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What drives cross-country differences in export variety? A bilateral panel approach

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ABSTRACT

A worldwide event like the 2020 Coronavirus outbreak can only reinforce the interest in modelling trade diversification as a key factor in countries' vulnerability to external shocks. This paper adopts a detailed relative framework to study the determinants of product-level export variety in a large bilateral panel of developing and developed economies (16,770 country pairs in the period 1988–2014). We find that country pairs characterized by large differentials in productivity and in the makeup of the labour force differ in export variety patterns. This result holds after controlling for other endowments and for trade costs. Further, productivity plays a significant role in the reduction of export variety dissimilarities between countries belonging to different income groups. Hence, without successful technological convergence the low-income economies will not be able to reduce their exposure to export risk.

1. Introduction

This paper implements a relative modelling approach to the study of export diversification patterns, analysing the factors in differences in the degree of export variety[1] between country pairs. A worldwide event like the 2020 Coronavirus outbreak (or, earlier, the 2008 financial crisis) can only reinforce the interest in trade diversification as a factor in countries' vulnerability to external shocks.[2] Excessive trade concentration is particularly dangerous for developing economies, whose export base remains dominated by a handful of products. The UN Economic Commission for Africa (ECA) expects that the negative economic effects of the COVID-19 are likely to be magnified in low-income economies due to their disproportionate exposure to the contagion effects of global shocks.[3] In particular, the dependence on a limited number of primary agricultural or mineral products, leading to highly concentrated export structures, can be problematic (Newfamer et al., 2009; UNCTAD, 2018).[4] Additionally, it has been demonstrated that overall employment expands with export diversification while vulnerable employment declines, especially in the less developed countries (see UNCTAD, 2018, on Africa). On the other hand, greater export variety (i.e. a rise in the extensive margin) produces multiple gains: productivity improvement for exporters (Feenstra and Kee, 2008), export growth (Hummels and Klenow, 2005; Kehoe and Ruhl, 2013), long-run stabilisation of export earnings (Ghosh and Ostry, 1994; Bleaney and Greenaway, 2001), reduction in the risk associated with changes in commodity prices and volatility in output or growth (Haddad et al., 2013), as well as facilitating countercyclical fiscal policy (Ouedraogo and Sourouema, 2018). It is thus very important to establish precisely what drives export variety differences between countries and how shortcomings can be addressed.

A whole series of estimates of gravity models (for a review see Head and Mayer, 2014) clearly show what determines the *volume* of bilateral trade between trading partners: size and distance have multiplier effects.

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[1] Throughout this paper we use 'degree of export variety' as a synonym for export diversification and the inverse of export concentration, considered in terms of product heterogeneity. Other works have adopted various definitions (and measurements) of export variety. For instance, Feenstra and Kee (2008) and Feenstra and Ma (2014) define variety (or extensive margin of exports) – in the spirit of Hummels and Klenow, 2005) – of exports of country h to country j as "the worldwide average export over all years to country j in those categories where country h actually exports to j, relative to the worldwide average export to j over all years in all categories" (Feenstra and Ma, 2014: 159).

[2] Recently, the relationship between trade induced specialisation, diversification and exposure to idiosyncratic shocks has been analysed by Kramarz et al. (2020) or Caselli et al. (2020).

[3] https://www.uneca.org/stories/economic-diversification-must-central-africa-faces-double-jeopardy-coronavirus [accessed on 3 April 2020].

[4] However, the role of natural resources in development and economic diversification is more complex than is often presumed (Lederman and Maloney, 2007), and the 'natural resource curse' has been questioned (see Frankel, 2010 for a review).

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As to the *variety* of trade, trade diversification determinants have been modelled principally in settings in which the composition of a country's trade basket is measured on the basis of total exports, i.e. exports to the world (among others: De Benedictis et al., 2009; Cadot et al., 2011; Agosin et al., 2012; Parteka and Tamberi, 2013a, 2013b; Jetter and Ramírez Hassan, 2015; Mau, 2016; Basile et al., 2018). Most of these studies posit the most general empirical model, in which the magnitude of a country's export variety (export diversification) is explained by a set of the exporter's characteristics: typically, countries that are richer, larger and less isolated geographically have more heterogeneous export structures than less developed and/or smaller economies located further away from the core of the international trade system (see Basile et al., 2018 for a review). Bilateral studies extend this perspective. As a result, the empirical literature on trade variety offers two main modelling approaches: working with country-specific trade data (i.e. the export diversification analysis based on the information of trade between the countries and the rest of the world aggregated, as in the studies cited above); and with bilateral trade data, to study the diversification of bilateral exports (as in Dutt et al., 2013; Regolo, 2013, Regolo, 2017; Persson, 2013 or Persson and Wilhelmsson, 2016).

This paper adopts a different perspective, a sort of mixture of the other two approaches. We work with bilateral differences in country-specific export variety (EV_i/EV_j, see Section 3.1 for details) instead of simple export variety of country i (computed using only the data on i's aggregated exports) or the variety of bilateral exports. We thus enrich the empirical international trade analysis with significant piece of information on the extensive margin by focusing on the determinants of the differentials in relative export variety, in particular the forces driving bilateral disparities between two economies. In particular, we investigate relative diversification patterns by testing whether the Ricardian forces (technological differences), together with differences in countries' size and other endowments, are able to explain the observed differences in export variety in a large bilateral panel of countries. We investigate a panel of 16,770 country pairs (130 reporting countries and their 129 partners, observed over the years 1988–2014), computing export variety indices with product level trade data (six digit HS). We also analyse the differences in export diversity between countries at different stages of development (relating to the literature following Imbs and Wacziarg, 2003). Using a series of bilateral differentials in country-specific export variety and the information on countries i and j, enables us to pose a different research question: we can focus on the magnitude and the determinants of the differences in export variety that are typical for countries belonging either to the same or to different income groups.[5] Given the importance of a successful export diversification strategy as one of the crucial elements of developing countries' productive transformation (Lectard and Rougier, 2018), it is a relevant policy research question.

We consider both cross-country differences in factor endowments (such as physical and human capital, land, fossil fuel reserves) and differences in the size and productivity of the labour force. This enables us to capture the importance of factors postulated by alternative theoretical explanations of international trade patterns (Heckscher-Ohlin, the Ricardian framework) and simultaneously test their relative importance in the international differences in extensive margin. This paper can be thus read as complementary to the valuable bilateral analysis of Regolo (2013) or Regolo (2017), who adopts the Heckscher-Ohlin bilateral perspective, and to Cieslik and Parteka (2018), who use the Ricardian framework to study countries' export variety with respect to the RoW.

We find that, ceteris paribus, a 1-per cent increase in bilateral productivity differentials is associated with a 0.5-per cent rise in the difference in the typical number of exported products for the country pair.[6] As expected, country size and endowments do affect export variety (the greater the difference in labour force, physical and human capital, arable land and fossil fuel resources, the greater the dissimilarity in the variety of their export products); however, productivity remains a key driver of bilateral export diversification differences. Additionally, we find that productivity differentials are crucial determinants of export variety dissimilarity between countries belonging to different income groups (high or low), so without successful technological convergence the low-income economies will not be able to reduce their exposure to export risk.

In the next section we review the relevant literature. In section 3 we describe the data, and the empirical methodology, along with the key statistics on bilateral export diversification. Section 4 presents the econometric model and the findings on the key factors in bilateral trade diversification. Section 5 summarises and concludes. Complementary materials are included in the Appendix.

2. The literature

First of all, this paper relates to works on export variety and the extensive margin of trade (among many others: Feenstra and Kee, 2004; Feenstra and Kee, 2008; Besedeš and Prusa, 2011; Feenstra and Ma, 2014), whose importance is not trivial. Hummels and Klenow (2005), examining 1995 data on 126 countries exporting to 59 markets, found a strong relationship between exporter size and the extensive margin which is responsible for over 60% of the greater exports of the bigger countries. Kehoe and Ruhl (2013) analysed 1900 country pairs and found that increased trade in goods not previously exported is an important factor in overall trade growth. In a recent survey Feenstra (2018) underscores that variety is one of the crucial sources of the gains from international trade, empirically estimated by Broda and Weinstein (2006) for the U.S. and confirmed in a cross-industry multi-country setting by Ossa (2015).

Secondly we refer to the literature on the factors determining export diversification. The degree of export diversity appears to be driven mainly by: per capita income (De Benedictis et al., 2009; Parteka, 2010; Cadot et al., 2011; Parteka and Tamberi; 2013a and 2013b; Mau, 2016) or productivity (Cieślik and Parteka, 2018); the size of the countries (Parteka and Tamberi, 2013b; Basile et al., 2018; Cieślik and Parteka, 2018), institutional setting (Sheng and Yang, 2016), human capital (Agosin et al., 2012; Jetter and Ramírez Hassan, 2015) trade cost factors, trade liberalisation and trade preferences (Regolo, 2013; Persson, 2013; Dutt et al., 2013; Feenstra and Ma, 2014; Mau, 2016; Persson and Wilhelmsson, 2016), geography, spatial effects and location (Agosin et al., 2012; Basile et al., 2018).

Most of these studies are from the perspective of a given country. That is, both the dependent variable (the degree of export variety/export concentration/export diversification) and the independent variables (the potential determinants of export variety) are measured for the countries under examination. A few adopt a relative setting, taking as dependent variable relative measures of export diversification (as in De Benedictis et al., 2009 or, recently, in Basile et al., 2018). With this approach one can refer a given country's degree of export diversification to trends in the world structure of trade, but the right-hand-side variables (the determinants of export diversification) are not relative, so it is impossible to explore the full structure of relative differences between countries that determine export variety differentials. Cieślik and Parteka (2018) take a step forward by relating export variety of the countries, assessed with respect to the RoW, to similarly measured relative technology differences and relative country size.

Finally, Dutt et al. (2013), Persson (2013), Regolo (2013), Regolo (2017) and Persson and Wilhelmsson (2016) adopt a bilateral

[5] See Table 1, Fig. 1, and estimation results in Table 5. Persson (2013) and Persson and Wilhelmsson (2016) adopt a bilateral setting to address export diversification in the development context but they restrict the sample to trade data from developing countries to the EU only.

[6] See Tables 2 and 3, column 1.

perspective. Dutt et al. (2013) estimate the gravity equations for the two (intensive and extensive) margins of bilateral exports and find that the WTO membership increases trade through the extensive margin. Persson (2013) focuses on trade between developing countries and the EU, finding that lower export transaction costs raise the number of products exported. This study is extended in Persson and Wilhelmsson (2016), analysing how the EU's non-reciprocal trade preferences affect export diversity of developing economies. Regolo (2013) analyses the role of endowments and bilateral trade costs in determining the variability of country's export diversification across destinations (more similar structure of endowments and lower trade costs fosters greater export diversification). She adopts the Heckscher-Ohlin setting to study what determines bilateral export concentration, i.e. concentration of exports from county *i* to country *j*. Using the North-South setting à la Romalis (2004), she finds that the structure of endowments typical for South–South or North–North countries tend to be associated with more highly diversified exports than those between less similarly endowed economies (South-North). In a subsequent paper (Regolo, 2017) she uses a bilateral model that focuses on newly exported products, finding that export diversification is accompanied by trade regionalisation. This study, instead, is based on a considerably greater degree of detail (5016 product lines as against 1090 HS4 manufacturing goods) and a longer time span (1988–2014 as against 2000–2010), and the focus here is on factors affecting bilateral differences in export baskets' heterogeneity, not on the process of adding new products.

Most of the literature on export diversification is empirical; theoretical explanations for changes in trade diversification in the course of economic development are found in just a few papers. Cadot et al. (2011) use the H–O arguments: the differences in factor endowments across countries affect specialisation, and as countries develop they move between different 'diversification cones'. The adjustment is slow, so as capital accumulation proceeds, the countries move from one cone to the other but the old lines may, at least temporarily, remain active (which implies increasing export variety). In a subsequent phase, the old lines die out, possibly leading to respecialisation. Along the lines of shift between diversification cones (Schott, 2003), we find the model of export diversification and sophistication dynamics (Lectard and Rougier, 2018), whose dynamics depends on how far the countries are from the comparative advantage. Less developed countries can diversify their exports by moving between diversification cones (as in Cadot et al., 2011) and upgrade towards more sophisticated export products using different strategies with respect to their comparative advantage. Lectard and Rougier (2018) address the nonlinearity in the diversification-development pattern and find that the strategy based on confronting their comparative advantage enhances the export diversification of middle-income and resource-rich countries but leads to the intensification of export concentration in lower-income economies.

Endowments are crucial also in the 'product space' approach (i.e. the cross-product connection network: Hidalgo et al., 2007; Hausmann and Klinger, 2007). According to Coniglio et al. (2018) the diversification of exports towards new products is driven by current production capabilities (determined by technology, endowments, institutional setting, etc.), which are re-combined to forge new goods. Radical changes (path-defying diversification) comes where a country diversifies towards these parts of the 'product space' that are not related to the initial set of products.

Another strand in the literature on diversification mechanisms focuses on the differences in technology and thus relates to the Ricardian framework. Mau (2016) contends that explanations relying on the H–O mechanisms hold only for the intensive margin and instead adopts the model of Eaton and Kortum (2002) to derive a gravity equation which describes the diversification at the extensive margin. In such a model, and accounting for the differences in factor costs and in geography, a country with higher level of technology will have a more diversified export structure. In Naito (2017) we may find a dynamic version of the model, developing the two-country setting (Naito, 2012) to a framework with multiple countries and combining the Eaton-Kortum Ricardian approach with the AK model (Acemoglu and Ventura, 2002). Naito (2017) focuses on the short-term and long-term effects of trade liberalisation on economic development and changes in the extensive margin of trade. His theoretical considerations on the connection between growth and the extensive export margin are in accordance with the empirical findings of Hummels and Klenow (2005) or Kehoe and Ruhl (2013). These considerations highlight the differences between the short-run and long-run effects of declining trade costs which can even reverse the welfare effects present in the static version of the Eaton-Kortum model. Shikher (2013) too relates to the EK model, examining the importance of technology, factor endowments, trade costs, and preferences for trade and specialisation. Based on data for 19 OECD countries in 1989, he finds that cross-country productivity differences (along with differences in tastes) and indirect trade costs are the most significant determinants of trade and specialisation patterns, factor endowments the least influential.

This paper builds upon and empirically extends that of Cieślik and Parteka (2018), which seeks to connect theory and the empirical data in export diversification literature. We use their framework to choose explanatory factors in the relative diversification model and to show the connection with the Ricardian model of international trade. Cieslik and Parteka (2018) draw upon the relative Ricardian approach of Dornbusch, Fisher, and Samuelson (DFS, 1977)[7] to explain countries' export variety as a function of technology and country size, all assessed in relative terms (with respect to the RoW). They use DFS approach to derive predictions on the factors underlying different diversification paths. As a result, there are two main mechanisms which drive differences in relative export variety observed around the world: change in relative productivity (due to technological progress) and change in relative size (due to the growth of labour force). On a sample of 132 countries (1988–2014), their data confirm the model's predictions, with the additional finding that the technological differences affect export variety more powerfully than differences in relative size and that the effect is non-linear – technology drives diversification at the onset of development but later on vanishes as a cause. Where Cieslik and Parteka (2018) view each country with respect to the RoW, this paper tests the bilateral specification of the panel regressions of export variety differentials between country pairs. Our analysis should thus be treated as an empirical extension of their work in the sense that it tests whether the relationship between relative export variety, relative productivity and relative size holds in a more detailed bilateral setting.

3. Empirical strategy

3.1. Modelling export variety and the data

Depending on the specific question that one addresses, the empirical approach for studying the determinants of export variety will differ. The simplest method, adopted in most of the studies on export diversification cited in the introduction (among others: De Benedictis et al., 2009; Cadot et al., 2011; Parteka and Tamberi, 2013a, 2013b; Basile et al., 2018), is to

[7] The DFS model extended earlier multi-commodity, two-country comparative advantage analysis (as in Samuelson, 1964; among others) to the case of a continuum of goods. The DFS framework is based on a setting with two countries, home and foreign, and explains the range of commodities produced domestically and those produced abroad; as it draws upon the Ricardian model, it is quite universal. Cieslik and Parteka (2018) use it to set up the empirical analysis of relative trade diversification with the rest of the world as point of reference. Eaton and Kortum (2012) illustrate the bilateral use of the DFS (1977) framework explicitly referring to Ricardo's original, classic example of the relative trade patterns of Portugal and England. They also go on to show how the Ricardian model can be adopted to a complex setting with multiple countries and multiple goods.

regress the measure of export variety (product diversity), *EV*, on country characteristics, *X* (per capita income, size, endowments, etc.), i.e. $EV_i = f(X_i)$. In such a model export diversification is measured by the composition of country *i*'s exports, and the empirical strategy focuses exclusively on country characteristics.

Alternatively, if the focus is on the diversification of bilateral exports (as in Regolo, 2013, or Persson and Wilhelmsson, 2016), one can regress the measure of diversification of bilateral exports between *i* and *j* (for instance, the number of active export lines by country pair and year) on the bilateral differences in country characteristics $EV_{ij} = f(DIFF^X_{ij})$. In Regolo (2013) $DIFF^X_{ij} = |lnX_i - lnX_j|$ and the dependent variable reflects the variety of export flows from *i* to *j* with input consisting in bilateral trade data disaggregated by product.

Since the point is to determine what drives bilateral differences in export variety between country pairs, we combine the two foregoing approaches and estimate the following model:

$$DIFF^{EV}_{ijt} = f\left(DIFF^{X}_{ij}\right) \quad (1)$$

where $DIFF^{EV}_{ijt} = lnEV_{it} - lnEV_{jt}$ measures the degree of export variety of country *i* with regard to country *j* at time *t* and is a function of bilateral differences in country characteristics *X* between *i* and *j*: $DIFF^X_{ijt} = lnX_{it} - lnX_{jt}$.[8]

To estimate equation (1) we use balanced panel data on 130 countries (shown in Table 1A in the Appendix) and their 129 trading partners for the period 1988–2014 (27 years). This yields 16,770 country pairs and a total of 452,790 observations (fewer in some specifications owing to the incomplete data availability of some of the explanatory variables). Given the additional focus on differences between economies at different stages of development, we classify the sample into high-, medium- and low-income countries relying on the World Bank's year-specific classifications,[9] which allow countries to change income categories from year to year.

The dependent variable is computed using mirrored exports from UN Comtrade, disaggregated at the highest degree of detail suitable for international comparisons, namely HS 6-digit, which corresponds to product-level.[10] We consider different indices of export variety $EV = \{N, 1/Theil, 1/Gini, 1/HH\}$: *EV* is either the number of active export lines (*N*) – or inverted (to allow easier interpretation) export specialisation measures based on the indices of *Theil*, *Gini* and Herfindahl–Hirschman (*HH*).[11]

The choice of the main explanatory variables, present in the set $X \in \left\{\frac{Y}{L}, L, K, T, F, M, HC, TC\right\}$, is guided by economic theory and empirical work on the determinants of export diversity. In line with the Ricardian approach (Cieslik and Parteka, 2018; Dornbush et al., 1977), we consider labour productivity, $\frac{Y}{L}$, using the data from PWT 9.0 on output per worker (*emp* and *rgdpo* series; Feenstra et al., 2015), which is closely correlated with development level proxied by per capita income.[12] Country size (indicated as a key factor in export diversification by Parteka and Tamberi, 2013b or Basile et al., 2018) is proxied by labour force (*L*), i.e. the number of persons economically active, also taken from PWT 9.0. Additional explanatory variables, related to the H–O view of international trade and specialisation (Regolo, 2013), serve to control for the importance of cross-country similarities in factor endowments, namely: the stock of physical capital (*K*, from Penn World Table, 9.0), territorial dimension (*T*, land area, from the World Bank's WDI[13]) and fuel (*F* - percentage of fuel in total merchandise exports, also from WDI) or mineral rents (*M*).

In considering the human capital (*HC*) as a driver of cross-country differences in export variety (Jetter and Ramírez Hassan, 2015), we use the human capital indicator of PWT 9.0. As a robustness check[14] we also consider other measures of human capital: we adjust the aggregate labour force *L* by the human capital *hc* index from the dataset in Barro and Lee (2013): $L_{HC} = hc*L$. We also use the information on the stock of employees with low (L_{low}), medium (L_{med}) and high (L_{high}) levels of education – these variables are computed combining the data on education enrolment ratios (Barro and Lee, 2016 update)[15] with the number of persons economically active (from PWT 9.0).

Trade costs (*TC*) are a powerful factor in determining both the volume and the variety of trade flows (Regolo, 2013; Feenstra and Ma, 2014; Mau, 2016). They are measured using the World Bank's data on the 'cost to export' (US$ per container), 'cost to export, border compliance' (US$) – TC_{BC} – or 'cost to export, documentary compliance' (US$)[16] – TC_{DC}.

Table 2A reports summary statistics, while Tables 3A and 4A (in the Appendix) report coefficients of correlation for the explanatory variables.

3.2. Key statistics on bilateral export diversification

Table 1 reports the average bilateral differences in export variety between countries[17] belonging either to the same or to different income groups (columns 1–3 and 4–6, respectively), at the beginning and at the end of our period of analysis (i.e. in 1988 and 2014). Considering the average values, i.e. $\overline{(EV_i/EV_j)}$, for *i* and *j* in the same income class, the most pronounced differences were found within the high-income group (column 1), with an average difference of 28% in export variety in 1988 and 21% in 2014. The largest bilateral differences show that even within the group of high-income countries, there are pairs in which one country has more than 4 times the export variety of the other (for instance, in 2014 countries like Italy or Germany had approximately 4.5 times the export variety of the least diversified high-income countries, such as Equatorial Guinea). Also, within countries at lower levels of income

[8] The full set of estimates obtained with dependent and explanatory variables expressed in absolute terms, i.e. $|lnEV_{it} - lnEV_{jt}|$ and $|lnX_{it} - lnX_{jt}|$ is available upon request.

[9] http://databank.worldbank.org/data/download/site-content/OGHIST.xls.

[10] Product level data has been used to study export diversification patterns by, among others: Hummels and Klenow (2005), Dennis and Shepherd (2007), Cadot et al. (2011); Parteka and Tamberi (2013a), Mau (2016), Basile et al. (2018) or Cieślik and Parteka (2018). Less detail is provided by sector level data (as in: De Benedictis et al., 2009 or Parteka, 2010). Given the extensive composition of our panel, we could not use firm level or shipment level data to measure export variety (as in Martincus and Carballo, 2008).

[11] For the definitions and formulas, and a comparison with relative measures of diversification, see Parteka (2010).

[12] Many studies consider GDP per capita as one of the main factors driving export diversification (see among others: De Benedictis et al., 2009; Cadot et al., 2011; Parteka and Tamberi, 2013a, 2013b; Mau, 2016). Given the very high correlation between bilateral differences in income per person and in productivity (in our sample, a coefficient of 0.98) we do not include both in the model, but we do consider per capita income differences (from PWT 9.0) in a robustness check (results in Table 6A in the Appendix).

[13] World Development Indicators (https://datacatalog.worldbank.org/dataset/world-development-indicators).

[14] The results are shown in Table 9A in the Appendix.

[15] We rely on 'Education Attainment for Population Aged 25 and Over' (1950–2010, 5-year averages) from http://www.barrolee.com. Combining *lu* and *lp* groups into one (low), we consider three categories of workers (low, medium, high) with at most primary, secondary, and tertiary education.

[16] Cost to export per container is obtainable from 2005 onwards, the other two only for 2014.

[17] Details on the calculations in Section 3.1. Note the difference between our variable of interest - bilateral differentials in export variety between country *i* and country *j*, EV_i/EV_j - and bilateral export variety from country *i* to country *j*, EV_{ij}, measured on the basis of the trade flow *between* the two countries (as in Feenstra and Ma, 2014).

Table 1
Bilateral differences in export variety: average, minimum and maximum ratios of export variety within and between income groups.

	Within income groups			Between income groups		
	i: high income *j*: high income	*i*: middle income *j*: middle income	*i*: low income *j*: low income	*i*: high income *j*: middle income	*i*: high income *j*: low income	*i*: middle income *j*: low income
	(1)	(2)	(3)	(4)	(5)	(6)
$\overline{(EV_i/EV_j)}_{1988}$	1.28	1.09	1.05	1.92	2.17	1.24
$\overline{(EV_i/EV_j)}_{2014}$	1.21	1.11	1.04	1.45	1.79	1.37
min-$(EV_i/EV_j)_{1988}$	0.21	0.29	0.33	0.32	0.37	0.33
min-$(EV_i/EV_j)_{2014}$	0.23	0.27	0.51	0.29	0.54	0.49
max-$(EV_i/EV_j)_{1988}$	4.81	3.44	3.00	5.28	5.28	3.45
max-$(EV_i/EV_j)_{2014}$	4.40	3.77	1.98	4.85	4.66	3.62

Note: sample splits into income groups according to historical (year-specific) World Bank classifications. Division of countries into income groups in Table 1A in the Appendix. *EV = 1/Theil.*
Source: own calculations

(middle or low) the differences are smaller than in the high-income group, but still substantial. To give an example: the Theil index of export variety for Turkey was 0.45 in 2014, that of Iraq 0.11, resulting in a bilateral ratio greater than 4-to-1, even though both of these countries were middle-income.[18] The data thus indicate that income differences alone cannot explain the whole pattern of export variety heterogeneity. Turning to export variety ratios between countries at different levels of income (columns 4–6), on average in 1988 high-income countries had about twice as differentiated exports as middle-income or low-income economies (columns 4 and 5 – values 2.17:1 and 1.92:1); these ratios diminished to 1.79:1 and 1.45:1 respectively in 2014.

That is, these differentials have been shrinking. Fig. 1, which plots average bilateral differences in export variety between country pairs, shows that in 2014 the export variety of high-income countries was 80% higher than that of low-income and 45% higher than that of middle-income economies. In 1988 the ratio between high-income and low-income countries had been 2.17:1 (compared, as just noted, with 1.8:1 in 2014). The question is what factors, apart from bilateral differences in development levels, can explain the differentials in export variety?

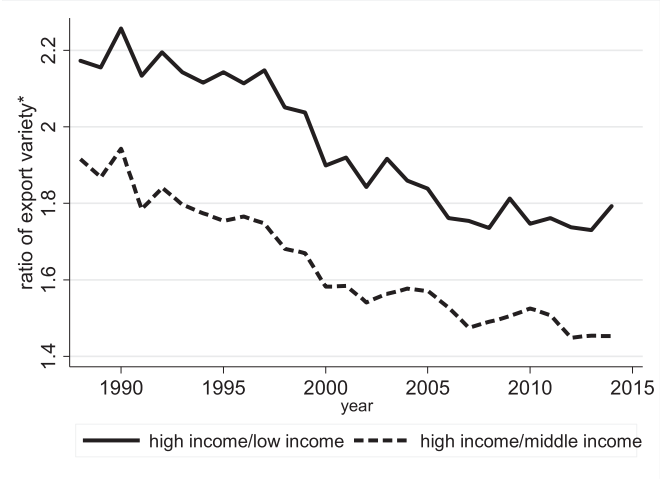

Fig. 1. Export variety differentials between countries at different development levels: high income countries (HIC) versus low- and middle income countries (LIC, MIC).
Note: * average bilateral ratio of export variety between country pairs: bold line shows $\overline{(EV_i/EV_j)}$ for i∈HIC and j∈LIC; dotted line shows $\overline{EV_i/EV_j}$ for i∈HIC and j∈MIC. Export variety of every country (*EV*) measured as (*1/Theil* index of export concentration) and computed with HS 6digit export data. Division of countries into income groups in Table 1A in the Appendix.
Source: own calculations with UNComtrade data

3.3. The empirical model and the estimation results

3.3.1. The model

The object of interest is the magnitude and the causes of cross-country differentials in export variety. The derivation of the empirical model is based on the Ricardian-based theoretical explanation of relative export diversification set out by Cieslik and Parteka (2018), itself built on the baseline DFS model (Dornbusch et al., 1977). They adopt a relative setting (Home country versus Foreign economy, denoted as RoW) with a continuum of goods [0,1] where the z-th good reflects the Home country's share in the overall number of tradable goods available globally. It is an indicator of relative export diversification (or degree of export variety), while the efficient specialisation and trade balance conditions define the equilibrium. According to theory, an increase in the relative productivity and size of the country denoted as Home should result in greater export variety relative to the foreign economy.[19]

In the first instance, therefore, we take the simplest model with these two main determinants of export variety assessed in a relative bilateral setting:

$$\ln\left(\frac{EV_{it}}{EV_{jt}}\right) = \alpha + \beta_1 \ln\left(\frac{Y_{it}/L_{it}}{Y_{jt}/L_{jt}}\right) + \beta_2 \ln\left(\frac{L_{it}}{L_{jt}}\right) + D_{it} + D_{jt} + \varepsilon_{ijt} \quad (2)$$

where bilateral differences in export variety, *EV*, between countries i and j at time t, with $EV = \{N, 1/Theil, 1/Gini, 1/HH\}$ are a function of bilateral differences in productivity $\left(\frac{Y_{it}}{L_{it}}/\frac{Y_{jt}}{L_{jt}}\right)$ and in labour force size (L_{it}/L_{jt}). Time- and country specific fixed effects D_{it} and D_{jt}, included in all the empirical specifications, capture business-cycle fluctuations, and control for omitted characteristics of reporting countries (and their partners) that may affect export variety patterns.[20] In particular, they help to take into account time varying multilateral resistance effects, addressing the problem of omitted bilateral/multilateral relationships and interactions across countries in the trade pattern. We have also considered the

[18] We refer here to the historical (year-specific) classification of the World Bank (see Section 3.1) and it is possible that today the countries are in a different income category. This is the case, for instance, of Equatorial Guinea, which since 2015 has been classified as upper-middle rather than high-income, as before.

[19] See Cieslik and Parteka (2018: 7–14) for the model propositions and the exact derivation of an empirical specification of the relative diversification model. In their setting each country is analysed relative to the RoW, but with a bilateral robustness check.

[20] In one of the robustness checks we consider the model with separate time- and country-specific fixed effects: D_t, D_i and D_j (see Table 11A in the Appendix).

specification a'la Regolo (2013) with a set of variables typical for classic gravity models (bilateral trade costs and trade agreement indicators, plus such bilateral control variables as distance, contiguity, common language and common currency, all from CEPII). Their inclusion in the model does not significantly change the essential results (Table 5A), but such a specification does make the interpretation of bilateral variables in our mixed model context less straightforward, so we leave them out in the subsequent specifications.

Next, the model is extended to other sources of dissimilarity that may potentially drive differences in export basket heterogeneity:

$$\ln\left(\frac{EV_{it}}{EV_{jt}}\right) = \alpha + \beta_1 \ln\left(\frac{Y_{it}/L_{it}}{Y_{jt}/L_{jt}}\right) + \beta_2 \ln\left(\frac{L_{it}}{L_{jt}}\right) + \gamma \ln\left(\frac{\varphi_{it}}{\varphi_{jt}}\right) + D_{it} + D_{jt} + \varepsilon_{ijt}. \quad (3)$$

where φ incorporates the following variables: capital (K), land area - territory size (T) as an alternative to L, human capital (HC), natural resource abundance measured in terms of fuel products (F) and minerals (M), as well as trade costs (TC).[21] In the estimation we consider the difference in the logarithms of relative endowments and other variables.

Table 2 reports the estimation results taking the two main explanatory variables of model (1) – relative productivity and labour force size – one by one; Table 3 refers to the joint estimate. We confirm that bilateral differences in EV relate to cross-country dissimilarities in productivity and labour force size. That is, countries characterized by significant differences in technology and labour force size are likely to differ in export variety. For instance, the joint specification (Table 3, column 1) shows that a 10% increase in relative productivity similarity implies an increase in relative quantity of exported products (N) of 5.6%, while, ceteris paribus, a 10% increase in the size difference is related to an increase in the difference between N_i and N_j of 3.5%. Using measures of export concentration (columns 2–4) the outcome is analogous: larger bilateral differences in productivity and in labour force are associated with more pronounced differences in the concentration of their export baskets.

Given that the correlations between the various EV measures are high (Table 3A in the Appendix) and, additionally, they yield analogous results (the sign, the values cannot be directly compared), we retain only the export variety measure based on the Theil index ($EV = 1/Theil$) in the discussion and the results shown in the main text.[22] This allows comparison of our results with those of related papers that also use the Theil measure (among others: Regolo, 2013).

Table 4 shows the estimation results for the augmented model (3). Note that the numbers of observations and country pairs available are significantly lower in some of the augmented specifications, owing to the limited data availability. Unlike country size (measured alternatively also in terms of land area – column 3), productivity differentials prove to be a robust source of bilateral differences in export variety. Additionally, the greater the differences in capital (both physical, K, and human, HC), the greater the dissimilarity in export variety. As expected, major dependence on natural resources (minerals, M, and fuel, F) lead to lower export variety (column 6 and 7).

3.3.2. Extensions: results by income group and the role of trade costs

Since what we are interested in is the drivers of export variety differences between countries at different development stages, we now split the reporting countries (i) and trading partners (j) into three income groups (low, middle and high). We use the World Bank's year-specific taxonomy because countries may move between groups. Table 5 refers to models (2) and (3) estimated within and between the subgroups of countries (with a particular focus on low- and middle-income economies). Panel A corresponds to the basic results given in Table 2, while Panel B relates to the augmented specification, which also takes account of dissimilarities in physical and human capital, as well as in fuel exports (Y/L is here omitted due to its high correlations with the other explanatory variables – see Table 4A).

Dissimilarities in the size of countries (L) are always statistically significant, both within and between income groups. Differences in Y/L drive bilateral differentials in export variety within groups (except high income countries assessed in a narrow specification - column 1a) and between them. Importantly, in the light of the results reported in columns 4a and 5a, productivity differentials play a significant role in determining the differences in export variety between low income - and middle or high income economies. As far as other sources of export variety differentials between pairs of countries in different income groups are concerned, the differences in labour force size, human capital and fuel dependency (columns 4 b, 5 b, 6 b). The latter (F), as expected, reduces relative export variety because provokes major export concentration.

The next step consists in assessing the role of trade costs. Table 6 reports the results when the model is augmented by various measures of trade cost differentials – TC alternated with $\{TC^{BC}, TC^{DC}\}$.

$$\ln\left(\frac{EV_{it}}{EV_{jt}}\right) = \alpha + \beta_1 \ln\left(\frac{Y_{it}/L_{it}}{Y_{jt}/L_{jt}}\right) + \beta_2 \ln\left(\frac{L_{it}}{L_{jt}}\right) + \gamma_1 \ln\left(\frac{TC_{it}}{TC_{jt}}\right) + D_{it} + D_{jt} + \varepsilon_{ijt}. \quad (4)$$

Unsurprisingly, the results indicate that relatively larger trade costs lead to lower export variety. We can quantify this effect quite precisely (column 1): after controlling for the bilateral differences in productivity and labour force size (and other country characteristics captured by reporting country and partner dummies), a 10% decrease in the relative trade cost implies almost 2% increase in relative export variety.[23]

3.3.3. Robustness checks

Given that a good part of the diversification literature (following the 'stages of diversification' approach, Imbs and Wacziarg, 2003) explores the relationship between export variety and per capita income, we have replaced $\frac{Y_{it}/L_{it}}{Y_{jt}/L_{jt}}$ in model (2) by bilateral differences in GDP per capita (results in Table 6A in the Appendix).

Additionally, we repeated the estimations excluding potentially enormous outliers for size like China and India (Table 7A) and re-estimated the main model using subsamples of countries (Table 8A), excluding other potential outliers – very large economies other than China and India, small states with limited possibilities for diversification, or countries with abundant fuel resources and accordingly highly concentrated export baskets (which generates large bilateral differences in the dependent variable). The main result is a positive relationship between the bilateral differences in productivity and in labour force size on one side, and those in export variety on the other.

We have also checked the effect of different measures of human capital. As Table 9A shows, the relationship between bilateral differentials in productivity and in export variety is robust (in view of the close correlation between human capital measured by employment and by

[21] To check the variation of the explanatory variables present in the empirical models over time, we have estimated time trend models using the data for all the countries in our sample. The results are shown in Table 12A in the Appendix.

[22] The results obtained with the other measures can be obtained upon request.

[23] In terms of magnitude it is difficult to compare this result directly with other studies, because these have assessed the effect of trade costs on levels of export diversification and not on export variety differentials. Dennis and Shepherd (2011), who analysed a sample of 118 developing countries, found that 10 per cent decreases in international transport costs and domestic costs of exporting imply gains in export diversification of 4 and 3 per cent, respectively. Persson (2013) concludes that in the case of developing countries' exports to the EU, a 10 per cent decline in export transaction costs is associated with a 6 per cent rise in the number of differentiated products exported and 3 per cent for homogeneous products. Feenstra and Ma (2014) estimate that a rise in bilateral port efficiency by 10% translates into export variety higher by 1.5%–3.4%, while tariffs discourage greater export variety.

Table 2
Bilateral differences in export variety (EV) vs. bilateral dissimilarities in productivity and in labour force - alternative *EV* measures.

	Dep.var.: $\ln\left(\frac{EV_{it}}{EV_{jt}}\right)$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	EV = N	*EV = 1/Theil*	*EV = 1/Gini*	*EV = 1/HH*	*EV = N*	*EV = 1/Theil*	*EV = 1/Gini*	*EV = 1/HH*
$\ln\left(\frac{Y_{it}}{L_{it}}/\frac{Y_{jt}}{L_{jt}}\right)$	0.519***	0.155***	0.019***	0.489***				
	[0.005]	[0.002]	[0.000]	[0.008]				
$\ln\left(\frac{L_{it}}{L_{jt}}\right)$					0.332***	0.102***	0.013***	0.320***
					[0.003]	[0.001]	[0.000]	[0.005]
R^2	0.322	0.212	0.231	0.16	0.326	0.23	0.247	0.169
Observations - n	452790	452790	452790	452790	452790	452790	452790	452790
No of country pairs	16770	16770	16770	16770	16770	16770	16770	16770

Note: Bilateral panel regression (whole sample: 130 reporters and 129 partners, 1988–2014).*, ** and *** denote significance at 10%, 5% and 1% level, respectively. Robust clustered standard errors in parentheses. Time varying reporter (*i*) and partner (*j*) fixed effects included in all models. Dependent variable based on: the number of active export lines, *N* (column 1, 5), the inverse of export concentration measures, *Theil*, *Gini* and *HH* (columns 2–4, 6–8).
Source: own calculations

Table 3
Bilateral differences in export variety (EV) vs. jointly considered bilateral dissimilarities in productivity and in labour force - alternative *EV* measures.

	Dep.var.: $\ln\left(\frac{EV_{it}}{EV_{jt}}\right)$			
	(1)	(2)	(3)	(4)
	EV = N	*EV = 1/Theil*	*EV = 1/Gini*	*EV = 1/HH*
$\ln\left(\frac{Y_{it}}{L_{it}}/\frac{Y_{jt}}{L_{jt}}\right)$	0.559***	0.167***	0.021***	0.528***
	[0.003]	[0.002]	[0.000]	[0.007]
$\ln\left(\frac{L_{it}}{L_{jt}}\right)$	0.357***	0.110***	0.013***	0.344***
	[0.002]	[0.001]	[0.000]	[0.004]
R^2	0.696	0.474	0.51	0.353
Observations - n	452790	452790	452790	452790
No of country pairs	16770	16770	16770	16770

Note: Bilateral panel regression (whole sample: 130 reporters and 129 partners, 1988–2014).*, ** and *** denote significance at 10%, 5% and 1% level, respectively. Robust clustered standard errors in parentheses. Time varying reporter (*i*) and partner (*j*) fixed effects included in all models. Dependent variable based on: the number of active export lines, *N* (column 1), the inverse of export concentration measures, *Theil*, *Gini* and *HH* (columns 2–4).
Source: own calculations

labour force size, the latter has been omitted - see Table 4A).

As an additional robustness check, Table 10A in the Appendix reports the results obtained with alternative estimators (Poisson and FPML estimation, Silva et al., 2014) that take account of the fact that the dependent variable is constructed on the basis of doubly bounded export data (below by zero, above by the number of categories in trade products' classification). We have also estimated a model with another structure of fixed effects: D_t, D_i and D_j (Table 11A in the Appendix). Finally, Following Regolo (2013: 334) and Baltagi et al. (2003), we have considered the absolute difference in the dependent variable and in the logarithms of relative endowments and other explanatory variables (Table 13A). All these estimations too produce results similar to the benchmark (Table 3) and the role of bilateral differences in productivity and size is confirmed.

4. Conclusions

This paper can be placed at the intersection between the studies on factors influencing the extensive margin of trade and the literature on the determinants of trade diversification, but from a perspective that has been largely neglected to date in the empirical literature on trade diversification. That is, we examine the magnitude of bilateral differences in export variety between country pairs and the factors that affect

Table 4
Bilateral differences in export variety (EV) vs. jointly considered bilateral similarities in productivity, labour force and other endowments.

	Dep.var.:$\ln\left(\frac{EV_{it}}{EV_{jt}}\right), EV = 1/Theil$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\ln\left(\frac{Y_{it}}{L_{it}}/\frac{Y_{jt}}{L_{jt}}\right)$	0.139***	0.050***	0.165***	0.030***		0.084***	0.100***
	[0.004]	[0.002]	[0.002]	[0.003]		[0.003]	[0.005]
$\ln\left(\frac{L_{it}}{L_{jt}}\right)$	0.085***			0.108***	0.097***	0.130***	0.121***
	[0.003]			[0.001]	[0.003]	[0.001]	[0.002]
$\ln\left(\frac{K_{it}}{K_{jt}}\right)$	0.025***	0.106***			0.009***		
	[0.003]	[0.001]			[0.003]		
$\ln\left(\frac{T_{it}}{T_{jt}}\right)$			0.039***				
			[0.001]				
$\ln\left(\frac{HC_{it}}{HC_{jt}}\right)$				0.714***	0.779***	0.617***	0.482***
				[0.012]	[0.011]	[0.013]	[0.017]
$\ln\left(\frac{F_{it}}{F_{jt}}\right)$						−0.041***	−0.049***
						[0.001]	[0.001]
$\ln\left(\frac{M_{it}}{M_{jt}}\right)$							−0.016***
							[0.001]
R^2	0.475	0.463	0.26	0.57	0.567	0.616	0.609
Observations - n	452790	452790	452790	353970	353970	236810	116398
No of country pairs	16770	16770	16770	13110	13110	12600	7952

Note. Bilateral panel regression (whole sample: 130 reporters and 129 partners, 1988–2014; n varies due to limited availability of some regressors)*, ** and *** denote significance at 10%, 5% and 1% level, respectively. Robust clustered standard errors in parentheses. Time varying reporter (*i*) and partner (*j*) fixed effects included in all models. *K*- capital, *T*-territory (arable land), *HC* – human capital; *F*- Fuel (as% of merchandise exports), *M* – mineral rents (as % of GDP).
Source: own calculations

Table 5
Countries split by income: bilateral differences in export variety (EV) and jointly considered similarities in productivity, labour force and other endowments.

Panel A.	Within income groups			Between income groups		
Dep.var.: $\ln\left(\frac{EV_{it}}{EV_{jt}}\right) EV = 1/Theil$	*i*: high income *j*: high income	*i*: middle income *j*: middle income	*i*: low income *j*: low income	*i*: low income *j*: middle income	*i*: low income *j*: high income	*i*: middle income *j*: high income
	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)
$\ln\left(\frac{Y_{it}}{L_{it}}/\frac{Y_{jt}}{L_{jt}}\right)$	−0.01	0.081***	0.141***	0.106***	0.114***	0.078***
	[0.016]	[0.006]	[0.004]	[0.006]	[0.008]	[0.010]
$\ln\left(\frac{L_{it}}{L_{jt}}\right)$	0.140***	0.080***	0.088***	0.083***	0.111***	0.103***
	[0.003]	[0.002]	[0.002]	[0.002]	[0.003]	[0.002]
R^2	0.763	0.248	0.458	0.311	0.673	0.561
Observations	27338	83570	43968	59946	33926	48670
No of country pairs	1716	5806	2634	3762	2024	3212
Panel B.	Within income groups			Between income groups		
Dep.var.: $\ln\left(\frac{EV_{it}}{EV_{jt}}\right) EV = 1/Theil$	*i*: high income *j*: high income	*i*: middle income *j*: middle income	*i*: low income *j*: low income	*i*: low income *j*: middle income	*i*: low income *j*: high income	*i*: middle income *j*: high income
	(1 b)	(2 b)	(3 b)	(4 b)	(5 b)	(6 b)
$\ln\left(\frac{L_{it}}{L_{jt}}\right)$	0.049**	0.119***	0.102***	0.121***	0.121***	0.113***
	[0.020]	[0.006]	[0.007]	[0.007]	[0.010]	[0.009]
$\ln\left(\frac{K_{it}}{K_{jt}}\right)$	0.109***	−0.003	0.021***	−0.005	0.028***	0.025***
	[0.020]	[0.006]	[0.007]	[0.007]	[0.011]	[0.009]
$\ln\left(\frac{HC_{it}}{HC_{jt}}\right)$	0.381***	0.586***	0.384***	0.537***	0.391***	0.550***
	[0.055]	[0.024]	[0.027]	[0.027]	[0.039]	[0.033]
$\ln\left(\frac{F_{it}}{F_{jt}}\right)$	−0.063***	−0.045***	−0.010***	−0.026***	−0.030***	−0.053***
	[0.003]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]
R^2	0.622	0.452	0.589	0.485	0.593	0.551
Observations	25448	47578	11626	23288	17093	35698
No of country pairs	1552	3908	1456	2358	1499	2503

Note: Bilateral panel regression - sample splits into income groups according to historical (year specific) World Bank's classifications.*, ** and *** denote significance at 10%, 5% and 1% level, respectively. Robust clustered standard errors in parentheses. 1a, 5a, 6a additionally controlled for *F*. Time varying reporter (*i*) and partner (*j*) fixed effects included in all models.
Source: own calculations

Table 6
Bilateral differences in export variety (EV) – similarities in productivity, labour force and the role of trade costs (all sample and countries split by income).

Dep.var. $\ln\left(\frac{EV_{it}}{EV_{jt}}\right) EV = 1/Theil$	(1) all sample	(2) all sample	(3) all sample	(4) *i*: high income	(5) *i*: middle income	(6) *i*: low income
$\ln\left(\frac{Y_{it}}{L_{it}}/\frac{Y_{jt}}{L_{jt}}\right)$	0.100***	0.103***	0.097***	0.072***	0.082***	0.093***
	[0.002]	[0.002]	[0.002]	[0.005]	[0.003]	[0.004]
$\ln\left(\frac{L_{it}}{L_{jt}}\right)$	0.095***	0.082***	0.088***	0.137***	0.074***	0.088***
	[0.001]	[0.001]	[0.001]	[0.002]	[0.001]	[0.002]
$\ln\left(\frac{TC_{it}}{TC_{jt}}\right)$	−0.189***			−0.140***	−0.256***	−0.142***
	[0.004]			[0.010]	[0.005]	[0.006]
$\ln\left(\frac{TC_{it}^{BC}}{TC_{jt}^{BC}}\right)$		−0.120***				
		[0.003]				
$\ln\left(\frac{TC_{it}^{DC}}{TC_{jt}^{DC}}\right)$			−0.132***			
			[0.003]			
R^2	0.447	0.421	0.459	0.392	0.442	0.428
Observations	160104	14520	14280	47132	74670	38302
No of country pairs	16770	14520	14280	5676	9131	5105
Time	2005–2014	2014	2014	2005–2014	2005–2014	2005–2014

Note. Bilateral panel regression (n varies due to limited variability of some regress *, ** and *** denote significance at 10%, 5% and 1% level, respectively. Robust clustered standard errors in parentheses. Time varying reporter (*i*) and partner (*j*) fixed effects included in all models (except columns 2 and 3 – data for TC_{BC} and TC_{DC} for 2014 only). Data for *TC* available only for 2005–2014.
Source: own calculations.

it. This perspective connects the literature assessing the determinants of export diversification patterns from the exporter's standpoint only with work on the factors determining the variety in bilateral export flows in the spirit of the gravity models.

This study exploits a rich panel database composed of 16,770 country pairs (130 reporting countries and 129 partners, at different levels of economic development) for which we measure export variety using product level trade data (HS six digit) in the years 1988–2014. Relative export diversification is empirically modelled as a function of bilateral differences in size and technology, together with differences in endowments and trade costs.

To our mind, the analysis presented here contributes to the expanding empirical literature on export diversification and cross-country trade structures' similarity. Our results should be read in relation to one of the key problems of developing countries – lack of export variety and risky concentration of export baskets. We have explored the full structure of relative differences between countries and the results indicate that apart from factors that are difficult to be changed (such as country size), bilateral differences in the heterogeneity of export baskets are determined primarily by disparities in productivity. We have checked whether

this relationship holds both within and between income groups. Bilateral regressions suggest that cross-country dissimilarities in export variety visible between low income- and high/middle-income economies are indeed driven by bilateral differences in technology (measured as labour productivity). In terms of policy, this implies that it is highly needed to promote successful technological convergence. This will enhance the reduction of export variety dissimilarities between low income countries, facing excessive export concentration, and richer economies.

Still, there remain important areas for further research, mainly relating to the theoretical modelling of export variety patterns and the link between export diversification and value added trade.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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References

Acemoglu, D., Ventura, J., 2002. The world income distribution. Q. J. Econ. 117 (2), 659–694.
Agosin, M.R., Alvarez, R., Bravo-Ortega, C., 2012. Determinants of export diversification around the world: 1962–2000. World Econ. 35 (3), 295–315.
Baltagi, B.H., Egger, P., Pfaffermayr, M., 2003. A generalized design for bilateral trade flow models. Econ. Lett. 80 (3), 391–397.
Barro, R.J., Lee, J.W., 2013. A new data set of educational attainment in the world, 1950–2010. J. Dev. Econ. 104, 184–198.
Basile, R., Parteka, A., Pittiglio, R., 2018. Export diversification and economic development: a dynamic spatial data analysis. Rev. Int. Econ. 26 (3), 634–650.
Besedeš, T., Prusa, T.J., 2011. The role of extensive and intensive margins and export growth. J. Dev. Econ. 96 (2), 371–379.
Bleaney, M., Greenaway, D., 2001. The impact of terms of trade and real exchange rate volatility on investment and growth in sub-Saharan Africa. J. Dev. Econ. 65 (2), 491–500.
Broda, C., Weinstein, D.E., 2006. Globalization and the gains from variety. Q. J. Econ. 121 (2), 541–585.
Cadot, O., Carrère, C., Strauss-Kahn, V., 2011. Export diversification: what's behind the hump? Rev. Econ. Stat. 93 (2), 590–605.
Caselli, F., Koren, M., Lisicky, M., Tenreyro, S., 2020. Diversification through trade. Q. J. Econ. 135 (1), 449–502.
Cieslik, A., Parteka, A., 2018. Export variety, productivity, and country size in a multi-good Ricardian model of export diversification. GUT FME Working Paper Series A No 6/2018 (52).
Coniglio, N.D., Vurchio, D., Cantore, N., Clara, M., 2018. On the Evolution of Comparative Advantage: Path-dependent versus Path-Defying Changes. SERIES Working Papers N. 01/2018. Available at: https://ssrn.com/abstract=3136471.
De Benedictis, L., Gallegati, M., Tamberi, M., 2009. Overall trade specialization and economic development: countries diversify. Rev. World Econ. 145 (1), 37–55.
Dennis, A., Shepherd, B., 2011. Trade facilitation and export diversification. World Econ. 34 (1), 101–122.
Dornbusch, R., Fischer, S., Samuelson, P.A., 1977. Comparative advantage, trade, and payments in a Ricardian model with a continuum of goods. Am. Econ. Rev. 67 (5), 823–839.
Dutt, P., Mihov, I., Van Zandt, T., 2013. The effect of WTO on the extensive and the intensive margins of trade. J. Int. Econ. 91 (2), 204–219.
Eaton, J., Kortum, S., 2002. Technology, geography, and trade. Econometrica 70 (5), 1741–1779.
Feenstra, R., Kee, H.L., 2004. On the measurement of product variety in trade. Am. Econ. Rev. 94 (2), 145–149.
Feenstra, R., Kee, H.L., 2008. Export variety and country productivity: estimating the monopolistic competition model with endogenous productivity. J. Int. Econ. 74 (2), 500–518.
Feenstra, R.C., Ma, H., 2014. Trade facilitation and the extensive margin of exports. Jpn. Econ. Rev. 65 (2), 158–177.
Feenstra, R.C., 2018. Alternative sources of the gains from international trade: variety, creative destruction, and markups. J. Econ. Perspect. 32 (2), 25–46.
Feenstra, R.C., Inklaar, R., Timmer, M.P., 2015. The next generation of the Penn world table. Am. Econ. Rev. 105 (10), 3150–3182 available for download at. www.ggdc.net/pwt.
Frankel, J.A., 2010. The Natural Resource Curse: a Survey. NBER Working Paper No. 15836. National Bureau of Economic Research.
Ghosh, A.R., Ostry, J.D., 1994. Export instability and the external balance in developing countries. IMF Staff Pap. 41 (2), 214–235.
Haddad, M., Lim, J.J., Pancaro, C., Saborowski, C., 2013. Trade openness reduces growth volatility when countries are well diversified. Canadian Journal of Economics/Revue canadienne d'économique 46 (2), 765–790.
Hausmann, R., Klinger, B., 2007. The Structure of the Product Space and the Evolution of Comparative Advantage (No. 146). Center for International Development at Harvard University.
Head, K., Mayer, T., 2014. Gravity equations: workhorse, toolkit, and cookbook. In: Handbook of International Economics, vol. 4. Elsevier, pp. 131–195.
Hidalgo, C.A., Klinger, B., Barabási, A.L., Hausmann, R., 2007. The product space conditions the development of nations. Science 317 (5837), 482–487.
Hummels, D., Klenow, P.J., 2005. The variety and quality of a nation's exports. Am. Econ. Rev. 95 (3), 704–723.
Imbs, J., Wacziarg, R., 2003. Stages of diversification. Am. Econ. Rev. 93 (1), 63–86.
Jetter, M., Ramírez Hassan, A., 2015. Want export diversification? Educate the kids first. Econ. Inq. 53 (4), 1765–1782.
Kehoe, T.J., Ruhl, K.J., 2013. How important is the new goods margin in international trade? J. Polit. Econ. 121 (2), 358–392.
Kramarz, F., Martin, J., Mejean, I., 2020. Volatility in the small and in the large: the lack of diversification in international trade. J. Int. Econ. 122, 103276.
Lectard, P., Rougier, E., 2018. Can developing countries gain from defying comparative advantage? Distance to comparative advantage, export diversification and sophistication, and the dynamics of specialization, 102. World Development, pp. 90–110.
Lederman, D., Maloney, W.F. (Eds.), 2007. Natural Resources, Neither Curse Nor Destiny. The World Bank & Stanford University Press.
Martincus, C.V., Carballo, J., 2008. Is export promotion effective in developing countries? Firm-level evidence on the intensive and the extensive margins of exports. J. Int. Econ. 76 (1), 89–106.
Mau, K., 2016. Export diversification and income differences reconsidered: the extensive product margin in theory and application. Rev. World Econ. 152 (2), 351–381.
Naito, T., 2017. An Eaton–Kortum model of trade and growth. Canadian Journal of Economics/Revue canadienne d'économique 50 (2), 456–480.
Newfamer, R., Shaw, W., Walkenhorst, P. (Eds.), 2009. Breaking into New Markets: Emerging Lessons for Export Diversification. The World Bank.
Ossa, R., 2015. Why trade matters after all. J. Int. Econ. 97 (2), 266–277.
Ouedraogo, R., Sourouema, W.S., 2018. Fiscal policy pro-cyclicality in Sub-Saharan African countries: the role of export concentration. Econ. Modell. 74, 219–229.
Parteka, A., 2010. Employment and export specialisation along the development path: some robust evidence. Rev. World Econ. 145 (4), 615–640.
Parteka, A., Tamberi, M., 2013a. Product diversification, relative specialisation and economic development: import–export analysis. J. Macroecon. 38, 121–135.
Parteka, A., Tamberi, M., 2013b. What determines export diversification in the development process? Empirical assessment. World Econ. 36 (6), 807–826.
Persson, M., 2013. Trade facilitation and the extensive margin. J. Int. Trade Econ. Dev. 22 (5), 658–693.
Persson, M., Wilhelmsson, F., 2016. EU trade preferences and export diversification. World Econ. 39 (1), 16–53.
Regolo, J., 2013. Export diversification: how much does the choice of the trading partner matter? J. Int. Econ. 91 (2), 329–342.
Regolo, J., 2017. Manufacturing export diversification and regionalization of trade: which destinations for newly exported goods? International Economics 151, 26–47.
Romalis, J., 2004. Factor proportions and the structure of commodity trade. Am. Econ. Rev. 94 (1), 67–97.
Schott, P.K., 2003. One size fits all? Heckscher-Ohlin specialization in global production. Am. Econ. Rev. 93 (3), 686–708.
Shikher, S., 2013. Determinants of trade and specialization in the organisation for economic Co-operation and development countries. Econ. Inq. 51 (1), 138–158.
Sheng, L., Yang, D.T., 2016. Expanding export variety: the role of institutional reforms in developing countries. J. Dev. Econ. 118, 45–58.
Silva, J.S., Tenreyro, S., Wei, K., 2014. Estimating the extensive margin of trade. J. Int. Econ. 93 (1), 67–75.
UNCTAD, 2018. Exports Diversification and Employment in Africa. https://unctad.org/en/PublicationsLibrary/aldc2018d3_en.pdf.