to stem the spread of the virus was to halt or delay logistics – for instance in delaying the processing of goods through various ports, due to amongst others health checks and quarantining of port workers. However, once the logistical blockages eased, there will still be at least three ways in which the pandemic will reduce export opportunities. The first is due to a reduction in demand as a result of an income effect, and secondly as result of a substitution effect as domestic competitors in foreign markets lower their prices in the face of excess demand. At the same time, domestic firms will likely face less competition in source inputs domestically and will find easier and cheaper access to intermediate inputs.

There will also be a third effect which could shrink export opportunities: uncertainty. Uncertainty in export markets have been shown, both theoretically and empirically, to affect firms' exports in both the extensive (whether or not to export new products or to new markets) and intensive (degree of exports of existing products into existing markets) margins of exporting (De Sousa et al., 2020). It is in particular the most productive firms, including firms with foreign presences, that are most sensitive to uncertainty in global export markets (Fillat and Garetto, 2015). In the case of Portugal, it has substantial foreign presence in traditional markets such as Angola and Brazil, which are two of its most important export destinations outside the EU. Given that Brazil at least, is one of the countries that are most

significantly affected by COVID-19 and hence is subject to potentially high uncertainty, it could be that Portuguese firms would like to diversify the risk of their exports exposed to these markets, at least over the shorter-term.

That the above negative impacts on exports can be very negative ex ante, is also clear from the fact that Portugal is a very open economy, and it depends significantly on exports as a source of aggregate demand. Teixeira and Fortuna (2010) provide a historical overview of the evolution of Portugal economic development since the 1930s, and its relationship with trade openness. Historically, economic growth and trade openness are closely associated. They document that the country's shift towards an open economy and growth driven by internationalization started in earnest in 1960/1961 when it joined the EFTA and GATT and was accelerated after 1986 when it became a member of the EU. As the authors note, this internationalization, which lead to growth in trade and FDI, contributed to a fairly rapid rise in GDP per capita during the initial phases of opening up, finding that "Between 1960 and 1973, Portuguese GDP per capita grew from one third to half that of the most developed European countries" (Teixeira and Fortuna, 2010: 337).

The country has recently enjoyed significant success in exporting, and exports have become an important engine of growth[10] (OECD, 2019; Felke and Eide, 2014). Between 1975 and 2019, the share of exports in GDP rose from 13% to 44% (see Fig 4). It was in particular after the 2009 global financial crisis, that Portugal saw an acceleration in the growth of exports- with an average annual growth rate in exports of 5,8% between 2010--2019 and export volumes increasing by 33% over this period. Both exports at the extensive and intensive margins[11] increased significantly. Since 2012 the country also, for the first time since the 1970s, enjoyed a positive trade balance. The export success since 2011 was in large part the result of a successful internal devaluation, which lowered per unit labor costs, following a Memorandum of Understanding (MoU) reached with its creditors (The European Commission, The European Central Bank and the International Monetary Fund) following the global financial crisis (Doulos et al., 2020; Felke and Eide, 2014).

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[10] Between 2009 and 2019 for instance, real GDP per capita increased from US\$ 22,125 to US\$24,590. In the five years before the COVID-19 pandemic broke out (2015-2019), average annual GDP growth was 2,4%, in comparison to average change in real GDP of -1,8% between 2009 and 2013. Unemployment declined from 16,2% in 2013, to 6,5% in 2019.

[11] The extensive margin of exports refers on the country level to "the number of product categories exported" and the intensive margin of exports refers to "the value traded per product category or per transaction" (Visser, 2019:41).

Figure 4: Exports as % of GDP, Portugal, 1970 – 2019
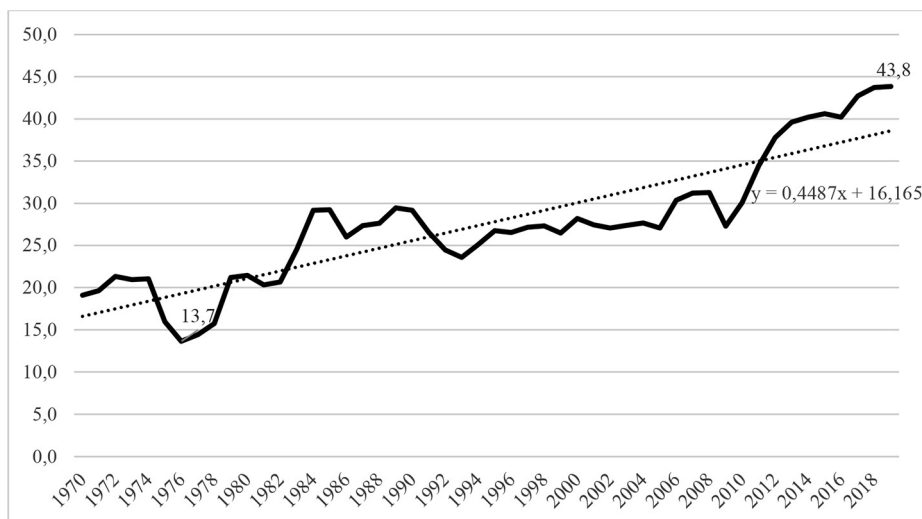
Source: Authors' compilation based on World Development Indicators Online.

Around 23% of export receipts (in 2018) are from tourism, and tourism contributed 16,5% to GDP in 2019, more than the Euro-area average of 10% (World Bank, 2020). Between 2014 and 2018, international tourist arrivals in the country increased by 54%, from 10 million to almost 17 million. Three quarters of these tourists are from the European Union[12].

As far as goods (merchandise) exports are concerned, Portugal most heavily exports manufactured goods (76%) and agricultural products (14%), with machinery and transport equipment and chemicals comprising the bulk of manufactured exports.

The COVID-19 pandemic has had a particularly deleterious effect on world trade, and also on the exports of Portugal. Figure 5 depicts the decline in merchandise exports for the first and second quarters of 2020, in comparison with 2019. Note: while many countries instituted restrictions on exports of personal and protective equipment (PPE) and other medical supplies, Portugal has not instituted such measures, although it is bound by a European Commission regulation[13] of 19 March 2020 that requires prior authorization for PPE exports to third countries. We do not consider this to have had a significant impact on the country's exports.

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[12] Source of data on tourism: *UN World Tourism Organization.*

[13] See: http://www.wcoomd.org/en/topics/facilitation/activities-and-programmes/natural-disaster/list-of--countries-coronavirus.aspx

Figure 5: Portugal: % Change in Monthly Merchandise Exports, 2020 compared to 2019
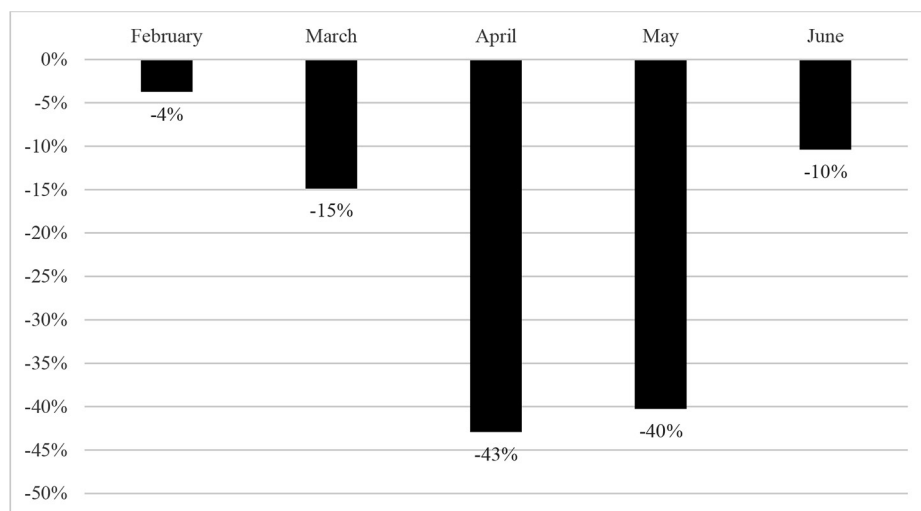
Source: Authors' compilation based on data from the World Trade Organization, at https://data.wto.org.

Figure 6 provides a longer snapshot of Portuguese exports – monthly figures from January 2006 to June 2020.

Figure 6: Portugal: Monthly Merchandize Exports, 2006 - 2019 (US$ millions)
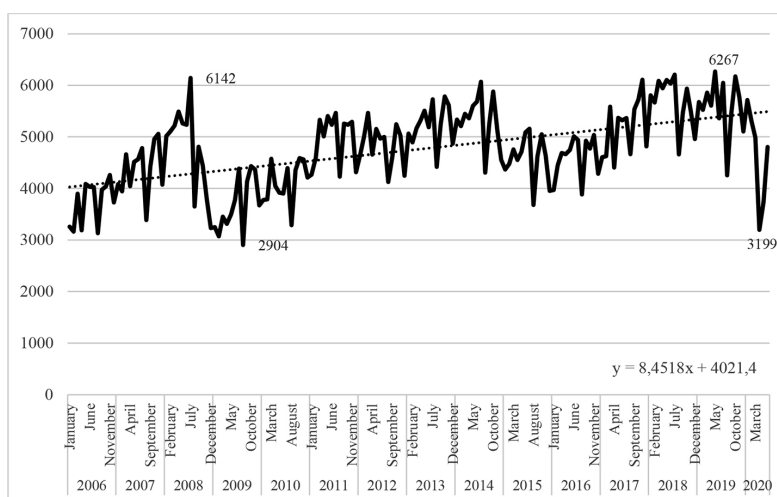
Source: Authors' compilation based on data from the World Trade Organization, at https://data.wto.org.

Figure 6 confirms first the upward trajectory in Portugal's exports, as can be seen in the upward sloping trend line. It furthermore clearly shows the dramatic impact that the COVID-19 pandemic has had, in a recent historical context, with exports contracting much more than in 2009 during the global financial crisis, both absolutely and relatively to the trend line. Figure 6 also shows that after the 2009 global financial crisis, it took the country until the first half of 2011 to recover exports to the level of the trend line and moreover it took until July 2018 before exports exceeded the monthly high-point level of US$6142 million achieved in July 2008. From this the conclusions are clear: the COVID-19 pandemic has been extremely detrimental to Portuguese exports, with a worse impact than that of the global financial crisis; the pandemic broke out just as Portugal was starting to enjoy the fruits from an upward trajectory in exports and export-led growth; and moreover, that it may take at least a year or two to recover exports to its trend level, of course depending on the duration of the pandemic and the nature of the global economic recovery.

Since almost a quarter of traditional Portuguese export revenue is from tourism and given that the tourism and travel industries have been amongst the worst affected by the COVID-19 pandemic, the decline in total exports will be much higher than only the decline in merchandise exports. Best case estimates are that the European tourism industry will suffer a US$ 770 billion loss in 2020 (worst case is US$ 1608 billion), with Portugal's tourism revenue declining by more than 40%[14]. Figure 7 shows the dramatic decline in tourist arrivals in advanced economies during the first months of 2020 – dropping 98,3% compared to the 2015 monthly average.

Figure 7: Monthly tourism arrivals: Deviation from 2015 average for 22 advanced economies, January 2018 to April 2020
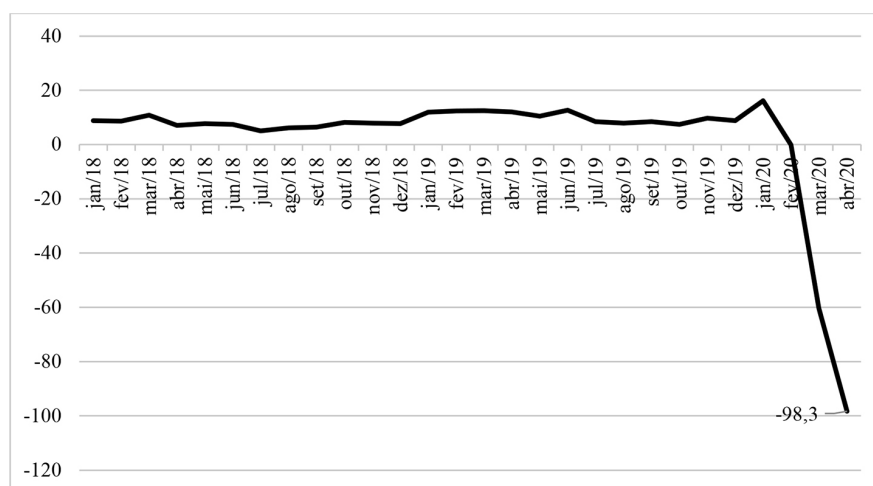
Source: Authors' compilation based on data from the World Bank, 2020, p.12.

[14] See the estimates of the World Travel and Tourism Council at: https://wttc.org/Research/Economic-Impact/Recovery-Scenarios-2020-Economic-Impact-from-COVID-19.

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The decline in merchandise exports and tourism is one of the reasons for the expected significant decline in economic growth that Portugal is expected to suffer in 2020 as a result the COVID-19 pandemic and the efforts to contain it.

3. Literature review

In this literature review we focus on three strands of relevant literatures. First, we provide a short overview of the arguments for the importance of exports, and export diversification, for growth and development. Secondly, we discuss the strand of literature that has tried to answer the question: what determines the exports of a country? And thirdly, we summarize the (smaller) strand of literature that has dealt with the promotion of exports, particularly trade facilitation. These three strands of literature are relevant as it provides the theoretical underpinnings of our approach that we apply to the case of Portugal.

The first strand is relevant because we are arguing that Portugal should base its economic recovery from the COVID-19 pandemic on an outward-looking, export-led growth (ELG) path, in particular expanding its exports on the extensive margin – i.e., along new product--destination combinations. The second strand is relevant as we are interested in identifying these potentially new product-destination export opportunities for Portugal, by using a unique decision-support model. In this model we use various filters applied to the CEPII BACI data set that is derived from UN-COMTRADE data to eliminate product-destination combinations that do not conform to the determinants of exports. The third strand is relevant given that our model is based on an understanding that reducing of informational gaps and knowledge about exporting, is at the core of trade facilitation.

3.1. Why do exporting, and export diversification, matter?

In the introduction of this paper, we motivated the need for Portugal to base its economic recovery from the COVID-19 pandemic on an outward-looking, export-led growth (ELG) path. This is based not only on practical considerations given the observed impacts of the COVID-19 recession on dampening demand, but also based on a substantial literature that establishes the positive relationship between ELG and economic growth, and which recognizes the contribution of an expansion of exports on the extensive margin (export diversification) to economic development. Exporting (and importing) allows countries to accumulate knowledge, through for instance sharing of ideas, obtaining scale economies for innovations, and by directly sourcing technologically embodied knowledge (Grossman and Helpman, 2015). Exporting firms also tend to be more productive than non-exporters (Wagner, 2007), which has also been found to be the case in Portugal (Neves et al., 2016). Moreover, expanding exports on the extensive margin can help reduce risk from volatility in demand (Bennett et al., 2019).

A large literature has empirically tested whether and how the export-led growth (ELG) hypothesis is valid. Hagemejer and Mućk (2019) briefly reviews this literature, concluding that the weight of evidence seems in favor of ELG, in particular when the endogeneity of

exports is taken into account. The literature also tends to support bi-directional causality, i.e., economic growth and development can also lead countries to export more, for instance by enabling them to produce a greater variety and better quality of products (Baldwin and Harrigan, 2011; Hummels and Klenow, 2005).

Hagemejer and Mućk (2019) conduct their own empirical investigation, using data covering 1994 to 2014 on the Central and Eastern Europe countries (CEECs), finding that indeed there is a significant positive and causal relationship between export growth and economic growth. Moreover, they found that "export-related growth is associated mainly with capital deepening" which could indicate that exports drive growth by facilitating a country's structural upgrading (Hagemejer and Mućk, 2019, p. 1996). Other evidence from small, open economies comes from Greece and the Gulf Cooperation Council countries, where respectively Tsitouras (2016) and Kalaitzi and Chamberlain (2020) found evidence of significant long-run relationships between economic development and export growth.

In the specific case of Portugal, Andraz and Rodrigues (2010) using data covering 1977 to 2004, found that in Portugal exports is a significant determinant of long-run growth. Teixeira and Fortuna (2010), relatedly found for Portugal, using macro-economic data over the period 1960 - 2001, that trade is a significant contributor to total productivity growth and hence GDP per capita. Neves et al. (2016) found, using a large dataset of over 300,000 firms in Portugal between 2006 and 2012, that firms that export are likely to invest more in R&D and that firms that export obtain better productivity through learning-by-doing. This suggest that the economies of scale through exporting can stimulate innovation, especially if innovation is subject to significant fixed costs, and takes place within a small domestic market, as in Portugal (Bastos et al., 2018).

The literature has also been concerned whether the nature of export growth matters, for instance whether growth of export at the intensive margin is sufficient or whether there are additional or special advantages from export growth at the extensive margin? This question has been motivated by the observation that countries with most rapid export growth and large export shares tend to be very specialized in product and exports, for e.g., oil and other commodity producing countries (see e.g., Easterly et al., 2009). Typically, most export growth is at the intensive margin (Brenton and Newfarmer, 2007), although growth at the extensive margin is not negligible – according Cadot et al. (2013, p. 794) between 14% and 40% of export growth are at the extensive margin. This may be of particular value when traditional exports are under pressure, such as after a global shock. In this case of Portugal after the COVID-19 crisis, we are arguing that the extensive margin is indeed important for recovery and future resilience, moreover without unduly putting downward pressure on real wages. Furthermore, breaking into new markets and new products will indeed require overcoming of informational asymmetries – and utilising data-intensive analytical tools to reduce these informational inadequacies – which we provide in section 4 of this paper.

Regarding the question of whether growth of exports at the extensive margin is important for economic growth and development, it can be concluded that both theory and empirical evidence support this idea. For instance, Funke and Ruhwedel (2002) provided an endogenous growth model wherein increasing export variety leads to faster GDP per capita growth via dynamic economies of scale. Export diversification, such as has been experienced in Portugal, is furthermore good for development as it is associated with reduced export

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volatility[15] and hence less GDP volatility, especially in small, open economies (Bennett et al., 2019; Cadot et al., 2013). Del Rosal (2018) found this also in the case of 28 EU countries, including Portugal[16.] A growing literature has found empirical evidence supporting the relationship between export diversification and growth, amongst others Herzer et al. (2006), Naudé and Rossouw (2011), Agosin et al. (2007) and Kaitila (2018). Funke and Ruhwedel (2002) moreover also found that export diversification improves not only economic growth, but also overall export performance in OECD countries. Kaitila (2018) found that also in the case of Portugal that there is a significant relationship between the increase in the number of different export products and GDP growth.

Second, regarding the related questions whether the kind of goods that a country produces and export, and the destination to which it exports, matters, both theory and empirics support the notion. From a theoretical perspective, Hausmann et al. (2007) argued that the type of goods that a country exports differs in terms of productivity implications, and that therefore the composition of a country's exports can determine its overall productivity and economic growth. Given the idea that what a country exports matters for its productivity and GDP growth, they constructed a measure of the "productivity level" associated with a country's basket of exports and found that "countries with initially high levels of EXPY subsequently experience higher growth in exports" (Hausmann et al., 2007, p. 23). A reason is that the kind of goods that are associated with high levels of productivity face a highly elastic price elasticity in world markets. Whether and how countries can upgrade and move into producing and exporting goods associated with a higher productivity level, is another question altogether. Hidalgo et al. (2007) proposed that this depends on what they term a country's product space, which will determine how related its current products are to higher quality/ higher productivity products. They explain the concept of product space as follows: "a country with the ability to export apples will probably have most of the conditions suitable to export pears. They would certainly have the soil, climate, packing technologies, and frigorific trucks […] if instead we consider a different product such as copper wires or home appliance manufacture, all or most of the capabilities developed for the apple business render useless" (Hidalgo et al., 2007, p. 484).

It is not only the type of good that countries export that may be important for their growth, but also the destination of their exports (Bastos and Silva, 2010). For example, Brambilla et al. (2012) found from a sample of Argentine firms that those who export to high-income countries would tend to employ better skilled labour. This has been taken to indicate that they are concerned to compete on better quality products in these high-income destinations. Bastos et al. (2018) calls this an "income-based quality-choice channel" and finds evidence that this is also the case for Portuguese firms - that they use higher priced and better-quality inputs when producing for exporting to high-income destinations. Thus, both what a country export and to whom it exports, may matter for its economic growth and development.

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[15] Measured for instance by the standard deviation of annual export growth.

[16] According to Del Rosal (2018, p. 329) Portugal's exports became slightly less concentrated in the top between 2002-2004 and 2012-2014, as reflected in the Theil Index of export concentration declining from 2,554 to 2,322.

Portugal's export performance in recent times shows evidence indeed of increased diversity. For example, Kaitila (2018) found that in the case of Portugal between 1995 and 2015 that there has been significant growth in the extensive margin of its exports, measured by its share of all the possible export products as per the HS8 classification. And according to Felke and Eide (2014, p. 173) Portugal also diversified the destinations to which it exports, reporting that the diversity of exports by destination country "as measured by the Herfindahl index, increased from 0.88 to 0.91 in the 2008-2012 period"[17]. Consistent with these studies, Portugal's export does not reflect concentration of exports by only a few large "global" firms as is often found (see the next section). According to Kaitila (2018, p. 719) in 2015 the share of the top 10 export products as % of the total value of goods exports in Portugal was 12,7%, which was amongst the lowest of their sample of EU countries, and much lower than that of other peripheral small open EU countries such as Ireland (47,1%) or Greece (32,5%), or its main trading partners, Spain (17,9%) and Germany (17,8%).

Note however, that there might seem to be tension between the strong evidence and theoretical case for export diversification, and the observations that export volumes and export specialization tend to be correlated, and that the distribution of countries' exports follows a power law (Easterly et al., 2009). Del Rosal (2018) confirms this "power law" of export concentration for the EU including Portugal.

The "big hits" model of Easterly et al. (2009) is based on this empirical observation that in terms of product-destinations most countries export only a few products to a very limited number of destinations, with most export success being reflecting in scoring one "big hit" in terms of a product-destination. As they describe the concept of a "big hit" in exporting: "Out of 2985 possible manufacturing products in our dataset and 217 possible destinations, Egypt gets 23 percent of its total manufacturing exports from exporting one product [...] Ceramic bathroom kitchen sanitary items not porcelain [...] to one destination, Italy, capturing 94 percent of the Italian import market for that product" (Easterly et al., 2009, pp. 1-2). Moreover, they note that this results in very high export concentration ratio's and that successful export countries differ from unsuccessful countries in terms of the degree of export concentration and the size of their big export hits: "a significant part of South Korea's greater success than Tanzania as a manufacturing exporter is exemplified by South Korea earning $13 billion from its top 3 manufacturing exports, while Tanzania earned only $4 million from its top 3" (Ibid, p. 2).

This explanation of export specialization can be consistent with the empirical patterns across levels of development, that countries tend to specialize in exports at low levels of development, then as they develop through middle income range their exports tend to diversify, often to increase again in specialization as they become richer (e.g. Parteka, 2013 for the case of the EU) – although not always (see Mau, 2015). The point is, as the literature also finds in terms of learning-by-doing effects and the productivity levels associated with various baskets of exports (Hausmann et al., 2007), that finding "big hits' requires export diversification as a form of experimentation and learning – and luck – before being able to find a particular product-destination niche where the country is good in – akin to the

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[17] In the context of exports, the Herfindahl index reflects the degree of diversification of exports. An index value of 1 represents perfect diversification (equal market shares for all countries), while an outcome closer to 0 means a very low level of diversification (so concentration).

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entrepreneurial knowledge-spillover mechanism described in Hausmann and Rodrik (2003). As they remark "In addition to the possible knowledge externality to a successful export, there is also a knowledge problem about the discovery itself" (Easterly et al., 2009, p. 4). In section 4 below, we will introduce a data-driven decision-support model to help address this "knowledge problem about the discovery' of export opportunities.

3.2. What determines export growth and diversification?

The previous sub-section has made a case that export growth and export diversification matters for growth and development. As such, a relevant question is what determines export growth and diversification? The theoretical and empirical literature on this topic is very rich, the former going back at least to Adam Smith, who considered exports to be a vital mechanism for longer-term growth and development, by facilitating productivity growth (Myint, 1977) and providing a useful "vent-for-surplus" in that it allowed that "at least some of the products that are available in excess supply may be exchanged for goods produced abroad for which there is a domestic demand" (Kurz, 1992, p. 480). While Smith's views on trade have been subject of controversy (Schumacher, 2015), less controversially classical trade theories, including the Ricardian model and the Hecksher-Ohlin-Samuelson (H-O-S) model, described exports being determined by a country's comparative costs and technology (the Ricardian comparative advantage model) or relative factor endowments (H-O-S). According to Feenstra (2016, p. 1) the Ricardian model, by emphasizing technological differences between countries as determinant of their exports, is "as relevant as it has ever been," while the H-O-S model is "hopelessly inadequate" to explain exports empirically.

Classical trade theories have at least two significant flaws for present purposes. One, they neglect trade costs, and the determinants thereof, such as distance. Trade costs typically refer to "all costs incurred in getting a good to a final user other than the marginal cost of producing the good itself: transportation costs (both freight costs and time costs), policy barriers (tariffs and nontariff barriers), information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs (wholesale and retail)" (Anderson and van Wincoop, 2004, pp. 691-692). And distance, a determinant of trade costs, which can be measured as a population-weighted average of distance between major cities, also include aspects of "institutional distance" such as "common language, common legal system, common colonial origins, membership of the same FTA "(Carrère et al., 2020, p. 886).

One dimension of trade costs and distance is time. For most countries, the majority of their exports are transported via ocean shipping or road transport (Cristea et al., 2013). The longer the distance, the more expensive these transport modes are in terms of time value of exports because it takes more time, which in turn requires more inventory to be held, increased depreciation costs, and possible adverse impacts on the perceived quality of the product (Hummels and Schaur, 2013). Especially time-sensitive exports, such as fresh produce, would therefore be less likely to be traded across large distances, and if so, it will be through air freight, which is however much more expensive. Hummels and Schaur (2013, p. 2936) stress that "timeliness is potentially important in the presence of demand

uncertainty," and suggest that this may be one reason that explains the gradual increase in the volume of exports through air freight in recent years. If demand uncertainty is a factor, and competition based on product quality differentiation important, then this would suggest that export volumes will be very sensitive to delivery times.

Trade costs, distance and time, critical determinants of exports, were given attention in the so-called New Trade Theory, where market size, scale economies, networks and monopolistic competition are key determinants of exports (see e.g. Krugman, 1979;1980) and in the New Economic Geography (e.g. Krugman, 1991) where agglomeration advantages and "iceberg" transport costs (following from Samuelson, 1952) are key determinants of both location and trade patterns. For example, a central result in new economic geography is that when transport costs fall enough, firms will tend to engage in more product differentiation and locate closer to their consumers. A recent review of geography and trade is by Redding (2020).

A second significant shortcoming of Classical trade theory is that it focusses on exports between countries, and between industries in countries, and assumes a representative firm. It is of course individual firms that engage in the production and exporting (and importing) of goods and services, and these firms are very heterogeneous. As a result and facilitated by growing volumes of firm level data[18] becoming available, the last two decades have seen the development of what has been termed New New Trade Theory, theories that jettisons the assumption of a representative firm, and focuses on the role of heterogeneous firms in trade – see for instance the seminal contribution by Melitz (2003) as well as Bernard and Jensen (2004), and overviews in Bernard et al. (2007), Redding (2011), and Ranjan and Raychaudhuri (2016).

These "new new" theories of trade, or heterogeneous firms in trade (HFT) theories attempt to explain some of the key empirical facts characterising world trade. These are that "only some firms export, exporters are more productive than non-exporters, and trade liberalization is accompanied by an increase in aggregate industry productivity" (Bernard et al., 2018, p. 565). Moreover, a salient fact of international trade, and in particular exports, is that it is relatively concentrated. Recent heterogeneous firms in trade models are concerned also to explain why most exporting tends to be by a few "global firms". Bernard et al. (2018, p. 566) defines these as "firms that participate in the international economy along multiple margins and account for substantial shares of aggregate trade."

In HFT models, as in Melitz (2003) and Chaney (2008), firms have different levels of productivity. Due to the presence of significant fixed trade costs in exporting (Anderson and van Wincoop, 2004), only the most productive firms will export. Bernard and Jensen (2004) found empirical evidence from the USA supporting this notion. A change in variable trade costs will affect the volumes of existing exports, i.e., exports at the intensive margin. In contrast, a change in fixed costs will affect the threshold level of productivity necessary for exporting, and hence affect exporting at the extensive margin (Persson, 2013; Helpman et al., 2008; Hummels and Klenow, 2005; Dennis and Shepherd, 2011). More generally, in the Melitz (2003) model, trade openness, financial access, human capital, trade costs

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[18] Reviews of the growing number of empirical studies that attempt to identify the firm-level determinants of exports include Sousa et al. (2008).

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(e.g., as a result of distance, or exchange rate volatility) and terms of trade changes will all determine the extent of new exporters entering the market and this export diversification.

There have been a number of tests of these predictions of HFT models, which have found some support for some of these predictions. For example, Agosin et al. (2012) found that export diversification across a sample of 79 countries between 1962 and 2000 were significantly associated only with human capital, distance and exchange rate volatility. They concluded that policies such as trade openness and financial development do not seem to be significant in determining export diversification, and recommend instead efforts to improve human capital, alleviate the impact of distance (location), and avoiding exchange rate volatility. Kehoe and Ruhl (2013) also found that trade openness stimulates exports at the extensive margin, reporting evidence from the case of the NAFTA.

In these models, different export destinations will be associated with different levels of profitability, depending on the costs and prices and demand in each market. Mayer et al. (2014) shows that when multi-product exporting firms face increased competition (and reduced mark-ups) in destination markets, that they will tend to shift their exports towards their better performing export products. The result is a reshuffle of their product mix, the combinations and extent of exports which will result in firms' export product range becoming narrower and more concentrated. As they put it (p. 496) "firms respond to increased competition by dropping their worst performing products". This could lead to firms getting more productive. Thus, competition in foreign markets could give rise to export firm productivity improving.

Naudé et al. (2015) provide a theoretical model wherein the presence of fixed trade costs gives exporting a similar decision-making structure as investment, and that as such the timing of when to export will matter. Thus, it is– not only the firm's productivity, but whether or not rates of return from entering the export market at a particular point in time will be considered. This may mean that even productive firms may postpone entry into export markets if they face high uncertainty – which is the case in the current global pandemic. Thus, in the Naudé et al. (2015) model, the kind of systemic uncertainty implied by the COVID-19 pandemic will reduce export growth at the extensive margin due to this postponement effect of investment under uncertainty.

Trade theory, from Adam Smith to Classical Models, to New Trade Theory and Heterogeneous Firms in Trade (HFT) theories, have thus identified a wide range of factors that determines the exports from a country and its firms along the intensive and extensive margins. While these theories provide much insight into explaining exports, their ability to describe and predict actual exports between countries, have remained a challenge – trade theories and trade data are not perfectly matched (Baldwin and Harrigan, 2011). The most successful model to describe the actual data of exports from one country to another, has been the Gravity Equation. The Gravity Equation has been "hugely successful in predicting trade flows" (Armenter and Koren, 2014, p. 2131).

A Gravity Equation can be derived from "a wide range of canonical trade models" (Carrère et al. 2020, p. 887), see also Haveman and Hummels (2004), Feenstra et al., (2001) and Baldwin and Harrigan (2011) on the theoretical bases of the Gravity Equation.

A typical Gravity Equation, which would specify the value of exports from country j to country k (following Carrère et al. (2020, p. 889) can be written as follows:

$$V_{jk} = \left(\frac{t_{jk}}{\Pi_j P_k} \right)^{1-\sigma} \frac{Y_j E_k}{Y_w} \tag{1}$$

where

$$\left(\Pi_j \right)^{1-\sigma} = \Sigma_{h=1}^{n} \left(\frac{t_{jh}}{P_h} \right)^{1-\sigma} \frac{E_h}{Y_w} \tag{2}$$

and

$$\left(P_k \right)^{1-\sigma} = \Sigma_{h=1}^{n} \left(\frac{t_{hk}}{\Pi_h} \right)^{1-\sigma} \frac{Y_h}{Y_w} \tag{3}$$

Equation (1) is a structural gravity equation denoting that the value of exports from country j to country k (V_{jk}) is a function of expenditure in the importing country k weighted by the relative size of the exporting country j in the world economy $\left(\frac{Y_j}{Y_w} \right)$ as well as of the trade costs (t_{jk}) of transporting the product from j to k, expressed as a fraction of the product of indices of the cost of living in countries j and k respectively (equations 2 and 3). The import demand elasticity is denoted by $(1 - \sigma)$. It results from assuming the consumer preferences following a Constant Elasticity of Substitution (CES) specification (Carrère et al., 2020).

This shows that both trade costs and the incomes (market size) and consumer preferences in destination countries matters for export volumes (Bastos et al., 2018). As was discussed above, these determinants have their deeper theoretical bases in new trade theory and HFT models.

For present purposes, while our decision-support model that will be used to identify new product-destination export opportunities for Portugal is data-driven, like the Gravity Equation it can be seen to reconcile the volumes of trade data with theoretical and structural determinants of exports. Moreover, the Gravity Equation, consistently with HFT models, provides a motivation for our approach to provide inputs into trade facilitation by reducing informational frictions that are part of trade costs. Thus, as per the Gravity Equation described here, trade costs, includes informational frictions (Artopoulos et al., 2013; Chaney, 2014; Kim et al., 2018).

The importance of informational frictions in exports are illustrated by Chaney (2014) who models and find empirical evidence for the significance of informational frictions in explaining the geography of French trade. In his model, existing exporters are more likely to start exporting to a different country than a non-exporter is to start exporting, due to the fact that the former will have a foreign network to provide information about export opportunities. So, for instance, his model shows that "if a French firm export to country a in year t, it is then more likely to enter in year t + 1 a country b geographically close to

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a, even if b is not close to France" (Chaney, 2014, p. 3601). In other words, in order to overcome gravity and export over larger distances, firms need more information, which in Chaney's (2014) model they obtain through networks.

They could also of course, increasingly obtain this information through data analytics, the increased connectivity that progress in cloud and mobile computing has enabled. In fact, there are many aspects of trade facilitation practices that either implicitly or explicitly aim to reduce the information aspects of trade costs / trade frictions. Reducing informational fractions may be particularly important for growing exports at the extensive margin, and not only by helping to match individual exporting / importing firms, but in general expanding the export possibility or opportunity set that a country face. In this respect, an intriguing perspective is provided by the "balls-and-bins" model of trade of Armenter and Koren (2014).

In the "balls and bins" model, Armenter and Koren (2014) models international trade – and exporting – as products being akin to balls and destinations akin to bins. Thus, at any point in time, the total product-destination combinations that can be filled, depends on the number of products traded and the number of countries that take part in trade. From the country's perspective, say of Portugal, some bins (destinations) are empty, and some bins contain more balls than others. Armenter and Koren (2014) perform various simulations on their model. Finding that on the extensive margin, the number of firms that export, will depend on the number of available bins. As they put it "By shutting down no more than one-fifth of the exporting bins the share of exporters drops below 70 percent" (Armenter and Koren, 2014, p. 2150). The aim of the model that we use in this paper is to "open" more export bins for Portuguese firms through lowering some of the informational friction, hence providing the basis for an increase in the extensive margin of the country's trade.

Given that the implications from the theoretical and Gravity models discussed in this sub-section converge on the conclusion that there is a role for trade facilitation, the next sub-section will provide a short review of the potential value of trade facilitation, particularly in the current global pandemic.

3.3. What is the value of trade facilitation?

In the previous sub-section, it was discussed that the various theories of international trade suggest that the extent to which a country can export (and as such the opportunities that is available to its exporters) will be determined by price competitiveness, the extent and nature of foreign demand, domestic "non-price competitiveness" determinants[19,] as well as the respective elasticities of export demand to price, income and non-income determinants (Algieri, 2014). Non-price competitiveness is often taken to be determined by the quality and variety of a country's products which may be proxied via the capital stock (Algieri, 2014; see also Muscatelli et al., 1995). It may also be determined by the knowledge base of the economy – in other words its intangible capital, which includes brands, networks, information, and relationships, all which would be associated with a larger export opportunity set

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[19] See e.g. Goldstein and Kahn (1985) and Funke and Ruhwedel (2002) for a discussion on the need for non-price competitiveness determinants to be included in a gravity equation / export equation so that it is not miss-specified.

(Haskel and Westlake, 2018). Non-price determinants of exports seem particularly important for export diversification, where countries extend their trade along the extensive margin, and not such much on the intensive margin (Krugman, 1989).

This is relevant in the case of Portugal, as the country's membership of the eurozone precludes it from promoting exports through setting its nominal exchange rate. As in the recent past, if the country wishes to expand exports through devaluation (assuming the demand for its exports are price elastic[20]) then it can only do so by reducing or keeping growth in domestic prices slow, for instance by moderating wage growth. However, over the medium to longer-term, particularly given the COVID-19 shock to household income, it would not be sustainable to continue to promote exports through a real exchange rate devaluation keeping wage growth low. Rather, an approach focusing on non-price competitiveness and expanding exports on the extensive margin, seems more appropriate.

Given that firms export, and that most firms are small and medium enterprises (SMEs), the challenge for any government wishing to stimulate growth through exports, is to create an environment for SMEs conducive to overcome obstacles to export. It is well known that exporting, and more generally firm internationalization, is a complex and risky process, as for instance described in the process model of internationalization and its elaborations and which means as was stressed in the previous sub-section, that only the most productive firms will export (Melitz, 2003).

Therefore, governments have resorted to trade facilitation to stimulate firm exports – both on the intensive and extensive margins. Trade facilitation refers to "any policy that reduces the transaction costs of international trade" (Dennis and Shepherd, 2011, p. 102). It includes specifically designed export promotion policies (EPP), including "brochures, websites and seminars that provide information on foreign markets and export procedures to lower informational barriers" (Kim et al., 2018, p. 2954). According to Feenstra and Ma (2014: 158) trade facilitation measures include "actions that allow for enhanced exports, though, for example, infrastructure development, foreign marketing opportunities and institutions." Given that trade facilitation could help expand the extensive margin of exports, it could be a welfare enhancing policy.

Trade facilitation may reduce the fix and sunk costs involved in exporting, and hence improve exports at the extensive margin – e.g., through reducing the administrative burden on exporting (Persson, 2013). By reducing fixed costs in exporting, trade facilitation aims to make it possible for less productive firms to export. Trade facilitation could also consist of measures to improve the productivity of firms so as to enable them to overcome the hurdles and thresholds to exporting. In this respect, as was pointed out in section 3.1, innovation is a determinant of exports (Damijan et al., 2010; Neves et al., 2016). The promotion of innovation will be consistent with productivity and competitiveness improvements which would be needed for expansion of exports on both the extensive and intensive margins. Innovation, moreover, and the adoption of new technologies in production, is what drives labour productivity improvements, which are crucial in the case of Portugal, where labour

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[20] Algieri (2014) estimates, using quarterly data from 1980 to 2012, that in the case of Portugal a depreciation of the real exchange rate by 10% will lead to an increase in exports of between 11% and 15%, suggesting a relatively price-elastic export demand. In contrast, he estimates that the income elasticity of demand for Portugal's exports has a relatively low elasticity of 1,03.

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productivity has traditionally been a weakness (Teixeira, 2010) and is still below that of most of its European trading partners.

Trade facilitation can also, implicitly through many of the above-mentioned measures, or explicitly, e.g., through providing export subsidies, try to reduce some of the uncertainty and risk attached to exporting. An important result from the literature is that exporting is akin to an investment decision under uncertainty (Naudé and Gries, 2015), and that when foreign demand uncertainty is reduced, that exports will increase predominantly through the extensive margin (De Sousa et al., 2020). Hence, uncertainty reduction is a valuable objective to facilitate the entry of more firms into exporting. De Sousa et al. (2020) in the case of France that if all destination countries have the lowest demand volatility, in other words demand uncertainty is reduced, that exports will increase by 18%, and primarily at the extensive margin.

What is the evidence for the efficacy of EPP/ trade facilitation? Dennis and Shepherd (2011, p.102) finds that "reducing by 10 per cent the costs of exporting, international transport or market entry can increase export diversification by 3, 4 and 1 per cent, respectively." Similarly, Persson (2013) found, using data on 130 developing countries, that if the costs of exporting (measured by the time to export) would decline by 1 per cent, that trade at the extensive margin would increase by 0,6% and at the intensive margin by 0,3 %. Malca et al. (2020) discusses the types of EPP and examine their efficacy in the case of Peru. They found that export support programmes such as "trade shows, trade missions, and support from trade offices in the foreign market" had a positive effect on the export performance of firms, and that firms who were successful in increasing exports, were more motivated to invest more resources in exploring foreign markets (Ibid, p. 833). Kim et al. (2018) performed one of the rare randomized control trails (RCTs) to evaluate the impact of export support policies. Specifically, they tested whether information seminars on export opportunities and process for Vietnamese textile firms would lead to more exports. They found that (p. 2956) "large participants were encouraged by the seminars to start exporting directly in the short run (i.e., 4 months later). Because larger firms are more likely to exhibit higher productivity and absorptive capacity, our results suggest that information provision is effective only when firms are equipped with sufficiently high productivity to compete in foreign markets […] our study implies that the provision of information is effective for productive firms, whereas policies for productivity improvement are also needed for underdeveloped firms".

ICT, and in particular the use of the internet, has been found to play a facilitating role in increasing exports, for instance by lowering information costs, improving communication and allowing better matching between exporters and importers (Visser, 2019). For example, Visser (2019) reports that empirical studies have found that a 10% increase in internet penetration can raise exports by 0,2% to 0,4%. The growing digitization of the economy has enabled what is termed "lean internationalization" indicating that even small businesses can now more easily enter into exporting and experiment through digital channels in order to match their product or service to foreign consumer demands (Autio and Zander, 2016).

In terms of the Digital Economy and Society Index[21] (DESI) of the European Commission (EC), Portugal ranked 16th out of 28 EU member states in 2018. The EC (2018) noted that in 2018 Portugal had done well in improving broadband access but that room for improvement remains, and moreover noted that "the share of e-commerce in corporate turnover (16 %) is almost 2 percentage points below the EU average, and the proportion of companies selling online seems to be flattening out. SMEs are significantly less active in both respects than their larger counterparts" (EC, 2018, p. 11). The IMD's World Digital Competitiveness Ranking 2019 (IMD, 2019) similarly ranked Portugal in the middle - 34 – out of 63 countries. It noted that the country's relative weaknesses were in mobile broadband subscribers (rank 59 out of 63), its relatively low % of high-tech exports (56 out of 63), and the agility of its business sector (54 out of 63).

In order however to upgrade export production into product-destination combinations that are associated with higher development, i.e., bridging the product space and exporting to high-income countries, is challenging. As Bastos et al. (2018, p. 357) observes "increasing exports to high income destinations may require quality upgrading of entire complexes of suppliers and downstream producers, not just of particular exporters."

In such a context, information on realistic export opportunities, quantified by potential monetary value, and focusing on new product-country combinations, are an essential input into not only the short-term demand-side recovery from the COVID-19 pandemic, but moreover for the longer-term restructuring and improved resilience of the Portuguese economy.

4. New export opportunities for Portugal, post covid-19

4.1. Identification of export opportunities

Easterly et al. (2009, p.4) raised an important question regarding the identification of export opportunities: "Our analysis raises a new issue. In addition to the possible knowledge externality to a successful export, there is also a knowledge problem about the discovery itself. Who is more likely to discover the successful product-destination category: the public or private sector?"

They argue that the private sector, through entrepreneurial discovery as also proposed by Hausmann and Rodrik (2003) and Hausmann et al. (2017) would be best to find a big hit in terms of product-destination combinations but qualified this by recognizing that "in the end it is an empirical question which approaches work."

Whether it is the private sector or the government discovering successful export opportunities ("the successful product-destination category") the question is how would they go about doing so? We believe that a greater use of big data, which traditionally was not available in such a way as to assist decision-making and export opportunity recognition, can play an important – even essential role. This is clear when one considers the fact, pointed out by Armenter and Koren (2014, p. 2127) in their "balls and bins" model, that "The

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[21] See https://ec.europa.eu/information_society/newsroom/image/document/2018-20/pt-desi_2018-country_profile_eng_B440E073-A50F-CF68-82F6A8FB53D31DE5_52232.pdf.

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recent availability of finely disaggregated trade data has spurred a fast-growing research that documents the extensive margin in trade" and moreover that this finely disaggregated data shows that trade data (export-destination combinations) are "sparse." For instance, analogously to Easterly et al. (2009) they point out (Armenter and Koren, 2014, p. 2128) that "There were about 22 million export shipments originating in the United States in 2005 – and thus the same number of observations. At the same time, there are 229 countries and 8,867 product codes with active trade, so a shipment can have more than 2 million possible country-product classifications. More than 40 percent of the traded country-product pairs had only one or two shipments during the year, a clear sign that the data are sparse". The sparseness of the actual export data, as compared to the potential data if more "balls" fall into more "bins" is suggestive of unutilized export opportunities.

The question is, how can the existing "sparse" data be used to identify possible new product-country combinations of export opportunities for a country, such as Portugal, in the present case? The answer is that although the data may be "sparse' from a particular country's point of view, the data is not that sparse from all countries' points of view. Thus, while Portugal may export product s to country d, and not product q, it may be the case that Spain, or some other country, does indeed export product q to country d. This provides spillover knowledge that may, or may not be, useful to Portugal. This property or feature of global trade data, as captured in the UN-COMTRADE database, and refined in the CEPII BACI data set is what we exploit in a trade decision-support model (which we label TRADE-DSM) used in the rest of the section.

4.2. Model description

The basic aim of the TRADE-DSM approach is to bridge the information gap described above and contribute to the identification of realistic export opportunities based on a process of 'filtering' data. The challenge of big data and large number of potential combinations discussed in the preceding sections is addressed by reducing the potential set of options (balls and bins) that need to be selected from based on well researched filters. The approach takes into consideration all possible worldwide product (HS 6-digit) and market (country) combinations, using four major filter categories containing various sub-filters applied consecutively. The approach systematically eliminates less-promising markets until those with the greatest prospects of success are revealed.

A brief description of these filters follows. A full description is to be found in Pearson et al. (2010) and Cuyvers et al (2012). The first filter (Filter 1) considers broad general market potential as reflected in economic size, growth, and political and commercial risk. Key variables considered in this filter include GDP and GDP per capita values as well as annual growth rates of these variables, as well as country risk ratings[22] The main filter consists of two sub filters. The primary aim of the first (sub-filter 1.1) is to eliminate markets that pose too high a relative political and/or commercial risk. The second (sub-filter filter 1.2)

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[22] Originally from the Belgian public credit insurance agency, Office National du Ducroire (ONDD), now the Credendo Group as the ONDD rebranded in 2013.

considers relative macro-economic size or growth. The overall rationale for Filter 1 is to reduce the set of countries that need to form part of the export potential investigation in the subsequent filters.

The second filter (Filter 2) classifies all potential product-market combinations' import demand characteristics (determined through relative size and growth trends). Three key descriptive quantitative characteristics of import demand patterns are calculated for each product x country combination in this filter, namely short-term import growth (last 2 years), long-term import growth (over the last 5 years) and relative import market size.

The third set of filters (Filter 3) considers product-country market access conditions. Cuyvers et al. (2012, p. 80) recognise that simply being selected on the basis of size and growth does imply that a market can easily be penetrated. There are 2 main categories of trade barriers identified in this filter. The first (filter 3.1) is that of the degree of import procurement supplier (import markets) concentration[23] while the second that of trade restrictions (filter 3.2) (Cuyvers et al., 1995:180; Cuyvers, 1997, p. 7; 2004, p. 261). Hoekman and Nicita (2008, p. 17) found that the logistics performance index (LPI) score as published in the World Bank Doing Business (WBDB) Surveys (World Bank, 2016), the Doing Business cost to import measures and ad valorem equivalent[24] tariffs per product[25] are important measures of market access. Filter 3.2 therefore considers transport and logistics costs elements through explicit assumptions regarding transport and logistics dimensions such as international shipping time and cost per country, domestic time and cost to import and the LPI. The above-mentioned components are brought together in the form of a market accessibility index that provides a score for each unique product-country combination relative to all other product-country combinations included in the analysis.

In the final step (Filter 4) each individual product-market combination is categorised based on the home market's current exports and the target market's size, growth patterns and accessibility as well as the home market's current revealed comparative advantage (RCA) and revealed trade advantage (RTA) (Cuyvers, 1997 and Cuyvers et al. 2012). The potential export markets are also further categorised according to the 'home market's current export performance in these markets compared to the performance of the top six competitors in each market (See Figure 8).

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[23] By making use of an adjusted Herfindahl-Hirschmann Index of Hirschmann (1964).

[24] An *ad valorem* equivalent tariff is defined as a tariff presented as a percentage of the value of goods cleared through customs and is calculated as the rate comparable with a tariff derived from unit quantities such as weight, number or volume (ITC, 2020).

[25] Obtained from the ITC's Market Access Map (*MacMap*).

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Figure 8: The TRADE-DSM realistic export opportunities map

Realistic Export Opportunities (REOs)	Home market relative market share of target market			
	Small	Intermediately		Large
		Small	Large	
Large	REO1,1	REO2,1	REO3,1	REO4,1
Growing (*short & long term*)	REO1,2	REO2,2	REO3,2	REO4,2
Large and growing (*short term*)	REO1,3	REO2,3	REO3,3	REO4,3
Large and growing (*long-term*)	REO1,4	REO2,4	REO3,4	REO4,4
Large and growing (*short & long-term*)	REO1,5	REO2,5	REO3,5	REO4,5

Target market characteristics (Detailed product x market)

OFFENSIVE Exploration OFFENSIVE Expansion DEFENSIVE Sustain and Maintain

Source: Cameron and Viviers (2015), adapted from Cuyvers et al. (2012).

Finally, a monetary value indicator is then calculated to distinguish the relative size of 'unconstrained' and 'untapped' potential export value with a view to prioritising the shortlisted export opportunities. This 'untapped' potential export value is considered as the average market import value of the top six competitors in each market, excluding imports from the 'home market' if such market happens to be one of the top six sources of imports for the target market for a given product. The 'unconstrained' qualifier refers to the fact that the potential is not constrained by production or supply constraints from the perspective of the home (exporting) market.

Since policies aimed at increasing diversity of exports in terms of products versus diversifying destination markets are obviously very different, policymakers need to be correctly informed to use the right tool for the right policy question (Cadot et al. Carrère, 2013). To

this effect Brenton and Newfarmer (2007) defines expansion of existing products in existing markets as growth at the intensive margin, while introduction of "new" products and new geographic markets as growth at the extensive margins and indicate that policies need to be sensitive to these objectives.

In line with informing such objectives, a key aspect of the TRADE-DSM methodology therefore is its ability to address both the intensive and extensive margin dimension of the export promotion and development challenge. The method e.g., offers alternatives to current exporters that are facing saturation and/or declining growth in their traditional markets, while also being able to identify possible new products that could be used to inform investment and industrial policy decision making. Next the stepwise filtering outcomes are shown followed by a brief focus on the outcomes arranged by extensive and intensive margins dimension.

4.3. Model results

While international trade data for nearly 200 countries[26] or areas are reported via the UN-COMTRADE data set, there are only 181 countries with all the required data available to be modelled through the TRADE-DSM methodology. Based on a combination of countries with available data for all aspects of the modelling and the evaluation of these countries relative to the methodology requirements for Filter 1, only 138 countries and 5,200 HS6-digit product lines remains at the end of the first filter iteration.

Considering all individual product and market import demand flow characteristics in terms of relative size and growth patterns, filter 2 yields 257,335 product x country combinations. When combining outcomes for market concentration and relative market access in terms of tariffs and logistics, the combinations reduces to 147,205 (only 128 countries and 5,159 products remain). The outcomes as obtained in terms of combination of number of products and countries are shown in Figure 9.

To further inform policy makers regarding opportunities related to the extensive and intensive margins with relation to products, the outcomes can be further distinguished based on the relative RCA and RTA outcomes for each product. To this effect the methodology identifies 44,124 product x country combinations for intensive margin product opportunities (i.e., opportunities that Portugal can consider for which products exported from Portugal exhibits a revealed comparative advantage relative to the world norm) and 2,689 product x country combinations in the extensive margin (so possible products that have RCAs >0.8 but less than 1, so being exported, but not so mature yet as proxied by the RCA measure).

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[26] https://comtrade.un.org/db/help/uReadMeFirst.aspx

Figure 9: Step-by-step outcomes from the TRADE-DSM filtering process

Filter 1
= 637,678 product x country flows
(5,200 / 6,374 of the traded HS products, 138 / 200 markets*)

Filter 2 – Product x Country market potential
= 257,335 product x country flows
(5,200 / 6,374 of the traded HS products, 138 / 138 markets)

Filter 3.1 – Market concentration
= 158,840 remain (5,169 / 5,200 of the traded HS products, 138 / 138 countries)

Filter 3.2 – Market access
= 229,621 remain (5,200 / 5,200 of traded HS products, 128 / 138 countries)

Filter 3.1 + Filter 3.2
= 147,205 remain (5,159 / 5,200 of traded HS products, 128 / 138 countries)

Products Intensive Margins

Filter 4 (RCA > 1 no RTA applied)
= 56,652 REOs (1,599 / 5,159 of traded HS products, 128 / 128 countries)
+RTA applied
= 44,124 REOs (1,203 / 5,159 of traded HS products, 128 / 128 countries)

Products Extensive Margins

Filter 4 (0.8 <= RCA < 1 no RTA applied)
= 7,097 (238 / 5,159 of traded HS products, 124 / 128 countries)
+RTA applied
= 2,689 (94 / 5,159 of traded HS products, 123 / 128 countries)

Overall Realistic opportunities (Product intensive + extensive)
= 46,813 (1,279 / 5,159 of traded HS products, 128 / 128 countries)

Source: Authors' calculations and representation, filter diagram from Cameron and Viviers, 2015.

The challenge however is that these numerous opportunities cannot all be pursued at the same time given resource constraints. To assist with this challenge around the international market selection (IMS) process, the outcomes are then arranged in Table 1 according to the REO map (as depicted in Figure 9).

Table 1: Outcomes of opportunities identified for Portugal arranged according to the REO Map

Map of Realistic Export Opportunities (REOs) number [% of total] Untapped potential value Billions (Bn) Euro(€) [% of total value]	Relative market share of Portugal into target market(s)				
	Small (1)	Intermediate small (2)	Intermediate large (3)	Large (4)	Total
Large (1)	2,965 [6.3%] 75.10 Bn [24.8%]	321 [0.7%] 4.66 Bn [1.5%]	74 [0.2%] 0.37 Bn [0.1%]	60 [0.1%] 0.19 Bn [0.1%]	3,420 [7.3%] 80.32 Bn [26.5%]
Growing (2) (Short & long term)	32,485 [69.4%] 51.52 Bn [17.0%]	1,588 [3.4%] 2.92 Bn [1.0%]	391 [0.8%] 0.37 Bn [0.1%]	698 [1.5%] 0.15 Bn [0.0%]	35,162 [75.1%] 54.96 Bn [18.1%]
Large and growing (3) (Short term)	540 [1.2%] 19.27 Bn [6.4%]	64 [0.1%] 0.98 Bn [0.3%]	12 [0.0%] 0.04 Bn [0.0%]	12 [0.0%] 0.01 Bn [0.0%]	628 [1.3%] 20.30 Bn [6.7%]
Large and growing (4) (Long term)	1,232 [2.6%] 26.05 Bn [8.6%]	116 [0.2%] 1.41 Bn [0.5%]	26 [0.1%] 0.36 Bn [0.1%]	23 [0.0%] 0.04 Bn [0.0%]	1,397 [3.0%] 27.87 Bn [9.2%]
Large and growing (5) (Short & long term)	5,342 [11.4%] 109.11 Bn [36.0%]	597 [1.3%] 9.24 Bn [3.0%]	112 [0.2%] 1.10 Bn [0.4%]	155 [0.3%] 0.51 Bn [0.2%]	6,206 [13.3%] 119.96 Bn [39.5%]
Total	42,564 [90.9%] 281.06 Bn [92.6%]	2,686 [5.7%] 19.20 Bn [6.3%]	615 [1.3%] 2.26 Bn [0.7%]	948 [2.0%] 0.90 Bn [0.3%]	46,813 [100.0%] 303.41 Bn [100.0%]

(Left vertical axis label: Product x target market (country) - size and growth)

Source: Authors' calculations.

In total there are 46,813 opportunities identified in Table 1, with the associated estimated untapped potential value of €303.41 billion. Of these outcomes, 90.9% of the number of opportunities (and 92.6% of the estimated untapped potential value) is associated with markets for which Portugal supplies none to very little of the target market(s) existing imports such as United States, Germany, United Kingdom and further away South Korea, Mexico and Canada. Markets where Portugal supplies an intermediately small share of target market(s) imports is associated with 5.7% (and 6.3% in value terms) of these opportunities such as Austria, China, Tunisia and Morocco. Portugal supplies an intermediately large share of target market(s) imports for around 1.3% (0.7% of the value) of these opportunities such as Spain, France, Germany and Netherlands. The market(s) where Portugal supplies a large share imports account for 2.0% and 0.3% of value such as the previous four countries as well as United Kingdom, Italy, Israel and Brazil.

Figure 10 shows the major destinations where the opportunities for these products are to be found. The size of the bubbles indicates the size of the opportunity in €. Details on the products are provided in Appendix G.

Figure 10: Geographic spread of opportunities identified for Portugal

| Markets x Products : | 128 x 1297 | Combinations: | 46 813 | Total Potential (Bn) [EUR]: | 303.41 |

Source: Authors' calculations and representation.

Evident is that there are still a lot of 'untapped' opportunities within the closer proximity of Europe, while some further away opportunities are also present in North America, East and South-East Asia and less so in South America, the Middle East and Africa.

Separating the outcomes into extensive and intensive margins for both products and potential markets (countries), in summary Table 2 presents the aggregate results based on these distinctions.

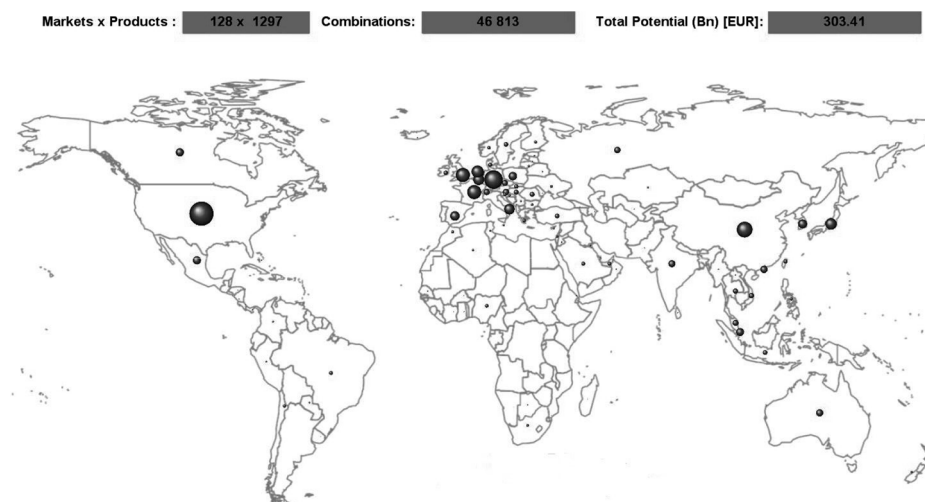Table 2: Opportunities identified for Portugal arranged according to margins

Map of Realistic Export Opportunities (REOs) Number / [% of total] Untapped potential value Millions (Mn) Euro(€) / [% of total value]	Extensive margin markets	Intensive margin markets	Totals
Intensive margin products	[Q2 – Green fields] 42,593 [91.0%] 286,630 Mn [94.5%]	[Q1 – Brown fields] 1,531 [3.3%] 3,160 Mn [1.0%]	44,124 [94.3%] 289,790 Mn [95.5%]
Extensive margin products	[Q3 – Blue sky] 2,657 [5.7%] 13,627 Mn [4.5%]	[Q4 – Grey fields] 32 [0.1%] 2.09 Mn [0.0%]	2,689 [5.7%] 13,629 Mn [4.5%]
Totals	45,250 [96.7%] 300,257 Mn [99.0%]	1,531 [3.3%] 3,162 Mn [1.0%]	46,813 [100.0%] 303,419 Mn [100.0%]

Source: Authors' calculations.

Evident is that there is (as expected) more opportunities for Portugal in the extensive margin markets (at 96.7% of number of opportunities), while the intensive markets only represent around 3.3% of total opportunities identified.

In line with the context provided in the preceding sections, this outcome points to the fact that Portugal should pursue export diversification from a market perspective with vigour to assist with contributing to improving the resilience of the Portuguese economy and as mentioned, provide insurance against future shocks (including future pandemics). To this purpose shorter term export promotion focused initiatives can be informed by the intensive margin products combined with extensive margin countries (so quadrant 2 "Green Fields" opportunities as indicated in Table 2 – see Appendix C for more details). This group of products (with RCAs > 1 and new potential markets) represents 91% of the number of opportunities and 94.5% of the associated untapped' value. Opportunities qualified as 'Green fields' therefore potentially provide insights into export promotion activities that could be leveraged to expand exports in the shorter-term. These opportunities include for example opportunities to export motor vehicles, parts and accessories, coke and refined petroleum products, wearing apparel, and machinery and equipment, amongst others. A list of these product opportunities aggregated by sector and key markets, are contained in Appendix F. What the Appendix F indicates is that if Portugal could exploit these export opportunities, it would diversify its exports along the extensive margin in terms of products, as well as in terms of trade partners. At present the country's main three trade partners are Spain, France and Germany. As Appendix F shows, much of the new opportunities are to export

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to countries such as the USA, Netherlands, Singapore, China, Ireland, South Africa and Vietnam.

For longer term planning the opportunities that may require potentially more investment from a product export development perspective, the extensive margin products (indicated in quadrant 3 "Blue Sky" quadrant in the representation in Table 2 – see Appendix D for more details) combined with extensive margin (new) markets, represent around 5.7% of the number of opportunities and 4.5% of the 'untapped' value of around €13.63 billion. Depending on the nature of exactly what investment is required to 'mature' and realise opportunities classified as 'Blue sky' results may take longer to materialise and may be more focused to industrial policy questions.

Opportunities identified as "Brown Fields" (extensive margin in terms of markets and intensive margin for products in quadrant 1, see Appendix B for more details) and "Grey Fields" (extensive margin in terms of products and intensive margin for markets in quadrant 4 – see Appendix E for more details) are of less interest from a market diversification strategy perspective and also holds relative small potential in terms of number of opportunities (3.3% and 0.001% respectively) as well as 'untapped' value (1.0% and 0.001% respectively).

5. Concluding remarks

Portugal is a small economy with an ageing population, and high levels of government debt. As such, domestic demand growth is constrained. Indeed, as the country's experience over the past decade has shown, this has left exports as the essential engine of growth. The COVID-19 pandemic, and its economic shock following from the global lockdown on economic activity so as to curb the spread of the virus and reduce pressure on health facilities, has therefore come as a particularly pernicious shock to the country. As with many other small, open economies, Portugal's recovery options depend on being able to export, and moreover, to expand export on both the extensive and intensive margins. The question is, can exports continue to be a driver of growth in Portugal, and in particular, can exports contribute to recovery from the COVID-19 crisis?

We answered this question in this paper in the affirmative. First, we provided an analysis of COVID-19 impact on Portugal's exports, finding that the COVID-19 pandemic has been extremely detrimental to Portuguese exports, with a worse impact than that of the global financial crisis. The pandemic broke out just as Portugal was starting to enjoy the fruits from an upward trajectory in exports and export-led growth; and moreover, that it may take at least a year or two to recover exports to its trend level, of course depending on the duration of the pandemic and the nature of the global economic recovery. Since almost a quarter of traditional Portuguese export revenue is from tourism and given that the tourism and travel industries have been amongst the worst affected by the COVID-19 pandemic, the decline in total exports will be much higher than only the decline in merchandise exports. However, the good news was that global trade has recovered faster than during the global financial crisis, and that a survey from the literature would suggest that, during and after a global crisis such as the COVID-19 crisis, that expanding its exports on the extensive margin could be an appropriate recovery strategy to follow.

The literature survey focused on three strands of relevant literature. First, we provided a short overview of the arguments for the importance of exports, and export diversification, for growth and development in a country such as Portugal. Secondly, we discussed the strand of literature that has tried to answer the question: what determines the exports of a country? And thirdly, we summarized the strand of literature that has dealt with the promotion of exports, particularly trade facilitation – so as to be able to suggest the use of information rich models to identify export opportunities. These three strands of literature are relevant as it provides the theoretical underpinnings of such a data-rich approach that we apply to the case of Portugal to identify new export opportunities.

Our model, applied to Portugal, showed that there is indeed significant potential scope for the country to expand its exports, on both extensive and intensive side. To be specific, we identified 42,593 new export opportunities at the extensive margins for markets and the intensive margin for products (of the overall 46,813 product-country opportunities identified), what we called "Green Fields" opportunities. The associated estimated value of this subset of opportunities was estimated at €286,6 billion in 'untapped' revenue potential (of the overall €303,41 billion identified). Of these 91.0% of the number of opportunities (and 94.5% of the potential value) is associated with markets for which Portugal supplies none, to very little, of the target market(s) existing imports currently – for products that Portugal is already good at exporting, such as machinery and equipment, motor vehicles and parts and wearing apparel. Moreover, we found that there is (as expected) overall more opportunities for Portugal in the extensive margin markets (at 96.7% of number of opportunities). These include countries such as United States, Germany, China, United Kingdom, France and Japan.

In line with the literature review in this paper, our empirical findings support the arguments made that Portugal should pursue export diversification from a market perspective with vigour to assist recovery and improving the resilience of the Portuguese economy, also against future shocks and future pandemics. Over the short-term trade facilitation initiatives can be informed by the intensive margin products combined with extensive margin countries – the "Green Fields" opportunities identified in this study. Clearly whilst COVID-19 has caused damage to health and economy in Portugal, there are still plenty of opportunities globally for its entrepreneurs to utilize. Two requirements for these opportunities to be realised are that the government nurture and support local export-oriented entrepreneurship, including through industrial policies and trade facilitation, and that the global multilateral trade system remains relatively free and open, without recent trends towards de-globalization being furthered by the pandemic.

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APPENDIX A

Figure 11: Lockdown Stringency: Portugal compared to Spain, France and Germany, 23 January 2019 to 6 December 2020
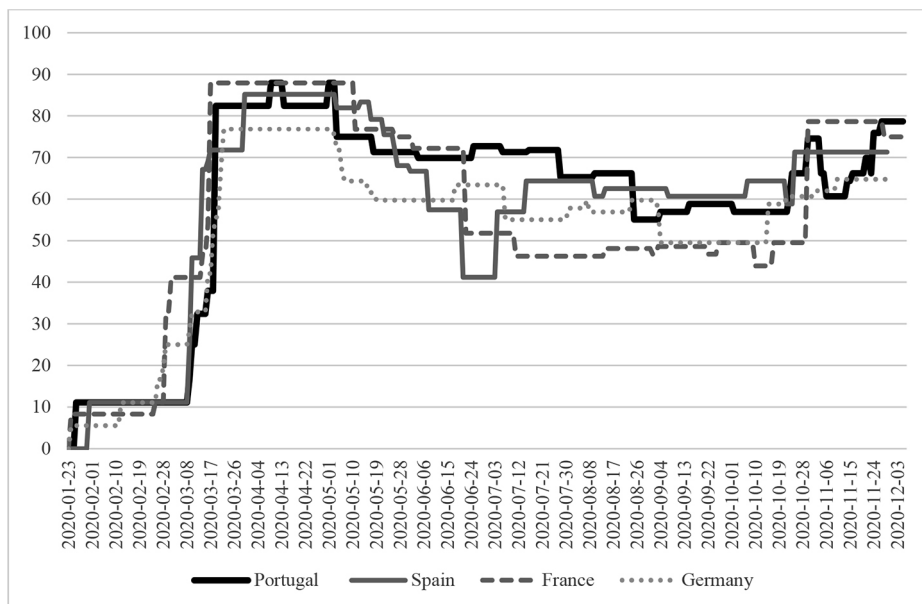
Source: Authors' compilation based on data from Our World in Data, available on Github.

APPENDIX B

Table 3: Intensive products and intensive markets – outcomes for Portugal

Map of Realistic Export Opportunities (REOs) number [% of total] 'Untapped' potential value Billions (Bn) Euro(€) [% of total value]	Relative market share of Portugal into target market(s)				
	Small (1)	Intermediate small (2)	Intermediate large (3)	Large (4)	Total
Large (1)	–	–	74 [4.8%] 0.37 Bn [11.9%]	60 [3.9%] 0.19 Bn [6.1%]	134 [8.8%] 0.57 Bn [17.9%]
Growing (2) (Short & long term)	–	–	382 [25.0%] 0.37 Bn [11.8%]	675 [44.1%] 0.15 Bn [4.7%]	1,057 [69.0%] 0.52 Bn [16.5%]
Large and growing (3) (Short term)	–	–	12 [0.8%] 0.04 Bn [1.4%]	12 [0.8%] 0.01 Bn [0.3%]	24 [1.6%] 0.05 Bn [1.6%]
Large and growing (4) (Long term)	–	–	26 [1.7%] 0.36 Bn [11.5%]	23 [1.5%] 0.04 Bn [1.3%]	49 [3.2%] 0.41 Bn [12.9%]
Large and growing (5) (Short & long term)	–	–	112 [7.3%] 1.10 Bn [34.9%]	155 [10.1%] 0.51 Bn [16.1%]	267 [17.4%] 1.61 Bn [51.1%]
Total	–	–	606 [39.6%] 2.26 Bn [71.5%]	925 [60.4%] 0.90 Bn [28.5%]	1,531 [100.0%] 3.16 Bn [100.0%]

(Row label at left: Product x target market (country) – size and growth)

Source: Authors' calculations.

This table shows that in total there are 1,531 opportunities, with an associated estimated untapped potential value of € 3.16 billion. Portugal supplies an intermediately large share of target market(s) imports for around 39.6% (71.5% of the value) of these opportunities. The market (s) where Portugal supplies a large share imports account for 60.4% and 28.5% of value.

APPENDIX C

Table 4: Intensive products and extensive markets - outcomes for Portugal

Map of Realistic Export Opportunities (REOs) number [% of total] 'Untapped' potential value Billions (Bn) Euro(€) [% of total value]	Relative market share of Portugal into target market(s)				
	Small (1)	Intermediate small (2)	Intermediate large (3)	Large (4)	Total
Large (1)	2 734 [6.4%] 70.28 Bn [24.5%]	319 [0.7%] 4.65 Bn [1.6%]	–	–	3 053 [7.2%] 74.93 Bn [26.1%]
Growing (2) (Short & long term)	30 518 [71.7%] 49.40 Bn [17.2%]	1 555 [3.7%] 2.88 Bn [1.0%]	–	–	32 073 [75.3%] 52.28 Bn [18.2%]
Large and growing (3) (Short term)	505 [1.2%] 18.23 Bn [6.4%]	62 [0.1%] 0.97 Bn [0.3%]	–	–	567 [1.3%] 19.20 Bn [6.7%]
Large and growing (4) (Long term)	1 130 [2.7%] 25.08 Bn [8.8%]	115 [0.3%] 1.40 Bn [0.5%]	–	–	1 245 [2.9%] 26.48 Bn [9.2%]
Large and growing (5) (Short & long term)	5 064 [11.9%] 104.55 Bn [36.5%]	591 [1.4%] 9.19 Bn [3.2%]	–	–	5 655 [13.3%] 113.74 Bn [39.7%]
Total	39 951 [93.8%] 267.53 Bn [93.3%]	2 642 [6.2%] 19.09 Bn [6.7%]	–	–	42 593 [100.0%] 286.63 Bn [100.0%]

Note: The row labels "Large (1)", "Growing (2) ...", etc. appear in the first data column under "Product x target market (country) – size and growth" (rotated label on the left).

Source: Authors' calculations.

This table shows that in total there are 42,593 opportunities, with an associated esti-mated untapped potential value of € 286.63 billion. 93.8% of the number of opportunities (and 93.3% of the estimated untapped potential value) is associated with markets for which Portugal supplies none to very little of the target market(s) imports. Markets where Portugal supplies an intermediately small share of target market(s) imports is associated with 6.2% (and 6.7% in value terms) of these opportunities.

APPENDIX D

Table 5: Extensive products and extensive markets - outcomes for Portugal

Map of Realistic Export Opportunities (REOs) number [% of total] 'Untapped' potential value Millions (Mn) Euro(€) [% of total value]	Relative market share of Portugal into target market(s)				
	Small (1)	Intermediate small (2)	Intermediate large (3)	Large (4)	Total
Large (1)	231 [8.7%] 4,827.47,Mn [35.4%]	2 [0.1%] 2.12,Mn [0.0%]	–	–	233 [8.8%] 4,829.59,Mn [35.4%]
Growing (2) (Short & long term)	1,967 [74.0%] 2,115.98,Mn [15.5%]	33 [1.2%] 38.52,Mn [0.3%]	–	–	2,000 [75.3%] 2,154.50,Mn [15.8%]
Large and growing (3) (Short term)	35 [1.3%] 1,047.15,Mn [7.7%]	2 [0.1%] 8.24,Mn [0.1%]	–	–	37 [1.4%] 1,055.39,Mn [7.7%]
Large and growing (4) (Long term)	102 [3.8%] 970.19,Mn [7.1%]	1 [0.0%] 14.62,Mn [0.1%]	–	–	103 [3.9%] 984.81,Mn [7.2%]
Large and growing (5) (Short & long term)	278 [10.5%] 4,559.68,Mn [33.5%]	6 [0.2%] 43.25,Mn [0.3%]	–	–	284 [10.7%] 4,602.93,Mn [33.8%]
Total	2,613 [98.3%] 13,520.47,Mn [99.2%]	44 [1.7%] 106.75,Mn [0.8%]	–	–	2,657 [100.0%] 13,627.22,Mn [100.0%]

(Left vertical label: Product x target market (country) – size and growth)

Source: Authors' calculations.

This table shows that in total there are 2,657 opportunities, with an associated estimated untapped potential value of € 13.63 billion. 98.3% of the number of opportunities (and 99.2% of the estimated untapped potential value) is associated with markets for which Portugal supplies none to very little of the target market(s) imports. Markets where Portugal supplies an intermediately small share of target market(s) imports is associated with 1.7% (and 0.8% in value terms) of these opportunities.

APPENDIX E

Table 6: Extensive products and intensive markets - outcomes for Portugal

Map of Realistic Export Opportunities (REOs) number [% of total] 'Untapped' potential value Millions (Mn) Euro(€) [% of total value]	Relative market share of Portugal into target market(s)				
	Small (1)	Intermediate small (2)	Intermediate large (3)	Large (4)	Total
Large (1)	–	–	–	–	–
Growing (2) (Short & long term)	–	–	9 [28.1%] 1.71 Mn [81.6%]	23 [71.9%] 0.38 Mn [18.4%]	32 [100.0%] 2.09 Mn [100.0%]
Large and growing (3) (Short term)	–	–	–	–	–
Large and growing (4) (Long term)	–	–	–	–	–
Large and growing (5) (Short & long term)	–	–	–	–	–
Total	–	–	9 [28.1%] 1.71 Mn [81.6%]	23 [71.9%] 0.38 Mn [18.4%]	32 [100.0%] 2.09 Mn [100.0%]

Product x target market (country) – size and growth

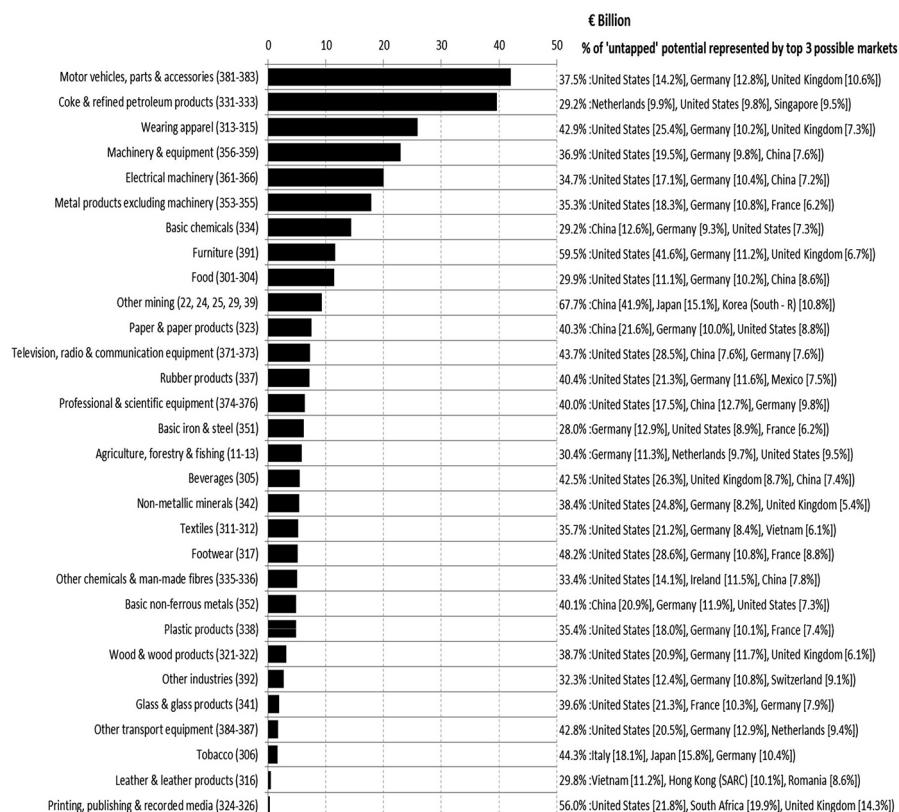Source: Authors' calculations.

This table shows that in total there are 32 opportunities identified, with an associated estimated untapped potential value of € 2.09 million. Portugal supplies an intermediately large share of target market(s) imports for around 28.1% (81.6% of the value) of these opportunities. The market(s) where Portugal supplies a large share imports account for 71.9% and 18.4% of value.

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APPENDIX F

Table 7: Outcomes for Portugal aggregated according to major economic sector and country

€ Billion

% of 'untapped' potential represented by top 3 possible markets

Sector	€ Billion (0–50)	% of 'untapped' potential represented by top 3 possible markets
Motor vehicles, parts & accessories (381-383)		37.5% :United States [14.2%], Germany [12.8%], United Kingdom [10.6%])
Coke & refined petroleum products (331-333)		29.2% :Netherlands [9.9%], United States [9.8%], Singapore [9.5%])
Wearing apparel (313-315)		42.9% :United States [25.4%], Germany [10.2%], United Kingdom [7.3%])
Machinery & equipment (356-359)		36.9% :United States [19.5%], Germany [9.8%], China [7.6%])
Electrical machinery (361-366)		34.7% :United States [17.1%], Germany [10.4%], China [7.2%])
Metal products excluding machinery (353-355)		35.3% :United States [18.3%], Germany [10.8%], France [6.2%])
Basic chemicals (334)		29.2% :China [12.6%], Germany [9.3%], United States [7.3%])
Furniture (391)		59.5% :United States [41.6%], Germany [11.2%], United Kingdom [6.7%])
Food (301-304)		29.9% :United States [11.1%], Germany [10.2%], China [8.6%])
Other mining (22, 24, 25, 29, 39)		67.7% :China [41.9%], Japan [15.1%], Korea (South - R) [10.8%])
Paper & paper products (323)		40.3% :China [21.6%], Germany [10.0%], United States [8.8%])
Television, radio & communication equipment (371-373)		43.7% :United States [28.5%], China [7.6%], Germany [7.6%])
Rubber products (337)		40.4% :United States [21.3%], Germany [11.6%], Mexico [7.5%])
Professional & scientific equipment (374-376)		40.0% :United States [17.5%], China [12.7%], Germany [9.8%])
Basic iron & steel (351)		28.0% :Germany [12.9%], United States [8.9%], France [6.2%])
Agriculture, forestry & fishing (11-13)		30.4% :Germany [11.3%], Netherlands [9.7%], United States [9.5%])
Beverages (305)		42.5% :United States [26.3%], United Kingdom [8.7%], China [7.4%])
Non-metallic minerals (342)		38.4% :United States [24.8%], Germany [8.2%], United Kingdom [5.4%])
Textiles (311-312)		35.7% :United States [21.2%], Germany [8.4%], Vietnam [6.1%])
Footwear (317)		48.2% :United States [28.6%], Germany [10.8%], France [8.8%])
Other chemicals & man-made fibres (335-336)		33.4% :United States [14.1%], Ireland [11.5%], China [7.8%])
Basic non-ferrous metals (352)		40.1% :China [20.9%], Germany [11.9%], United States [7.3%])
Plastic products (338)		35.4% :United States [18.0%], Germany [10.1%], France [7.4%])
Wood & wood products (321-322)		38.7% :United States [20.9%], Germany [11.7%], United Kingdom [6.1%])
Other industries (392)		32.3% :United States [12.4%], Germany [10.8%], Switzerland [9.1%])
Glass & glass products (341)		39.6% :United States [21.3%], France [10.3%], Germany [7.9%])
Other transport equipment (384-387)		42.8% :United States [20.5%], Germany [12.9%], Netherlands [9.4%])
Tobacco (306)		44.3% :Italy [18.1%], Japan [15.8%], Germany [10.4%])
Leather & leather products (316)		29.8% :Vietnam [11.2%], Hong Kong (SARC) [10.1%], Romania [8.6%])
Printing, publishing & recorded media (324-326)		56.0% :United States [21.8%], South Africa [19.9%], United Kingdom [14.3%])

Source: Authors' calculations.