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Untapped export potential in developing countries: evidence from the car industry

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Abstract – Car production is moving from North to South, and carmaker ownership is moving from West to East. Meanwhile, new carmakers are arising in China, India, and Iran. Car exports in developing countries increased over the 2007-2015 period. However, their share in global exports is still low. In this sense, exports are the last bastion of the North. The increase in car exports could accelerate the indigenous capacity building, especially in China. In this paper, we identify the determinants of car exports in the case of developing countries. Then, we measure their capacity to increase the latter. The results are discussed in light of various industrial strategies implemented in these countries.

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INTRODUCTION

The automotive industry is a key sector for industrial development. Its share in global manufacturing is high[1], and its intra-branch trade is growing. Its regional and local roots have proven to be strong under globalization. This industry is relatively fragmented: Design engineering is locally clustered, conceptual design is regionally integrated, and some parts are globally sourced. The production is close to end markets and regionally integrated. The global value chain (GVC) is driven by automakers. However, the power of producers is limited by local realities, political influence, and public policies. The autonomy of suppliers has increased to an unprecedented level (Sturgeon et al., 2009).

The automotive industry is facing many challenges: environmental constraints, digital economy, and emerging economies [2]. Although the rise of digital and eco-friendly vehicles is in its infancy, relocation is already reshaping the geography of the automotive industry [3].

Demand and supply of cars were traditionally located in developed countries. After 2000, they both began shifting toward emerging economies. This global trend is led by both traditional carmakers and newcomers from emerging economies (Traub-Merz, 2017). Car production and carmaker ownership are key elements in the transformation of the automotive geography and depend on factors such as demand, corporate strategies, state policies, and trade. Observations show that car production is shifting from the North to the South, and carmaker ownership is shifting primarily from the West to the East and secondarily from the North to the South. For example, Suzuki, General Motors (GM), Renault, and Volkswagen (VW) are producing around 60% of their production in developing countries. Jaguar ownership, for example, moved to Tata Motors, an Indian automaker. Nevertheless, despite this shift of ownership to the new carmakers, the threat to the hegemony of traditional carmakers remains limited in the absence of a technological catch-up.

Despite this shift in car production and carmaker ownership to emerging economies, their share from global car exports is limited. In fact, car exports from developing countries involve relatively smaller cars. These exports are growing rapidly, but they remain relatively modest compared with those from developed economies. The markets of top exporters from developing countries (Mexico, Central and Eastern European Countries [CEECs], and Thailand) are high-income countries. Other developing countries export elsewhere.

In this context, exports and core technologies could be called the last bastions of the North. The convergence of high levels of production and exports in emerging economies could facilitate the development of indigenous capabilities.

Recent events, such as the enlargement of the European Union (EU), the World Economic Crisis, the rise of major players such as China, and new carmakers and mega-suppliers, affected the automotive industry in developing countries. The new realities make it relevant to track and assess the evolution of key aspects in the automotive industry over a more recent period.

In this paper, we assess the export potential of car producers in the developing world based on the 2007-2015 period. Here, the "export potential" refers to the expected exports measured based on some determinants of car exports. The expected

[1] In 2000-2014, the share of "Motor vehicles, trailers, and semi-trailers" industry in total manufacturing output was 19% in Mexico, 17% in Germany, and 12% in South Africa (UNIDO Statistics).
[2] Many consider that an "automobile revolution" is under development (See Freyssenet 2009). Freyssenet (2011) defines this revolution as an event that "would completely change the architecture, the industry, the geography, the economy, the geopolitics, and the sociology of the automobile."
[3] In this paper, the relocation is defined as being the movement of manufacturing activities from developed countries towards developing countries.

exports are compared with actual exports. Per example, if actual exports are below expected exports, we note that the exports have the potential to increase. We say the export potential is "untapped." Then, we classify this "untapped potential" by country according to three categories: low, moderate, and high. If actual exports are close to expected exports, we indicate that exports might stagnate. We examine the export potential on the country level in the industry of car manufacturing. By car industry, we mean the design, assembly, and distribution of passenger cars (PCs). In 2015, PC production constituted 75% of global vehicle production.

Our findings show that top exporters from developing countries might stagnate, and therefore their industrial model might become unsustainable. The newcomers are located in emerging countries that have high export potential. However, the technology gap from which they suffer might affect their capacity to benefit from this country-level export potential. Most emerging countries have an untapped export potential. This provides multinational corporations (MNCs) with many alternatives and therefore a large margin of maneuver.

In this paper, we present the changing geography of the PC industry through a review of literature and descriptive statistics in the first section. In section two, we present our econometric assessment. This work allows us to measure the expected exports of developing countries and to identify the determinants of their exports.

1. THE CHANGING GEOGRAPHY IN CAR PRODUCTION

1.1. Review of literature

The topic of our research lies at the intersection of several theoretical fields. The main themes of these theories are offshoring, firm strategy, and industrial policies. In this literature review, we present the link between these issues and the automotive industry, and we highlight the architecture of the automotive industry today. Thus, this literature review is essential for the interpretation of quantitative results in section two.

Offshoring

The offshoring phenomenon might not comply enough with the theory of comparative advantage. Recently, offshoring to lower-income countries has been growing. Head and Mayer (2019) studied offshoring in car assembly and examined the comparative advantage based on countries' development level and car models skill intensity. *They showed that the driving force behind offshoring is rather market seeking (host markets and export platforms).* It is driven by foreign market penetration goals rather than by the quest for cost advantages. Thus, the offshoring of automotive MNCs does not occur at the expense of home-country employment. The authors show that in fact, developed countries have a cost advantage over emerging ones as locations for car assembly. Nevertheless, despite cost advantages, producing near final markets increases market shares, whether carried out in the brand's home markets or in the markets of poorer countries. Additionally, proximity and regional trade agreements (RTAs) increase shares in external markets. In this respect, *export platforms in developing countries are key element in offshoring***.** The authors found that low-price and small-sized cars are more offshorable[4]. Thus, they show that the comparative advantage of rich countries is rather in skill-intensive models.

Offshoring is also affected by firms' competitive strategy rather than product cycle. Over time, the well-known Vernon (1966) sequence lost its explanatory power

[4] Smaller cars might be more offshorable because of lower shipping costs and tariffs, and less skill-intensity (Head & Mayer, 2019).

(Michalet, 1999). The localization of new products is international instead of exclusively in the innovative country. Today, electric cars, for instance, are produced in many countries, such as the USA, Europe, and China. Nissan Leaf, a 100% electric car, has been produced in Japan, the USA, and the UK, then exported to other countries. The production of Dacia by Renault started in Romania and was then exported to France. More generally, Head and Mayer found that offshoring probability is greater when years left for a car's model are more important. This reveals the impact of firms' competitive strategy on localization. Different types of offshoring exist, and each reflects a certain strategy at the firm level (Mouhoud, 2006). *The optimization of a company's value chain is achieved when activities are located in top economies in terms of sales, production, and export capacity.*

The headquarters-subsidiaries relationship revolves around internalization of activities and outsourcing. The company retains direct control over its subsidiaries for the production of items containing core technologies and could outsource for standardized items. Carmakers share their control over production with local partner carmakers, notably in China and India. For example, SAIC-GM produces American brands for China. Additionally, outsourcing has increased in auto parts production. Thus, *carmakers focus their activities more on assembly, design, and distribution; they still control production and marketing.*

Foreign direct investment

The localization of production is related to firms' strategies. The internationalization of production can be driven by the complementarity between two strategies: market strategy and cost-reduction strategy. *This approach suggests that a "selected" group of countries is very attractive for foreign direct investment (FDI)* (Michalet, 1999). The countries are selected based on relative market growth and size. Triad countries are both recipients and senders of FDI flows; and emerging countries are recipients of flows. The third group includes countries that can potentially become recipients; finally, peripheral countries are not attractive. This hierarchy is dynamic; however, it did not predict the transformation of emerging countries into FDI senders. FDI by Chinese and Indian automotive companies, for instance, began in the 2000s: SAIC (China) purchased MG Rover, Geely (China) purchased Volvo (Amighini, 2012; Richet, 2015a), and Tata Motors (India) acquired Daewoo Trucks, Land Rover, and Jaguar (Pradhan & Singh, 2008). Richet (2015b) examined the reasons for the early internationalization of Chinese carmakers; the pursuit of strategic assets, such as long-standing car brands, is one of the main motives[5].

State policies

State policies implemented by host countries are key determinants of the role the domestic economy will play for the hosted industry. The role of the domestic economy can be limited to the provision of labor and other services that are not related to the production. However, it could also contribute to the production and technological development. In the first case, governments simply try to improve countries' attractiveness for foreign investors; in the second case, the government becomes directly involved in the production and technological development.

Literature divides catch-up experiences between "integrationist" and "independent" (Amsden, 2001 ; Kohli, 2009). The integrationist strategy relies on MNCs to bring advanced technology; this is the case, for instance, in Brazil (Viotti, 2002). The independent strategy is based on a national process of technological capacity building, as has been the case in South Korea (Amsden, 1989).

[5] In 2014, Tata produced in UK 75152 Jaguar and 374355 Land Rover, and Geely produced 461507 Volvo in China, Malaysia, Belgium, and Sweden.

Automotive-related literature also evokes two different approaches: import substitution (IS) and GVC. The first (IS) revolves around protectionism and local final production, while the second (GVC) is led by MNCs and focuses on free trade, component and intra-firm trade, and FDI. The rise of component trade in the automotive industry might imply that integration into the GVC could be a more appropriate approach. Traub-Merz (2017a) believes, however, that IS is still more relevant because carmakers depend on government protection. IS could be implemented under liberal principles or under a highly interventionist framework. The first aims at replacing imports with local production, while the second tries to build a locally headquartered industry. In addition, according to Traub-Merz, IS can increase prices, but it also leads to income redistribution. More importantly, the rise of monopolies in the context of an IS approach is probable and leads to a lack of market discipline. Impo-sing technological performance and export targets could be a way to overcome this limit. In its broadest sense, IS begins with an import substitution in its strict sense, increases local content, and then must move toward exports. Thus, exports are essential both for integration into the GVC and in the case of IS in its broadest sense. However, the success of outward orientation depends on the development of independent capabilities and on the mobilization of significant resources. *The existence of an export potential on the country level is strategic, whether for building domestic capabilities or integrating into the GVC.*

State policies also shape the ownership structure of automotive industries. The independent strategy favors the existence of public and private-owned firms. For example, in China, SAIC and Dongfeng are state-owned carmakers, whereas Chery and BYD are private firms. The integrationist strategy allows MNCs to dominate the industry; in Brazil, there are no locally headquartered carmakers.

Clearly, the integrationist strategy promotes exports but often risks transforming the country into an "economic territory" for MNCs (Kohli, 2009). *The car exports grew in Mexico, Thailand, and CEECs by virtue of integration into the GVC and RTAs.* The basis of their export platforms are foreign-owned activities, RTAs, and access to high-income markets, high production, and low trade costs. By contrast, the car industry in China and India counts on domestic demand and low costs. These countries dared to implement import substitution industrialization (ISI) *but did not yet seize significant shares in world markets.*

The catch-up strategies at the firm level are as important as catch-up strategies at the country level. The autonomy of Hyundai management allowed the diversification of its technology sources and the achievement of outstanding success. Daewoo, in contrast, was dependent on GM and disappeared after its acquisition by GM (Kim, 1997).

Regional integration

Firms can deploy their value chain activities in the best markets either globally or regionally. The regional path is less complex in terms of specialization and organization (Michalet, 1999), and it is more developed in the automotive industry than global integration (Freyssenet & Lung, 2007). In the case of exporting industries, RTAs increase economies of scale and intra-industry specialization (Siroën, 2004); carmakers lobby in favor of RTAs (Carrillo, Lung & van Tulder, 2004). *RTA membership constitutes the cornerstone of the car export activity for Mexico, CEECs, and Thailand.* The expansion of global scale integration could weaken regional-based exports. Recently, Frigant and Zumpe (2017) studied the trade pattern aspects based on the auto-parts trade of four European countries over the 2000-2012 period. *The authors showed an insignificant progression in the globalization of automotive production networks.*

Peridy and Abedini (2008) showed the untapped export potential of emerging countries in the car industry based on the 1999-2006 period and suggested that exports could increase. In absolute terms, the exports of developing countries have increased, but their global share remains limited. Since 2006, the automotive industry has undergone considerable changes, especially under the effects of the 2008 crisis, the EU enlargement, the rise of China, the increase in Mexico's car exports, etc. The consequences of these events are still unfolding. Therefore, it would be relevant to track and assess the mutations in the automotive industry over a more recent period. In this paper, we track and assess the evolution of the export potential in developing countries based on the 2007-2015 period. We show that untapped export potential for developing countries is still visible. Neither major events nor export increases eliminated this export potential. Our results indicate that offshoring could continue to benefit from the external markets of host countries, MNCs have alternative locations with significant export potential, integrationist strategies risk being unsustainable with export stagnation in sight, and newcomers can seize markets abroad, especially in high-income countries. The countries that take advantage of this potential might solve problems such as unemployment, trade deficits, and technological gaps.

This literature review shows how country-level export potential is an integral element in the strategies of MNCs, countries, and regions. Thus, it plays a role in reshaping the global geography of the car industry. The combination of the existence of this potential and the technological rise of newcomers could be decisive for the future of the automotive industry in developing countries.

1.2. Markets, production, and ownership

Markets for car sales

Figures show a shift of production to the South. This shift has been encouraged by various factors, notably the car sales pattern. In developing countries, demand increased by a growing middle-class, and in developed countries, the demand increased for lower-cost vehicles that are often produced in low-cost countries (Jullien & Lung, 2011).

The world average growth of car sales was equal to 4% during the 2005-2016 period. This growth was boosted by sales in developing countries that were growing more rapidly, when sales in developed countries were decreasing (Table 1). For example, the average growth was equal to 18% in China and 9% in India during this period.

Table 1: Annual Average Growth Rate (AAGR) of world car sales over the 2005-2016 period

Region	AAGR
Asia and Middle East	9.6%
Central & South America	3.2%
Russia, Turkey, & Other Europe	2.7%
Africa	2.5%
Europe new members	2.1%
Oceania	1.7%
Europe 28 + EFTA	-0.1%
NAFTA	-0.1%
Europe 15 + EFTA	-0.2%
All countries (144)	*4.0%*

Source : Author's own calculations, OICA.

Movement of automakers from north to south

Traditional carmakers have been building alliances to facilitate the relocation of their production. In general, alliances and mergers help these firms mitigate costs and maximize size. The destination varied over time: It was Brazil in the 1990s, then China and India in 2000s (Jullien & Lung, 2011).

During the 2000-2014 period, production located in developing countries was increasing. In 2014, seven carmakers were producing half or more of their production in a specific group of developing countries[6]. The top destinations were Mexico, Brazil, Eastern Europe, China, India, and Thailand. China was the first production location for GM, VW, Ford, and Nissan; India for Suzuki; and Brazil for Fiat. Fiat is the exception that proves the rule; it is the only carmaker whose production in developing countries has decreased. In contrast, during the same year (2014), the primary production location for seven carmakers was their country of origin. The country of origin of traditional carmakers is a developed country[7].

Obviously, the countries of destination differ from one automaker to another. Their choice could heavily depend on their production and profit strategies[8]. For example, traditional automakers have been pursuing different quality-centered strategies. Emerging automakers (for example Chery, Tata, Avtovaz and Iran Khodro), and Fiat, implemented volume-centered strategies.

Movement of production from north to south

Over 15 years, the share of developed countries in world production decreased by half. It decreased from 84% in 1999 to 43% in 2015[9]. Japan, USA, France, and many others lost significant shares. In contrast, India's share witnessed a five-fold increase, and the share of China increased from 1% in 1999 to 42% in 2015[10].

During the 2006-2015 period, production grew in developing countries in terms of annual average growth rate (AAGR). Slovakia, China, Thailand, Indonesia, and India recorded the highest rates. For instance, average growth in Thailand was 15%. Brazil and Poland were the exceptions; they missed an opportunity to increase their production. Meanwhile, production growth of most developed countries was either negative or positive but below the world average (3.8%).

Between 2006 and 2015, a specific group of developing countries hosted half (49.3%) of global car production. China hosted 45% of the latter. The combined share of BRIC[11], Mexico, Czech Republic, and Iran reached 79%. In parallel, eight developed countries produced 92% of the second half (50.7%) of global production[12].

Based on the above, we can state that the location of production is shifting from North to South, especially to China. This movement is clearly seen in terms of absolute value, growth, and cumulative value. This phenomenon has affected most traditional carmakers, most developed countries, and a specific group of developing countries.

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[6] The gap of traditional carmakers production between that located in developing countries and that located in developed countries, in 2014: gap reversed for Suzuki, GM, Renault, VW, Fiat; gap closed for Ford, PSA, Nissan, Hyundai; gap narrowed for Honda, Mitsubishi, Toyota, Mazda, Daimler AG, BMW (in units, author's own calculations, OICA).

[7] Top 1 destination-country by traditional carmakers in 2014: China for GM, VW, Ford, Nissan; India for Suzuki; Brazil for Fiat; Spain for Renault; France for PSA; Germany for BMW, Daimler AG; USA for Honda; South Korea for Hyundai; Japan for Mitsubishi, Mazda, Toyota (in units, author's own calculations, OICA).

[8] For extensive studies on these profit strategies consult Freyssenet (2009).

[9] The distribution of car production share between developed countries and developing countries in 1999, 2006, 2015, respectively, is: 84% versus 17%; 67% vs 33%; 44% vs 56% (author's own calculations, OICA).

[10] Vehicles production in China is composed of two elements: production of foreign firms and production of emerging firms i.e. SAIC group and Great Wall.

[11] Brazil, Russia, India, and China.

[12] Japan, Germany, South Korea, USA, France, Spain, United Kingdom, and Canada.

Movement of ownership from west to east

The ownership of carmakers has been moving from West to East and, secondarily, from North to South. In this sense, two movements are happening simultaneously[13]: the shift of car-making property to Asian countries and the emergence of new carmakers in China, India, and Iran.

Since 2007, in absolute terms, the production of Asian carmakers has surpassed the production of non-Asian carmakers. Between 2007 and 2014, the gap widened. In average terms, the production of Asian carmakers increased remarkably during the 1998-2014 period[14].

The production of Chinese carmakers increased at an annual average of 62% between 2000 and 2014. It reached 8 million units in 2014, compared with 384 thousand in 2002[15]. Similarly, average growth of Indian carmaker production was 25%[16]. Tata car production reached 744 thousand in 2012, compared with 71 thousand in 1999.

The average growth of South Korean carmaker production was 10% between 1998 and 2014. Hyundai caught up with traditional leaders. The AAGR of Japanese carmakers was 4.71%[17] between 1998 and 2014.

Indeed, this movement has been at the expense of non-Asian carmakers. The production of non-Asian carmakers either decreased or increased weakly. The average growth of American and French carmaker production was below 2%[18].The production of Italian and Russian carmakers decreased[19]. The production of German carmakers increased by 3.9%[20].

Average growth of Asian carmakers production was 7%[21] over the 1999-2014 period, whereas average growth of non-Asian carmaker production was 1.9%[22].

The second movement is represented by the emergence of new carmakers in developing countries. AAGR of production by carmakers originating from China, India, and Russia was 19% during the 1998-2014 period. We can add to this two Iranian carmakers (Saipa and Iran Khodro) that were producing around 800 thousand units in 2011 and 2014. In contrast, average growth was limited to 3.5% in the case of carmakers originating from developed countries[23]. Global production grew by 4.2% over this period.

Although emerging carmakers have grown rapidly, they are far from being the driving force in production. In fact, the share of carmakers originating from developed countries was 85% in 2014, compared with 88% in 2007 and 96% in 1998. The driving force is Asian carmakers production, more specifically, that of Japan, China, and South Korea.

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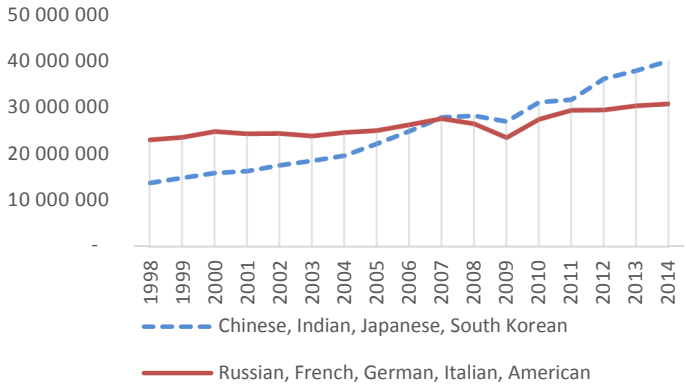
[13] OICA publishes statistics about vehicles production by manufacturers. In our work, per example, Germany is considered the country of origin of Daimler.
[14] Included Asian countries are China, India, South Korea, and Japan.
[15] In 2014, included Chinese carmakers are 12. The top five among them are SAIC, Changan Automobile, Geely, Dongfeng Motor, and Great Wall. In 2002, included carmakers are CNAIC, Faw, Changan, SAIC, Dongfeng, and BAIC.
[16] Included Indian carmakers are Tata, Tata (Telco), Ashok Leyland, Hindustan, Mahindra, Mahindra & Mahindra.
[17] Included Japanese carmakers are Daihatsu, Fuji, Fuji-Subaru, Honda, Isuzu, Mazda, Mitsubishi, Nissan, Suzuki, Suzuki-Maruti, and Toyota.
[18] Included American carmakers are Chrysler, Ford, and GM. French carmakers are PSA and Renault.
[19] Included Italian carmaker is Fiat. Included Russian carmakers are Avtovaz, Avtovaz-seaz, Gaz, Gaz-Paz, Ijmach Avto, Ijmach-Avto-Roslada, Kamaz, Roslada, and UAZ. Russian carmakers production slumped from 854,559 units in 2008 to 296,898 units in 2009, and stayed low between 2009 and 2015.
[20] Included German carmakers are BMW, BMW Rover, Daimler, DaimlerChrysler, VW, and Porsche.
[21] The countries of origin are China, India, Japan, and South Korea.
[22] In 2014, Tata produced in UK 75152 Jaguar and 374355 Land Rover, and Geely produced 461507 Volvo in China, Malaysia, Belgium, and Sweden.
[23] The countries of origin are France, Germany, Italy, Japan, South Korea, and USA.

Figure 1: The car production of Asian and non-Asian carmakers



Source : Author's own calculations, OICA.

1.3. Exports as the last bastion of the north

The oligopolistic structure in the automotive industry makes relocation inescapable. To maintain their profitability, carmakers should increase their production in developing countries. Relocation entails risks related to political influence, demand, exchange rate, and interest rate. For instance, demand in many developing countries is sometimes volatile. Therefore, to reduce their dependence on host markets, carmakers try to transform their sites into export bases (Lung, 2000).

The AAGR of car exports over the 2006-2015 period reflects a rapid increase in the car exports of many developing countries such as Romania, India, Indonesia, and Russia, where AAGR was above 20%. On the contrary, Poland, Brazil, and Turkey were among few developing countries to exhibit weak growth. The AAGR was remarkably positive in many developed countries. For example, it was 8% in the USA, 5% in Italy, and 4% in Germany. However, it was negative in many others, such as France, for instance, where the AAGR was -5% over the same period.[24]

Despite a decrease between 2007 and 2015, the share of developed countries in global exports was still high[25] in 2015. The share of top exporters among them dropped from 83% in 2007 to 77% in 2015. Although the share of Germany, the USA, Canada, South Korea, the UK, Spain, and Italy slightly increased during this period, the share of France, Belgium, Sweden, and Austria decreased; the same was the case for Japan, whose share decreased by 5%.

In parallel, the share of developing countries from top exporter countries increased to 18%. Leading exporters were Mexico (4.9%); Eastern European[26] countries, including Turkey (8.6%); and Thailand (1.4%). Their combined share was 13%. The share of countries that are close to advanced economies was high. In contrast, the combined share of BRIC countries was 2.7% in 2015, slightly above their share in 2007, which was 1.9%. In fact, the share of Brazil decreased over the period.

[24] AAGR of car exports in the 2006-2015 period: Ukraine -25%, France -5%, Austria -3%, Portugal -1%, Sweden -0.7%, Belgium -0.1%, Poland 0.2%, Brazil 0.4%, Australia 1.5%, Japan 1.8%, Turkey 2.8%, Canada 4%, Spain 4%, Germany4%, Slovenia 4%, Italy 5%, South Korea 5%, Netherlands5%, Malaysia 6%, Argentina 7%, United Kingdom 7%, USA 8%, Czech Republic 8%, Mexico 9%, South Africa10%, Finland 10%, Slovakia 11%, Thailand 17%, Hungary 19%, China 19%, Russia 20%, Indonesia 21%, India 22%, Romania 25% (author's own calculations, UN Comtrade, 2020).

[25] In the years 2007 and 2015, around 95% of world car exports was from 25 countries.

[26] Czech Republic, Slovakia, Hungary, Turkey, Poland, and Romania.

Based on this observation, we can divide developing countries into two groups based on their proximity to developed markets.

Despite the significant growth of developing countries' exports, their combined share remains low. Their share in exports is not growing at the same pace as their share in global car production. While their production level accounts for half of global production, their export level is below one quarter of global exports. This points to a potential for future acceleration of their upward trend in exports. Nevertheless, most developing countries are coming from far and still have a long way to go.

Now we will try to identify where, what, and how much the developing countries export PCs [27].

Over the 2007-2015 period, three-fourths of car export value was destined to high-income economies[28] and two-thirds were destined to developed countries[29]. If we exclude exports originating from Mexico, CEECs[30], and Turkey, the share of developed countries falls to 30%. This shows that developed countries are the main market of top exporters from developing countries. Thailand, exporting mainly to Association of Southeast Asian Nations (ASEAN) countries, is an exception, with a third of its exports destined to developed countries. This rate is close to that of India. As for China, this share is 22%; for Brazil and Russia, it is even lower.[31]

To measure how much of local production is exported, we divide the quantity of exported items (X_i) by that of produced items (P_i)[32]. The coefficient $(\gamma_i = \frac{X_i}{P_i})$ is very high (above 70%) for Mexico, CEECs, Turkey, Thailand, Morocco, and a few other countries. This indicates that the production in these countries is destined for exports and not for domestic demand. The ratio is very low (below 20%) for Brazil, China, Malaysia, Indonesia, Iran, and many other developing countries. The ratios of India and Argentina are in the middle, at 32% and 58%, respectively.

The small car segment is leading Indian production, and India sells small engines to global carmakers (Remesh, 2017). Head and Mayer found that offshoring is higher for smaller cars, and the Harmonized System (HS) 6-digit codes export data (by engine type and displacement[33]) shows that developing countries export smaller cars. Engine displacement, power output, fuel-saving technologies, and other factors, determine cars' fuel economy. Lower displacement means lower fuel consumption. *We assume that cars with low displacement are "small cars."* Figures show that developing countries export relatively smaller cars. The share of spark-ignition (SI) below 1500 cylinder capacity (cc) is 29% for developing countries versus 10% for developed countries; and that of cars above 3000 cc is 4% for developing countries versus 22% for developed countries. The share of compression-ignition (CI) cars above 1500 cc is 21% for developing countries and 27% for developed countries. Thus, developing countries' exports could be differentiated by their cylinder capacity but not by the type of engine

[27] We mean here by the "developing countries" a selection of developing countries that produce passenger cars; according to OICA Production Statistics over the period 2007-2015.
[28] Based on the World Bank yearly country classifications by income level.
[29] Here, the country classification is according to the United Nations (2014); but we excluded the "New EU member states" from the developed countries category.
[30] According to OECD definition, Central and Eastern European Countries (CEEC) are six: Czech Republic, Hungary, Poland, Romania, Slovakia, and Slovenia.
[31] The share of developed countries in exports over 2007-2015 period: Mexico 84%, South Africa 81%, Mexico&CEEC&Turkey 78%, Central and Eastern European Countries (CEEC) 75%, Morocco 70%, Turkey 69%, Developing Countries 64%, India 33%, Thailand 31%, Developing Countries (excl. MEX&CEEC&TUR) 30%, China 22%, Brazil 10%, Russia 1%.
[32] Exports in quantity of items is from UN COMTRADE and production in unites from OICA Production Statistics. Therefore, the calculated ratio (or indicator) measure approximatively the export rate.
[33] Spark-ignition (SI) engine runs on gasoline and compression-ignition (CI) engine runs on diesel. Spark-ignition engine by cc: <1000cc, 1000cc-1500cc, 1500cc-3000cc, >3000cc. Compression-ignition engine by cc: <1500cc, 1500cc-2500cc, >2500cc.

(SI versus CI). This pattern can be related to differences in market structure. The market share of vehicles with high displacement is more significant in OECD countries, notably in North America and Australia (OECD/IEA, 2017). This pattern could also be related to the fact that large cars are more skill intensive.

Generally, the share of smaller cars in exports increased between 2007 and 2015, notably for SI cars. For developing countries, the share of SI cars below 1500 cc increased by 7% and that of cars above 1500 cc decreased by 4%. For developed countries, the share of SI cars below 3000 cc increased by 5% and that of cars above 3000 cc decreased by 5%. In fact, during 2005-2015, engine displacement declined and power output per unit displacement improved. This trend can be favorable to developping countries, especially if they own new technologies that increase the power output per unit displacement.

In section two, we identify the determinants of exports, measure the expected exports, and compare expected exports to actual exports.

2. ECONOMETRIC RESULTS

After a short introduction, we present the model and variables. Then, we show the results of various estimations and measure the expected exports of developing countries. This measurement is based on the results of the Hausman-Taylor estimator (HTM) and on the out-of-sample technique.

Our empirical model is influenced by the gravity empirical approach and trade cost literature. In the gravity equation, bilateral trade is proportional to countries' economic size and inversely proportional to distance (Tinbergen, 1962). New equations appeared with additional independent variables[34]. This approach is recognized for its empirical success, which lasted 25 years before the arrival of theoretical contributions (Anderson, 1979; Anderson & Van Wincoop, 2003). Indeed, this equation has been found to be compatible with different international trade theories[35].

According to Deardroff (2004), the concept of comparative advantage is not sufficient to explain trade. He introduced the concept of "local" comparative advantage that takes into account production costs and trade costs. According to Anderson and Van Wincoop (2004), trade costs "include all costs incurred in getting a good to a final user other than the marginal cost of producing." They also showed that trade costs are higher than production costs, and they suggested a typology of trade costs[36].

Peridy and Abedini (2008) measured the expected car exports of developing countries based on the 1999-2006 period. This measurement was founded on a set of observable characteristics, including gravity variables and trade costs. The level of expected exports can be close, below, or above the actual level of exports. This comparison provides an indication of whether exports might stagnate, increase, or decrease, respectively. In other words, expected exports could be an indicator of the theoretical "export potential" in the car industry. The results show, based on a set of characteristics, that expected exports are above actual exports in the case of developing countries, which means that they could increase their exports.

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[34] Egger and Pfaffermayr (2003) classify explanatory variables of the gravity equation in four categories: supply factors (GDP of the exporter country), demand factors (GDP of the importer country), trade facilitators (common language) and trade barriers (tariffs).

[35] It can be derived from the monopolistic competition model (Feenstra, 2004) and from other models. Per example, Feenstra mentioned that it can be obtained from a Heckscher-Ohlin model of a continuum of good. Haveman and Hummels (2004) derived the equation under the assumption of an incomplete specialization. Feenstra, Markusen, & Rose (1998) derived the equation within a reciprocal dumping model and Feenstra et al. (2001) showed empirically the pertinence of this derivation.

[36] Anderson & van Wincoop (2004) distinguish between trade costs determined by policies as tariffs, and costs determined by the environment as transport costs; and between international and local costs.

2.1. The empirical model

The objectives of this econometric work are to identify the determinants of car exports and then to measure the expected exports of developing countries. By "untapped export potential," we refer to when expected exports are higher than actual exports. Identification of the determinants constitutes a basis for the interpretation of export ratio (expected/actual) results. The choice of the model specification and the estimation techniques was made empirically based on the objectives and data characteristics.

Model, variables, data, and specification

The estimation of the equation below allows us to identify the determinants of car exports and to measure the expected exports of developing countries.

$$\text{Ln Exports}_{ijt} = \beta_0 + \beta_1 \text{Ln GDP}_{it} + \beta_2 \text{Ln GDP}_{jt} + \beta_3 \text{Ln Distw}_{ij} + \beta_4 \text{Prod‰}_{it} + \beta_5 \text{Sales‰}_{jt} + \beta_6 RQ_{jt} + \beta_7 \text{Lang}_{ij} + \beta_8 RTA_{ijt} + \beta_9 GCI_{it} + \delta_{it} + \varphi_{jt} + \varepsilon_{ijt}$$

This model has three dimensions (i, j, t). In the basic sample, exporter countries include leading car exporters along with developing countries involved in the car industry[37]. Developing countries are selected based on their car export growth rate and PC production level. We selected in total 29 exporter countries[38]. The list of importer countries includes the exporters, the top importers, and a selection of importers. In sum, we have 47 importer countries[39].

In the larger sample, we adopt a different selection criteria. Therefore, the list of exporter countries includes 48 car-producing countries[40] and the list of importers includes 232 countries[41]. The results obtained based on the larger sample are used for sensitivity analysis.

Based on HS 4-digit codes, the traded product 8703 is the "motor vehicles for transport of less than ten persons"[42]. Collected data of variables comes from various sources and covers the 2007–2015 period and the following exporter and importer countries:

Exporters: Argentina, Austria, Belgium, Brazil, Canada, China, Czech Republic, France, Germany, Hungary, India, Indonesia, Iran, Italy, Japan, Malaysia, Mexico, Poland, Romania, Russia, Slovakia, South Africa, South Korea, Spain, Sweden, Thailand, Turkey, UK, USA.

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[37] A developing country involved in the passenger cars industry should have a high level of production and/or growing exports.

[38] Leading exporters are Germany, Japan, USA, Canada, South Korea, United Kingdom, Spain, Belgium, Mexico, France, Czech Republic, Slovakia, Italy, Poland, Hungary, Turkey, Sweden, Thailand, Austria, Brazil, South Africa, India, and China (despite being a main exporter, United Arab Emirates was excluded because of lack of data about PCs production). Selected developing countries involved in car industry are China, Czech Republic, India, Indonesia, Iran, Mexico, Russia, Slovakia, Thailand, Turkey, Malaysia, Argentina, Romania and Hungary.

[39] It includes the 29 exporter countries, and some leading importers like Russia, Saudi Arabia, Netherlands, Switzerland, Norway, Argentina, Portugal, Denmark, Chile, Israel, and Finland; in addition to a selection importers across the globe: Ukraine, New Zealand, Colombia, Nigeria, Greece, Ireland, Romania, Indonesia, Singapore, and Kazakhstan.

[40] According to OICA production statistics over the 2007-2015 period.

[41] According to OICA definitions, "passenger cars," are road motor vehicles, other than a motor cycle, intended for the carriage of passengers and designed to seat *no more than nine persons* (including the driver). The term "passenger cars", therefore, covers taxis and hired passenger cars provided that they have fewer than ten seats. This category may also include pick-ups or microcars (need no permit to be driven).

[42] Based on the harmonized commodity description and coding system (HS), traded good in our model is the product 8703 which covers: motor vehicles designed for the transport of *less than ten persons* (except buses). Thus, it includes automobiles (SI engine or diesel engine), snowmobiles, golf cars, and similar vehicles.

Importers: Argentina, Austria, Belgium, Brazil, Canada, China, Czech Republic, France, Germany, Hungary, India, Indonesia, Iran, Italy, Japan, Malaysia, Mexico, Poland, Romania, Russia, Slovakia, South Africa, South Korea, Spain, Sweden, Thailand, Turkey, UAE, UK, USA, Saudi Arabia, Netherlands, Switzerland, Norway, Portugal, Denmark, Chile, Israel, Finland, Ukraine, New Zealand, Colombia, Nigeria, Greece, Ireland, Singapore, Kazakhstan.

The theoretical number of observations is 12,267. The number of available observations is 9,876. Based on standardized and studentized residuals criteria, we removed 46 observations. The number of observations increases to 11,264 when the zero-export observations are included. The left side of the equation represents the car exports measured by the value of trade in US dollars. This data comes from UN Comtrade (2020). The right side of the equation is composed of nine variables. They can be grouped in three categories: gravity variables, trade costs, and sectorial aspects.

The variables of gravity approach are gross domestic product (GDP PPP) and geographical weighted distance (Distw). GDPs are proxies for the total demand and supply. Baldwin and Taglioni (2011) showed that GDPs are poor proxies when studied trade flows comprise a significant fraction of intermediate goods. However, we study the trade flows of a final consumer good. The data source is CEPII. We expect a positive coefficient of economic size: $\beta_1>0$ & $\beta_2>0$. For distance, we expect a negative coefficient β_3 between -0.5 and -1.5 ($\beta_3<0$)[43].

Trade costs could be reflected by distance, RTAs, common language (Lang), global competitiveness index (GCI) in the exporter country, and regulatory quality (RQ) in the importer country.

Distance reflects trade costs in different ways. For instance, it has an impact on transport costs and trade risks. Vehicles and some parts[44] are "large, heavy, and fragile." This could explain the high transportation costs in the automotive industry and the production proximity to end markets.

Lang is a dummy variable for two countries with at least nine percent of their population speaking the same language. Thus, it could refer to cultural proximity and communication costs. We expect it to have a positive impact ($\beta_7>0$). RTA is a dummy variable for regional trade agreements such as ASEAN. It is a policy variable that can reflect the level of regional integration and bilateral free trade. We expect it to have a positive impact ($\beta_8>0$). The level of RQ reflects agents' confidence in the capacity of the importer country government to promote the private sector[45]. We expect it to have a positive impact ($\beta_6>0$). GCI in the exporting country ranges between 1 and 7; it reflects countries' competitiveness based on pillars such as institutions, infrastructure, ICT, and innovation capability. We expect a positive coefficient ($\beta_9>0$).

The RTA and Lang data source is CEPII. RQ data is collected from World Bank Worldwide Governance Indicators (WDOP, 2017) and GCI data from the World Economic Forum.

The sectorial aspect is covered by PC production (Prod) and PC sales (Sales) per thousand population, in the exporter and importer countries, respectively. The data source is OICA statistics and World Bank Population Statistics (WBPS). Production is the number of units produced per year in the exporter country.

[43] Expected coefficient range [-0.5; -1.5] is based on empirical results either on a macroeconomic scale (Egger & Pfaffermayr, 2003) or sectorial scale (Abedini & Péridy, 2009).
[44] Seats, engines, transmissions, and body panels (Sturgeon et al., 2009).
[45] The Regulatory Quality (RQ) definition, as formulated by the World Bank Data Catalog, is as following: "captures perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development."

Table 2: Estimation Results

	OLS[a]	FE	RE	HT
Ln GDP_{it}	0.86*	-	0.796*	0.799*
	(0.0247)		(0.0618)	(0.0785)
Ln GDP_{jt}	0.659*	0.691*	0.684*	0.687*
	(0.0237)	(0.0213)	(0.0215)	(0.0213)
Ln $Distw_{ij}$	-0.959*	-1.045*	-1.023*	-1.031*
	(0.0326)	(0.0331)	(0.0327)	(0.0327)
PC $Sales\%_{0jt}$	0.0182*	0.0197*	0.0196*	0.0197*
	(0.00276)	(0.0025)	(0.00252)	(0.0025)
PC $Prod\%_{0it}$	0.03*	-	0.0316*	0.0319*
	(0.000777)		(0.00205)	(0.00259)
RQ_{jt}	0.207*	0.311*	0.29*	0.298*
	(0.0422)	(0.038)	(0.0383)	(0.038)
$Lang_{ij}$	0.429*	0.514*	0.509*	0.508*
	(0.0811)	(0.0765)	(0.0766)	(0.0762)
RTA_{ijt}	1.669*	1.087*	1.202*	1.161*
	(0.0674)	(0.0653)	(0.0651)	(0.0649)
GCI_{it}	1.567*	-	1.764*	1.848*
	(0.0528)		(0.133)	(0.168)
Constant	-5.945*	15.1*	-5.883*	-6.313*
	(0.542)	(0.388)	(0.975)	(1.205)
Obs.	9,841	9,841	9,841	9,841
Rsq within	0.4502	0.326	0.325	
Rsq overall		0.21	0.44	
Adj Rsq (in OLS)	0.4997			
Fisher Test	894.55*			
VIF	1.53			
BIC (in OLS)	45219.88			
Groups		256	256	256
Exp-year effects	YES	YES	YES	YES
Imp-year effects	YES	YES	YES	YES
Wald Test			5301.16*	
Rho		0.5	0.15	0.23
BPLM			5147.12*	
Hausman Test			215.68*	
Wald chi2				5110.33*
F Test		770.9*		
F all u_i=0		33.24*		

Dependent variable: Ln $Exports_{ijt}$.
[a] *Ordinary Least Squares (OLS) regression.*
*Standard errors in parentheses; * p<0.01, ** p<0.05, *** p<0.1.*

We included production per thousand population to avoid multi-collinearity with GDP_{it}. Production would indicate the existence of economies of scale. Therefore, we expect it to have a positive impact ($\beta_4>0$). Sales is the number of new PC registrations per year in the importer country. We included sales per thousand population to avoid multi-collinearity with GDP_{jt}. This variable would measure the market size in the partner country. Unfortunately, the lack of required data[46] on bilateral tariffs prevented us from testing this important variable. Finally, the empirical literature assigns to the constant term an interpretation whereby β_0 is equal to $(1 + \alpha)Y_w$ (Péridy, 2005).

[46] This data is published by the International Trade Center: http://www.macmap.org/.

Table 3: Estimation results (zero observations, larger sample)

	PPML (robust)	***PPML*** (Gamma RE, robust)	**FE** (larger sample)	**HT** (larger sample)
Ln GDP_{it}	-	0.56*	-	1.229*
		(0.075)		(0.0797)
Ln GDP_{jt}	1.095*	1.095*	0.686*	0.684*
	(0.0237)	(0.0237)	(0.00814)	(0.00812)
Ln $Distw_{ij}$	-0.436*	-0.436*	-1.116*	-1.109*
	(0.0362)	(0.0362)	(0.0203)	(0.0202)
PC Sales $\%_{0jt}$	0.0169*	0.0169*	0.0156*	0.0156*
	(0.00217)	(0.00217)	(0.00122)	(0.00121)
PC $Prod\%_{0it}$	-	0.0182*	-	0.0387*
		(0.0023)		(0.00284)
RQ_{jt}	0.405*	0.405*	0.422*	0.422*
	(0.0584)	(0.0584)	(0.0179)	(0.0179)
$Lang_{ij}$	0.366*	0.366*	0.736*	0.724*
	(0.0499)	(0.0499)	(0.0429)	(0.0426)
RTA_{ijt}	1.057*	1.057*	0.921*	0.933*
	(0.0777)	(0.0777)	(0.0376)	(0.0375)
GCI_{it}	-	1.043*	-	1.615*
		(0.216)		(0.168)
Constant		-16.67*	15.38*	-10.99*
		(0.806)	(0.196)	(1.138)
Obs.	11,264	11,484	28,463	28,463
Rsq			0.45	
Rsq overall			0.21	
Log PL	-1.891e+08	-1.891e+08		
Groups	256	261	376	376
Exp-year Effects	YES	YES	YES	YES
Imp-year Effects	YES	YES	YES	YES
Rho			0.58	0.35
Wald chi2	4182.83*	95609.44*		23415.54*
F Test			3830.78*	
F all u_i=0			65.04*	

Dependent variable: Ln $Exports_{ijt}$.
*Standard errors in parentheses; * p<0.01, ** p<0.05, *** p<0.1.*

The model specification has exporter-country-year (δ_{it}) and importer-country-year (φ_{jt}) effects that measure, respectively, the propensity to exports of country i and the propensity to imports of country j in year t. This specification allowed the inclusion of many observable characteristics. Other specifications could have been employed (Egger & Pfaffermayr, 2003) but under which most effects are captured by dummies[47].

Estimation and model selection

We estimated our empirical equation using various econometric models. The stability of our results showed their reliability. In addition, the sign of each coefficient was in-line with theoretical expectations (Table 2, Table 3).

The Hausman specification test showed that independent variables and errors are correlated. The fixed-effects (FE) model is, in this sense, better than the random-effects (RE) model. Among the limitations of both models, we can mention that the

[47] This empirical reasoning is used in empirical literature, as a recent article see Greaney & Kiyota (2020).

first is unable to estimate the coefficients of importer-year-invariant variables GDP Prod, and GCI, and the second is limited by the assumption of absence of correlation between REs and regressors. The Hausman-Taylor estimator takes into account the possibility of correlation between unobservable individual effects and explanatory variables. This is why our analysis is based on the HTM results (Allison, 2009; Davidová, 2015; Sevestre, 2002). RQ in the importer country was selected as an endogenous variable; thus, we assumed it correlated with residuals [48].

The robust regressions provided similar results (Wooldridge, 2001) (Annex: Table 7). This indicates the absence of serious problems of autocorrelation and/or heteroscedasticity. The problem of cross-sectional dependence is ignored because our data is a micro panel[49] (Baltagi, 1995). The variance inflation factor (VIF) value did not indicate the existence of a severe problem of multi-collinearity.

Then, we employ the Poisson pseudo-ML (PPML) estimator to keep the zero-export data in the regression (Santos Silva & Tenreyro, 2006)[50]. The size of the sample increases. In this way, we verify the statistical significance of coefficients after keeping the zero-export observations. We point out that the PPML is consistent under heteroscedasticity.

After that, we verify the statistical significance and stability of coefficients with the larger sample size (including 28,463 observations) (Table 3).

2.2. Results and robustness checks

The explanatory variables were significant in different estimations. The sign of each coefficient was in line with our expectations. Based on HTM results, the GDP has a significant positive impact. When the GDP of the exporter country increases by 1%, exports increase by 0.8%. Additionally, when the GDP of the importer country increases by 1%, exports increase by 0.7%. The impact of the geographical distance was found to be significant and negative. When distance increases by 1%, exports decrease by 1%.

PC sales in the importer country and PC production in the exporter country have a significant positive impact on PC exports. RQ in the importing country has a significant positive impact. Lang and RTAs have a significant impact and a positive coefficient. The GCI score in the exporter country is significant and has a positive impact.

The robustness checks consist of testing the model after replacing one proxy with another. These analyses confirm the stability of the results (WTO UNCTAD, 2012).

Our robustness checks cover the following variables: GDPs, distance, RQ, sales, language, GCI, and the endogenous variable (Annex: Table 8, Table 9). The GDPs are replaced by the economic size of the pairs of countries (sum of GDPs). Weighted distance is replaced by other variables measuring the distance by a modified formula (Distwces) or a different approach (Dist & Distcap) (Mayer & Zignago, 2011). RQ is replaced by political stability, and then by corruption control. Sales per thousand population is replaced by the number of units sold, and language by common official (or primary) langue (CEPII) (Mayer & Head, 2014). GCI score is replaced by the 2012 Knowledge Index (World Bank Institute).

[48] Hausman-Taylor estimator (1981) is an instrumental variable estimator. Here, it is limited by the arbitrary selection of exogenous variables. As a sensitivity test, we select other variables as exogenous. First we select "corruption control," then "Lang," and after "RTA" (Annex: Table 8, Table 9).

[49] Micro panel is composed of many individuals (countries) and few periods (over 20-30).

[50] Kareem & Kareem (2014) discuss the various issues of different empirical techniques used to estimate gravity model in the presence of zero trade observations.

Table 4: Exports ratio (expected exports / actual exports) based on out-of-sample results

Exporter Country	Average Exports Ratio	Average Exports Ratio (larger sample)
Hungary	1.01	*0.96*
Turkey	1.01	*0.97*
Poland	1.06	*1.03*
Thailand	1.06	*0.88*
Mexico	1.07	*0.99*
South Africa	1.10	*0.96*
India	1.10	*1.01*
Romania	1.11	*0.97*
Slovakia	1.11	*1.16*
China	1.12	*1.09*
Czech Republic	1.16	*1.17*
Indonesia	1.26	*1*
Argentina	1.28	*1.09*
Brazil	1.32	*1.14*
Malaysia	1.33	*1.19*
Russia	1.39	*1.20*
Iran	1.53	*1.31*

Out-of-sample technique and export ratio

We estimated the model based on a sample including developed countries as exporters. Thus, this sample excluded the observations where developing countries are exporters. The results of this model were similar to previous results. The "out-of-sample" technique consists of projecting these results to the excluded observations. In this way, the advanced countries are considered a benchmark for the "long-term equilibrium" of exports. Then, we created an exports ratio: ln expected exports/ln actual exports. This ratio allowed us to compare the expected exports with the actual exports. We also calculated the in-sample export ratio. We calculated these ratios based on the basic sample and then based on the larger sample. Both the results obtained with the in-sample and those obtained with the larger sample are interpreted as a sensitivity test.

Based on the in-sample export ratios, we classified developing countries in two categories (Table 5). In the first category, the actual exports are below the expected exports. In the second category, the actual exports are above the expected levels. In the case of developed countries, the expected exports are below the actual exports[51], except for France, Sweden, and Canada.

Table 5: Expected exports versus actual exports, groups based on in-sample results

Group (in-sample)	Countries
Expected Exports ≤ Actual Exports	*Italy*, **Turkey**, **Hungary**, *Japan*, **Mexico**, *South Korea*, *United Kingdom*, *Spain*, **Thailand**, *Belgium*, *Germany*, **Poland, India**, *USA*, *Austria*, **South Africa**
Expected Exports > Actual Exports	*France*, **Slovakia**, **Romania**, **China**, *Sweden*, **Argentina**, **Czech Republic**, **Indonesia**, **Brazil**, *Canada*, **Russia**, **Malaysia**, **Iran**

[51] Developed countries are: Austria, Belgium, Canada, France, Germany, Italy, Japan, South Korea, Spain, Sweden, United Kingdom, and USA. Developing countries are: Argentina, Brazil, China, Czech Republic, Hungary, India, Indonesia, Iran, Malaysia, Mexico, Poland, Romania, Russia, Slovakia, South Africa, Thailand, and Turkey.

The average ratio increased slightly for most developing countries in out-of-sample results compared with in-sample results. Thus, the expected exports of developing countries are higher in the case of the assumed "long-term trend." In other words, the combination of their current observable characteristics and their current export level might have biased the in-sample results. The same applies to the in-sample and out-of-sample results with the larger sample.

The out-of-sample results indicated that expected exports are above actual exports in the case of the 17 developing countries. This means that their actual exports are below their assumed "long-run exports" equilibrium. In the case of Hungary, Turkey, and Slovakia, however, the expected exports are close to the actual exports.

Grouping the out-of-sample results is possible. Group A is composed of countries where expected exports are close to actual exports, Group B is countries where expected exports are above actual exports, and group C is countries where expected exports are significantly above actual exports.

Table 6: Expected exports vs actual exports, groups of countries based on out-of-sample

	Groups (out-of-sample)		Developing countries
A	$1 < ratio \leq 1.09$	Expected Exports ≈ Actual Exports	Hungary, Turkey, Poland, Thailand, Mexico
B	$1.1 \leq ratio \leq 1.19$	Expected Exports ≥ Actual Exports	South Africa, India, Romania, Slovakia, China, Czech Republic
C	$1.19 \leq ratio$	Expected Exports > Actual Exports	Indonesia, Argentina, Brazil, Malaysia, Russia, Iran

Interpretation of results

If the expected exports are above actual exports, we assume the existence of "untapped export potential." The results show that all included developing countries have an untapped export potential. Indonesia, Brazil, Malaysia, Russia, and Iran have the highest untapped export potential. This means that actual exports are very low in comparison with expected exports. Malaysia, Russia, and Iran have local brands. The untapped export potential level for South Africa, India, Romania, Slovakia, China, and Czech Republic is in the middle. India and China also have local brands. Hungary, Turkey, Poland, Thailand, and Mexico have the lowest level of untapped potential, and none of them has local brands.

Exporters among developing countries are large, influential, and emerging. In theory, they should have an export capacity in the car industry. We found that they have an untapped export potential. Thus, their export capacity is visible. The results raise the question of what it means for a country to have an untapped export potential. This complex question can be examined in light of countries' specificities introduced in the literature review, mostly state policies, trade ties with industrialized countries, industrial structure, etc. Thus, our results should be interpreted from a holistic and comparative view instead of focusing on the understanding of each variable separately. We apply this perspective to the following cases: Turkey, Thailand, Mexico, India, China, Indonesia, Brazil, and Russia.

Let us examine first, among this group of countries, the case of top exporters: Mexico, Turkey, and Thailand. Their high level of exports could be attributed to their agreements with the North American Free Trade Agreement (NAFTA), EU, and ASEAN. While Mexico and Turkey are highly dependent on the demand from one market, the US and Europe, respectively, Thailand is characterized by market diversification. In Turkey, Mexico, and Thailand, the export-oriented automotive industry is composed of MNCs, financed by FDI, and there are no locally headquartered carmakers. Tier 1 suppliers exist in Turkey, there are very few in Mexico, and they are

nonexistent in Thailand. In Turkey, suppliers achieved progress in items' production but lag behind in production processes and product design. They missed a technology transfer opportunity due to the low absorption capacity (Sönmez, 2013). They are not sufficiently integrated into the GVC and do not export. In Mexico, the role of suppliers is limited to activities unrelated to production (Barragán & Usher, 2009) due to technological backwardness and low-quality products (Carrillo & Contreras, 2008). Thai suppliers have the same problems as those in Mexico and Turkey.

In general, a higher added value in the parts' sector, whether locally headquartered or foreign, improves integration into the GVC and reduces the import of parts. However, to achieve this higher added value, producers need local roots and long-term investments. MNCs' control in these countries over the whole structure reduces the possibilities for local roots and local added value to grow. This situation may delegitimize state policies and increase the vulnerability of investments to technological and political changes. This concern is serious at the dawn of a new industrial revolution and nationalism return. Thus, in these countries, the existence of the automotive industry is fragile, and their export-oriented model could have reached its limits. This is supported by our results showing that actual exports are close to expected exports, which could indicate a risk of export stagnation and an inherent vulnerability. Let us now look more closely at the specificities of each of the three cases.

Mexico witnessed an exponential rise of car production for exports, while production for domestic use remained stagnant. This industry brings jobs, foreign currencies, small and medium-sized enterprise (SME) expansion, and high-tech activities (Ruiz Durán, 2017). Its high performance is attributed to low wages, abundance of skilled labor, and modern infrastructure. However, Barragán and Usher ascribed it to Mexico-USA ties. Paradoxically, this industry is threatened by heavy dependence on the USA and quasi-inexistent locally headquartered tier 1 suppliers and carmakers (Dower, 2014). A higher integration into the GVC, localization, and market diversification could restore its sustainability. Thus, exports would increase if Mexico-Mercosur free trade took off and higher local value were achieved. The latter could be possible thanks to the availability of a skilled and specialized workforce.

In Turkey, the industry is composed of foreign-owned carmakers that highly depend on their parent companies for technology. The low level of research and development (R&D) localization and low market diversification threaten the industry (Sönmez, 2013). The actual exports are close to expected exports. To avoid the risk of export stagnation, Turkey needs new free trade agreements to diversify its external markets and foster integration of direct suppliers into the GVC.

In Thailand, over the last two decades, auto exports increased substantially, and this continued during the 2007-2010 period. Nevertheless, the growth of FDI and exports receded during the 2011-2015 period. Nidhiprabha (2017) explained this slowdown by productivity decline, baht appreciation, and mostly political unrest and bad governance. In addition, we find it important to mention that Thailand is characterized by a scarcity of skilled personnel. If unfavorable factors persist, mostly bad governance, the export model could collapse. In such a situation, Thailand's close neighbors might inherit its export platforms; China and India could also become a strong challenge as destinations for FDI. Thus, Thai export performance requires good governance and internal stability. As mentioned, actual exports are close to expected exports. Therefore, to lower the risk of export stagnation, Thailand should benefit more from ASEAN's major partners. Moreover, exports could be increased if the added value were improved through training more specialized laborers.

Following this comparative assessment of Mexico, Turkey, and Thailand, let us now examine separately the situation in the remaining countries: India, China, Indonesia, Brazil, and Russia.

In India, the automotive industry shifted toward liberalism. Restrictions on ownership and local content were removed. FDI and MNC production increased. Exports of cars increased by 274%, and the export-to-production ratio increased from 14% to 19% (SIAM, 2004-2015). India's advantages are low wages, skilled labor, steel production, clusters and supply chains, and a growing demand. It can export, mostly small cars, to Africa, Southeast Asia, Europe, and the USA (Remesh, 2017). Thus, the untapped export potential implies that exports from India can continue increasing. This could continue as long as liberalization has not reached its maturity. However, we believe that its share from global exports will not increase significantly unless Indian carmakers become among top exporters. This cannot be achieved without indigenous technology. Currently, the Mahindra-Renault joint venture depends on Renault for key parts. In fact, joint ventures with MNCs within a liberal framework might slow down in-house learning. This weakness could be countered by the ongoing early internationalization (FDI outflows) of Indian carmakers that might lead to technology leapfrogging.

China limits access to its market within an interventionist framework. Thus, joint ventures between foreign and national brands are compulsory. China aims to protect its brands and ensure technology transfer; it also invests in independent R&D efforts. However, this path has not yet achieved full access to core technologies. Maybe the ongoing mergers between existing Chinese producers might increase R&D input and resolve the problem. China exports mainly to volatile markets in North Africa, West Asia, and Southeast Asia. According to Head and Mayer (2019), it does not have enough free trade agreements with high-income countries. Paradoxically, the low openness hinders exports while being the core of the Chinese strategy. The low level of actual exports to expected exports could be explained by state policies and technological gap. Certainly, exports can increase if Chinese carmakers achieve higher added value (Yi, Ying, & Xueling, 2017). The exports can also increase if China becomes a member of a regional free trade agreement. China's case raises the question of whether outward orientation accelerates technological learning or threatens its brands.

Soejachmoen (2016) examined the determinants of low auto parts trade in Indonesia. The identified factors were FDI restrictions, shortage of skilled labor, weak infrastructure and low competitiveness. Indonesia seems unprepared to integrate into the GVC, and it does not adopt IS policy. Thus, it is not an essential export platform, nor the land of newcomers. However, Indonesia is, on the other hand, a member of the ASEAN and highly populated. Overall, this would explain why actual exports are very low in comparison with expected exports.

Brazil is specialized in small cars, and the industry is composed of foreign carmakers. The production is destined for domestic markets and threatened by imports. The rise of the small car segment in China and India increased this threat. This industry contributes to GDP, tax revenues, FDI, and employment. During the 2003-2014 period, supply, demand, and imports increased but exports declined. Carmakers transferred their surplus to their home country, while the Brazilian National Development Bank financed their investments (Sarti & Borghi, 2017). Thus, the low actual exports to expected exports is explained by MNCs' discouragement, absence of Brazilian carmakers, low competitiveness, and overvalued exchange rate (Sarti & Borghi, 2017). Brazil's membership in Mercosur would have increased the expected exports. However, regional integration in South America was not very successful, and Mercosur-Mexico free trade did not take off.

In Russia, during the 2005-2012 period, the oil price boom increased income and car demand. The government aimed to substitute car imports with local production. This policy did not seek to protect locally headquartered carmakers but rather increase foreign-owned production. For instance, AvtoVaz ownership shifted to Renault. This path improved productivity at the expense of employment and local content. In 2014, the industry plunged into a crisis because the demand plummeted. In such a case, exports could have mitigated the negative effects of volatile demand. Initially, carmakers did not intend to build export platforms in Russia and state policy prioritized high employment. This internal structure can explain why actual exports are very low in comparison with expected exports. The untapped export potential could be toward Europe and Central Asia. However, the member states of the Eurasian Economic Union have relatively low GDP, and MNCs have built important export platforms in CEECs (Traub-Merz, 2017b).

CONCLUSION

In this paper, we identify the determinants of car exports on the country level. These are economic size, distance, bilateral common language, bilateral regional free trade, production level and GCI score in the exporter country, and regulatory quality and sales level in the importer country. The expected exports for developing countries are above their actual exports. This could indicate the existence of untapped export potential. Thus, exports from developing countries can continue increasing; however, the main challenge is to expand their global shares.

Regionally integrated production surpassed globally integrated production in the USA, Japan, and Europe. In Mexico and CEECs, integration was centered on USA and West Europe, respectively. Thailand benefited from the ASEAN's successful attempt to build a regionally integrated industry, as well as from its proximity to Australia. The trajectory, followed by developed countries, consists of transforming their neighbors into production sites and export platforms. The function of these platforms is to meet the demand for cars in advanced economies (Jullien & Lung, 2011).

Top exporters (Mexico, CEECs, and Thailand) are an integral part of this trajectory. They have the highest shares in global exports. We found that the actual exports of Hungary, Turkey, Poland, Thailand, and Mexico are close to their expected exports. This might be an indicator of a high level in current exports relative to their stage of economic development. However, the non-dependence on local demand and absence of local brands reflect fragile local roots. In Mexico, for instance, Mastretta Cars started production in 2011 and closed in 2014. This failure indicates a weak or unorganized indigenous capability. The state policies do not impose on foreign carmakers the obligation of conducting technology-transfer projects. Enhancement of collaboration with local suppliers is required. Otherwise, the integration process into the GVC and exports might stagnate, which could delegitimize implemented public policies.

The expected exports are above actual exports for India, China, and Iran. Their current exports are relatively low in comparison with their "long-term equilibrium." These countries try to develop indigenous capabilities, and their newcomers show strategic ambitions. On the other hand, traditional carmakers aim vigorously to gain shares in their internal markets, which makes exports a secondary objective. Consequently, competition with external markets is lower. However, low exports slow down the improvement of indigenous capabilities. The increase of exports is inevitable if newcomers, notably in China, seek technological maturity.

Argentina, Indonesia, Brazil, Malaysia, and Russia are characterized by a very low level of actual exports relative to expected exports. Indonesia and Malaysia

could learn from Thailand's trajectory in export development. They can benefit from the ASEAN and their proximity to Australia and Japan. For Brazil and Argentina, their weak strategic positioning calls for the adoption of alternative strategies and stronger regional integration. Iran and Russia have the lowest actual exports relative to expected exports. This could be explained by intensified sanctions against them.

Drawing conclusions from our results is complex, but we can make few general statements.

First, the existence of untapped export potential in host countries can promote offshoring that is especially driven by market seeking. The large untapped potential for six countries reflects the existence of a wide margin of maneuver for MNCs. The latter have a wide range of alternative locations. This margin of maneuver seems to exist inside each region. For instance, Romania, Slovakia, and the Czech Republic are characterized by a larger untapped export potential than that of their regional counterparts.

Second, the existence of untapped potential in countries that have locally headquartered carmakers is important. Thus, newcomers should not neglect their capability to conquer external markets.

Third, the top exporters in developing countries are characterized by low untapped export potential. The first interpretation of this low potential could be that exports of these countries might slightly increase. However, more in-depth analysis leads to a different interpretation. The existence of low untapped potential may hide the risk of export stagnation. Eventually, this undermines the implemented strategies in these countries mostly because they are associated with weak local roots.

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ANNEX

Table 7: Robust Estimation Results

	Robust OLS	**Robust FE**	**Robust RE**	**Robust HT**
Ln GDP_{it}	0.860*	-	0.796*	0.799*
	(0.0245)		(0.0692)	(0.0654)
Ln GDP_{jt}	0.659*	0.691*	0.684*	0.687*
	(0.0273)	(0.0309)	(0.0316)	(0.0313)
Ln $Distw_{ij}$	-0.959*	-1.045*	-1.023*	-1.031*
	(0.0306)	(0.0486)	(0.0468)	(0.0469)
PC $Sales\%_{0jt}$	0.0182*	0.0197*	0.0196*	0.0197*
	(0.00277)	(0.00241)	(0.00242)	(0.00241)
PC $Prod\%_{0it}$	0.03*	-	0.0316*	0.0319*
	(0.000696)		(0.00237)	(0.00232)
RQ_{jt}	0.207*	0.311*	0.29*	0.298*
	(0.0478)	(0.0512)	(0.0517)	(0.0515)
$Lang_{ij}$	0.43*	0.514*	0.509*	0.508*
	(0.0859)	(0.0813)	(0.0852)	(0.0838)
RTA_{ijt}	1.669*	1.087*	1.202*	1.161*
	(0.0709)	(0.105)	(0.106)	(0.105)
GCI_{it}	1.567*	-	1.764*	1.848*
	(0.0531)		(0.173)	(0.158)
Constant	-5.945*	15.10*	-5.883*	-6.313*
	(0.536)	(0.596)	(0.958)	(0.984)
Obs.	9,841	9,841	9,841	9,841
Rsq.	0.45	0.326	0.3254	
Rsq. overall		0.21	0.4457	
Fisher Test	1013.09*			
Groups		256	256	256
Exporter-year Effects		YES	YES	YES
Importer-year Effects		YES	YES	YES
Wald Test			3450.73*	
Rho		0.5	0.15	0.2356
Wald chi2				80243.42*
F Test		335*		

Dependent variable: Ln $Exports_{ijt}$ *.*
*Robust standard errors in parentheses; * p<0.01, ** p<0.05, *** p<0.1.*

Table 8: Robustness Check

	HTM1[a]	**HTM2**	**HTM3**	**HTM4**	**HTM5**[b]
Ln GDP_{it}	0.801*	0.805*	0.792*	0.796*	0.812*
	(0.0779)	(0.0786)	(0.0792)	(0.078)	(0.0781)
Ln GDP_{jt}	0.664*	0.691*	0.680*	0.655*	0.668*
	(0.0216)	(0.0213)	(0.0213)	(0.0288)	(0.0213)
Ln $Distw_{ij}$	-0.981*	-1.038*		-1.091*	-1.022*
	(0.0322)	(0.0326)		(0.0318)	(0.0328)
Ln $Distwces_{ij}$			**-0.99***		
			(0.0309)		
PC $Sales‰_{0jt}$	0.0265*	0.0189*	0.02*		0.0222*
	(0.00233)	(0.00249)	(0.00249)		(0.00272)
PC $Sales_{jt}$				**5.10e-08***	
				(1.26e-08)	
PC $Prod‰_{0it}$	0.032*	0.0321*	0.032*	0.0316*	0.0322*
	(0.00257)	(0.0026)	(0.00262)	(0.00259)	(0.00258)
RQ_{jt}		0.303*	0.296*	0.481*	
		(0.0379)	(0.0379)	(0.0289)	
$PoliticalS_{jt}$	**0.141***				
	(0.0318)				
$CorruptionC_{jt}$					**0.153*****
					(0.031)
Com $Lang_{ij}$	0.586*		0.469*	0.454*	0.622*
	(0.0759)		(0.0762)	(0.076)	(0.0885)
Com $OffLang_{ij}$		**0.61***			
		(0.088)			
RTA_{ijt}	1.3*	1.166*	1.159*	1.107*	1.259*
	(0.0622)	(0.0649)	(0.0644)	(0.0646)	(0.0634)
GCI_{it}	1.835*	1.846*	1.855*	1.825*	1.835*
	(0.167)	(0.168)	(0.17)	(0.168)	(0.167)
Constant	-6.373*	-6.381*	-6.505*	-5.031*	-6.206*
	(1.2)	(1.208)	(1.213)	(1.224)	(1.201)
Obs.	9,841	9,841	9,841	9,841	9,841
Rsq (in OLS)	0.4496	0.4499	0.4499	0.4486	0.4496
BIC (in OLS)	45303.35	45297.39	45297.54	45321.57	45303.39
Groups	256	256	256	256	256
Export. year Effects	YES	YES	YES	YES	YES
Import. year Effects	YES	YES	YES	YES	YES
Rho	0.2317	0.2366	0.24	0.234	0.233
Wald chi2	5054.39*	5114.86*	5154.44*	5041.41*	5061.36*

Dependent variable: Ln $Exports_{ijt}$.
*Robust standard errors in parentheses; * p<0.01, ** p<0.05, *** p<0.1.*
[a] *Political Stability in the importer country is assumed as an endogenous variable; thus, we assumed it correlated with residuals.*
[b] *Corruption Control in the importer country is assumed as an endogenous variable; thus, we assumed it correlated with residuals.*

Table 9: Robustness Check

	HTM6	**HTM7**	**HTM8**	**HTM9**	**HTM10[a]**	**HTM11b**
Ln GDP_{it}	1.119*		0.788*	0.795*	0.797*	0.803*
	(0.0769)		(0.0825)	(0.0828)	(0.0785)	(0.0785)
Ln GDP_{jt}	0.686*		0.677*	0.685*	0.687*	0.686*
	(0.0214)		(0.0215)	(0.0215)	(0.0213)	(0.0213)
Ln $EcoSize_{ijt}$		**1.072***				
		(0.037)				
Ln $Distw_{ij}$	-1.024*	-1.016*			-1.031*	-1.041*
	(0.0328)	(0.0331)			(0.0327)	(0.0328)
Ln $Dist_{ij}$			**-0.952***			
			(0.0308)			
Ln $Distcap_{ij}$				**-0.953***		
				(0.0312)		
PC Sales $\%_{0jt}$	0.0197*	0.0275*	0.0175*	0.0178*	0.0197*	0.0195*
	(0.0025)	(0.0024)	(0.0025)	(0.0025)	(0.0025)	(0.0025)
PC Prod $\%_{0it}$	0.03*	0.0284*	0.0323*	0.0323*	0.0319*	0.0321*
	(0.00283)	(0.0024)	(0.0027)	(0.0027)	(0.00259)	(0.00259)
$RegulationQ_{jt}$	0.297*	0.118*	0.3*	0.305*	0.299*	0.304*
	(0.038)	(0.0369)	(0.0383)	(0.0383)	(0.038)	(0.038)
Com $Lang_{ij}$	0.516*	0.589*	0.493*	0.501*	0.511*	0.508*
	(0.0763)	(0.0893)	(0.0775)	(0.0775)	(0.0765)	(0.0762)
RTA_{ijt}	1.161*	1.2*	1.164*	1.191*	1.160*	1.129*
	(0.065)	(0.066)	(0.0646)	(0.0643)	(0.0649)	(0.0653)
GCI_{it}		1.901*	1.873*	1.878*	1.844*	1.835*
		(0.163)	(0.175)	(0.176)	(0.168)	(0.168)
$Know_{i2012}$	**0.433***					
	(0.0503)					
Constant	-5.137*	-1.878**	-6.819*	-7.063*	-6.271*	-6.214*
	(1.236)	(0.947)	(1.298)	(1.301)	(1.205)	(1.205)
Obs.	9,841	9,841	9,841	9,841	9,841	9,841
Rsq (in OLS)	0.4391	0.4349	0.445	0.4434	0.4502	0.4502
BIC (in OLS)	45489.5	45554.16	43073.24	43099.37	45291.88	45291.88
Groups	256	256	256	256	256	256
Export. year effects	YES	YES	YES	YES	YES	YES
Import. year effects	YES	YES	YES	YES	YES	YES
Rho	0.2512	0.2361	0.2498	0.251	0.235	0.235
Wald chi2	5028.22*	4695.77*	4797.27*	4773.04*	5109.77*	5091.62*

Dependent variable: Ln $Exports_{ijt}$.
*Standard errors in parentheses; * p<0.01, ** p<0.05, *** p<0.1.*
[a] Common Language is selected as an endogenous variable; thus, we assumed it correlated with residuals.
[b] RTA is considered is selected as an endogenous variable; thus, we assumed it correlated with residuals.

Table 10: Exports ratio based on in-sample results

(Expected Exports / Actual Exports) ratio based on Hausman-Taylor model results

Export Country	Average Expected/ Actual Exports Ratio
Italy	0.92
Turkey	**0.94**
Hungary	**0.94**
Japan	0.95
Mexico	**0.96**
South Korea	0.96
United Kingdom	0.97
Spain	0.97
Thailand	**0.98**
Belgium	0.98
Germany	0.99
Poland	**0.99**
India	**0.99**
USA	1
Austria	1
South Africa	**1**
France	1.01
Slovakia	**1.01**
Romania	**1.02**
China	**1.04**
Sweden	1.04
Argentina	**1.08**
Czech Republic	**1.09**
Indonesia	**1.13**
Brazil	**1.16**
Canada	1.16
Russia	**1.26**
Malaysia	**1.28**
Iran	**1.36**

Un potentiel à l'exportation inexploité dans les pays en développement : le cas de l'industrie automobile

Résumé - La production automobile se déplace du Nord au Sud et la propriété des constructeurs automobiles se déplace de l'Ouest vers l'Est. En parallèle, de nouveaux constructeurs se développent en Chine, en Inde et en Iran. Même si les exportations de véhicules dans les pays en développement ont augmenté au cours de la période 2007-2015, leur part dans les exportations mondiales reste faible. Une hausse de leurs exportations pourrait accélérer le renforcement des capacités locales, en particulier en Chine. En premier lieu, nous identifions les déterminants des exportations de voitures dans le cas des pays en développement. En second lieu, nous mesurons leur capacité à accroître leurs exportations. Les résultats sont discutés à la lumière des différentes stratégies industrielles mises en œuvre dans ces pays.

Mots-clés
Industrie automobile
Pays en développement
Potentiel à l'exportation
Modèle gravitationnel
Estimateur Hausman-Taylor