Economic Development and Export Diversification: The Role of Trade Costs

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Abstract

As exports grow, export diversification tends to increase in developing countries, but decrease in high-income countries. We offer a novel explanation for this pattern of export diversification observed across countries. We examine how the effect of transportation costs on export diversification vary with the level of economic development. Using trade and trade cost data, we find that transportation costs impact export diversification in developing countries, primarily. Higher transportation costs do not reduce high income countries' ability to add new export products, or increase export value for existing trade linkages. For developing countries, on the other hand, higher variable transportation costs negatively affect all of these, when compared with high income countries. Our findings are related to and have implications for the debate on whether economic growth requires diversification, or whether diversification should come before growth.

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I Introduction

Low-income countries have export portfolios and economies that are vastly more concentrated than their higher-income peers. The large gap in economic diversification features in papers that link diversification to growth (e.g., Hummels and Klenow, 2005), and more descriptive studies of exports that tread diversification as endogenous (e.g., Cadot, Carrère, and Strauss-Kahn, 2011). Causal or otherwise, most studies agree on a positive association between diversification and export growth. These include work that show export diversity as a crucial growth determinant for low-income countries (Eicher and Kuenzel, 2016). In Europe, export growth over 1995-2015 was associated with a slightly higher level of export diversification (at the HS8 level) with a few exceptions (Kaitila, 2019). Similarly, as middle income countries have grown, they have diversified (Hanson, 2012).[1]

Falling transport costs always top the list of reasons for the steady growth of global trade in the past decades (Hummels, 2007). Given that we have long-standing evidence that a non-trivial share of the differences in export growth between countries is on the extensive margin (e.g., Hummels and Klenow, 2005; Mora and Olabisi, 2021), it is reasonable to expect that transport costs may play a part in which products are added or dropped from a country's portfolio as it diversifies, or which destinations are added for existing products. Nothing in this paper excludes other proposed rationales for increased trade, including telecommunications advances (e.g. Lincoln and McCallum, 2018), trade agreements, and aggregate income growth at the global scale (Mora and Olabisi, 2020). Nevertheless, we have found no papers that document how trade costs affect the diversification efforts of low-income countries.

In this paper, we study the role transportation costs play in diversification – with a focus on the extensive margin of export growth, as countries add and drop destinations and products from their export portfolios. The question is motivated by the gap in the literature that we noted above, and the stark contrasts in the data on export diversification. The average high-income country exports products in more than 2,500 HS6 categories, several times the number for low-income countries. The differences are even more notable when one considers the concentration indexes: no product category accounted for more than 5% of US exports in 2016, while 74% of Nigeria's exports in the same year were from one product – crude oil.

[1] At least one sttudy suggests that causality goes both ways between GDP per capita and export diversification (Mau, 2016).

We find that the effects of transportation costs on diversification depend on the level of economic development. First, LDCs, unlike HICs, are negatively affected by high transportation costs. Compared to HICs, higher transpiration costs for these countries predict lower probabilities of adding a product, lower probabilities of increasing export values, and lower export growth. The estimated effect of transport costs on diversification for MICs is similar to LDCs. The effects are somewhat muted for incumbent trade linkages in MICs. The link between transportation costs and the variables of interest is weaker for HICs . There is a slight positive estimate for the probability of adding a product and for increasing export values on incumbent trade linkages. The positive estimates arguably reflect the lower competition for HICs in serving product-markets with high transportation costs.[2]

We use a combination of two data sources – the BACI dataset for trade between countries at the detailed HS6 product level, and the UNCTAD Trade Costs Database. The BACI dataset allows us to measure diversification at the detailed product level by showing the value of trade between country pairs and how the number of products and destinations change over time. The dependent variables ADD and INC (Increase) are dummies equal to 1 if a linkage was added, or if an incumbent linkage increased between 1996 and 2016. We also use the percentage change in the export value from 1996 to 2016 as an outcome variable (VAL). The change was measured as the midpoint growth rate. The UNCTAD Trade Costs Database shows estimates of trade costs for each product traded between country pairs in 2016. Transportation costs in the data are measured as the difference between the reported Cost-Insurance and Freight (CIF) basis of trade, and the Free-on-Board (FOB). The variable used in our analysis is trade cost's share of exported value $(CIF - FOB)/FOB$.

As expected, we find that the estimated effects of trade costs on diversification vary by sector. Sectors 2, 3, 5, 6 and 9 have negative estimated effects of costs on the addition of new trade linkages, for our baseline category of high-income countries. (Sectors 4 and 8 – Oils, fats, waxes and Miscellaneous manufactured articles, have positive and statistically significant estimates for the same). More notably, compared with HICs, higher transport costs predict lower trade linkage additions for MICs across all sectors except for sector 3 (Mineral fuels, lubricants and related materials), where the estimated effect is not significant at the 5% level. We find a similar pattern, but with fewer statistically significant estimates for LDCs. The finding of

[2]Our findings are consistent with a related paper that shows a weak-to-no effect of export diversity on growth for high-income countries, and a relatively high effect for low income countries (Eicher and Kuenzel, 2016).

differences across sectors is consistent with earlier papers that show growth for some sectors with diversification, and the converse, or growth with specialization for others (Jongwanich, 2020).

Our findings are relevant to policy because export diversification is strongly linked to economic growth, as documented in several notable papers in the literature. In one paper, a one standard deviation increase in trade partner diversification is associated with a 1 to 1.5 percentage point increase in the annual income growth rate (Onder and Yilmazkuday, 2016). Other papers show that export specializations do not last for long, nor do they contribute consistently to growth (Daruich, Easterly, and Reshef, 2019).

Possible policy implications of our work relate to the necessity of investments countries can make in infrastructure or technologies that lower transportation costs. We expect our work to also inform the response of developing countries to aid-based policies intended to support economic diversification. Most notable among current policies to address this goal are trade preferences policies. Some, like the Generalized System of Preferences (GSP), have been shown to help developing economies, while others like the ACP, have not (Persson and Wilhelmsson, 2016). There is broad agreement in the literature that improving market access helps exports from developing countries (Nicita and Rollo, 2015). For example, AGOA helped to diversify African exports (Cook and Jones, 2015). In the same way, trade facilitation improves export diversification (Beverelli, Neumueller, and Teh, 2015), and lowers trade costs (Saslavsky and Shepherd, 2012; Dennis and Shepherd, 2011).[3]

Our work build on previous studies that undertake a broad exploration of the determinants and impacts of diversification (e.g., Parteka and Tamberi, 2013; Agosin, Alvarez, and Bravo-Ortega, 2012). The literature includes evidence that export diversification depends on countries' trade partners (Regolo, 2013). That finding is consistent with our work, to the extent that transport costs vary by destination country. Other destination-country related features, like the economic growth of the trade partner, may also matter. In related work, Africa's trade with China appeared to help its economic growth more than trade with the US or EU (Mullings and Mahabir, 2018). Along those lines, others find that resource-dependent countries find it hard to diversify their economies and exports. For one, oil-booms reduce export diversity (Djimeu and Omgba, 2019; Wiig and Kolstad, 2012).

[3]Export diversification may have implications for poverty in developing countries (Gnangnon, 2021). The endogenous nature of diversification is revealed in studies that say it calls for deep structural change, like updating the system of basic education (Jetter and Ramírez Hassan, 2015).

II Theoretical Framework

Model: Here is an outline what is important is to first establish that observed transportation can be explained in part by bilateral features (like distance), or the share of goods that move with certain modes of transport. Other parts are idiosyncratic - like the nature of the good, so transporting steel may be cheaper than transporting flowers, just as transporting steel may be more expensive than transporting a low-density non-perishable item like aluminium. Others may be even more idiosyncratic, in that shipping flowers to the relatively hotter Egypt, may be more expensive than to the relatively colder Norway. So the thought is that a model for our paper should show diversification as a process for firms to find growth by exploring the options for possibly buyers subject to the Zero-Profit-Condition. This may be as simple as shipping existing products to new destinations, subject to the additional costs of transport not exceeding the marginal profit from that destination.

The last point calls for a data question - do we have price indexes for the export linkages? That is, do we know whether flour shipped from the UK cost more FOB per kg, than say flour shipped from Mexico? If so, the 'quality' or branding difference that allows UK firms to charge higher prices, also means that they have more of a profit margin to spare on more costly or distant destinations. If we do not have the price index data – we may need some other tool for identification, which may have to do with differences in the portfolio of goods shipped from each country.

It is also important to look for data on trade costs over time. This is because important considerations like whether trans costs are driven largely by scale. That is, whether shipping wine to the US per bottle from France is cheaper than from Portugal, simply because more bottles are shipped from France. Such cross-sectional comparisons are hard to justify in the absence of evidence that linkages that saw more trade growth, also saw transport costs fall more.

The policy-point of the paper is calling for public investments to lower transportation costs, as those will lead to more trade gains from LDCs and MICs. We might also try to motivate the paper by looking for data (think about Hummels and others), that show [1] falling trade costs drive much of the global growth in trade [2] costs have not fallen uniformly - some countries have seen transport costs fall much more than others. Conditional on finding such data, and making some kind of graph, we could further bolster the point by contrasting how transport costs have changes with how tariffs have fallen.

II.a Consumers

Consumer preferences in all countries are defined by a standard constant elasticity of substitution (CES) utility function over varieties. Solving the consumer's problem and aggregating over all consumers, gives us the demand for variety ω: $q_l(\omega) = A_l p(\omega)^{-\sigma}$. A is the demand shifter, p is the price, and σ is the elasticity of substitution.

II.b Firms

Firms pay F_E to enter the market and get a cost draw (a), where a is the labor needed to produce one unit. Conditional on exporting to market l from j, firms must pay a fixed cost (F_{jl}) and iceberg trade costs (d_{jl}). For a firm with unit labor requirement, a, we get the following when defining $\lambda = \left(\frac{1}{\sigma}\right)^{\sigma}\left(\frac{1}{\sigma-1}\right)^{1-\sigma}$:

Variable profit from exporting is written as:

$$\pi_{jl}(a) = A_l \lambda \left(d_{jl} a\right)^{1-\sigma}$$

Export revenue is similarly written as:

$$v_{jl}(a) = A_l \lambda \left(d_{jl} a\right)^{1-\sigma} \sigma$$

The productivity cutoff to export from j to l is determined by the zero profit condition; $\pi_{jl}(a^*) = F_{jl}$. The productivity cutoff to every country l can be defined as follows:

$$a_{jl}^* \equiv \frac{1}{d_{jl}} \left(\frac{A_l \lambda}{F_{jl}}\right)^{\frac{1}{\sigma-1}} \tag{1}$$

Proposition 1: Higher transportation costs and higher fixed exporting costs results in less export diversification (ie, fewer exporters), and an increase in demand leads to an increase in export diversification (ie, more exporters).

When looking at higher trade costs, we see that fewer firms export and that export revenue for existing firms decreases. However, the exiting firms are less productive (have higher a) and have lower export revenue. Thus, only the larger firms with higher exports will survive. This will result in less diversification of the export sector in terms of both firms and varieties.

II.c Past diversification leads to lower fixed trade Costs

In this section we focus on no the number of export linkages ($N_{jlt}^{ex} = \sum_{0}^{a_{jlt}^{*}} 1$) impact of the fixed trade costs (F_{jl}). That is, not only do trade costs impact diversification, but diversifying cant itself change trade costs. This means that developing countries, who are the countries with fewer exporters will encounter higher trade costs.

If we define fixed trade costs of a function of the number of previously-established export linkages in bilateral trade ($\left(N_{jlt}^{ex}\right)$), then large countries with many exporters will face lower trade costs, and small countries with fewer exporters will face higher transportation. The reasons being that new trade linkages require new transportation routes and new export infrastructure. This will put developing countries at a disadvantage.

For illustrative purposes, we can define $F_{jlt} = f_{jl}^{\left(1/N_{jlt-1}\right)}$. According to this, economies that diversify late (mostly developing countries), will be at a disadvantage as they will face higher fixed costs to enter export markets. Thus, the productivity cut off will be lower so that only the most productive firms in developing countries will be able to export.

Proposition 2: Countries that diversified in the past (with many trade linkages) will lave lower trade costs, and vice versa. This will put developing countries at a disadvantage.

Proof: Since developing countries, as shown in the data, are the ones who have fewer trade linkages, they will also have higher fixed trade costs; that is, $F_{jl}^{l} > F_{jl}^{m} > F_{jl}^{h}$. Thus, less diversification in the past not only lead to higher trade costs, but this higher costs prevent more diversification in the present since the productivity cut off will be lower in developing countries (i.e., $a_{jl}^{*l} < a_{jl}^{*m} < a_{jl}^{*h}$).

Past diversification will also impact current trade margins. On the extensive margins, as shown above, there will be fewer exporter ($a_{jl}^{*l} < a_{jl}^{*m} < a_{jl}^{*h}$) for countries that didn't diversify in the past. On the intensive margin, since only the larger firms survive, export revenue will be larger on average in countries that didn't diversify in the past. These points on the link between the trade margins and past diversification will be reinforce when aggregating exports.

II.d Productivity and Aggregation

When aggregating exports we see that only do developing countries face higher transportation costs, but similar transportation cost will have a greater impact on developing countries. To show this, we will assume that firm productivity draw (a) comes from from a Pareto distribution with parameters that vary by country, as in Spearot (2016) and **?**:

$$g_j(a) = k_j \frac{a^{k_j - 1}}{(a_j^m)^{k_j}} \quad , \quad a \in [0, a_j^m]$$

As in **?**, Lower values of k are associated with greater productivity dispersion, so that countries drawing from a distribution with a low k parameter will have a lower percentage of low- efficiency firms (firms with high a values).

Taking the zero profit condition, we can define total firm exports as a function of the productivity cutoff (a^*): $v_{jl}(a) = F_{jl} \left(a/a^*\right)^{1-\sigma} \sigma$. Thus total country exports, given the firm-size distribution above, can be expressed as:

$$V_{jl} = \underbrace{N_j \left(\frac{a_{jl}^*}{a_j^m}\right)^{k_j}}_{\text{Extensive Margin}} \underbrace{F_{jl} \frac{\sigma k_j}{k_j - \sigma + 1}}_{\text{Intensive Margin}} \tag{2}$$

This equation reinforces Proposition 1. That is, higher variable trade cost (d_{jl}) lower a_{jl}^*, and, thus, affect the extensive margin. Fixed costs, on the other hand, effect both the extensive and intensive margins. Substituting in the definition of a^* and simplifying, we get our key equation for total exports by country j to country l at time t:

$$V_{jl} = N_j (a_j^m d_{jl})^{-k_j} \left(A_l \lambda\right)^{\frac{k_j}{\sigma - 1}} \; F_{jl}^{-\frac{k_j}{\sigma - 1} + 1} \left(\frac{\sigma k_j}{k_j - (\sigma - 1)}\right) \tag{3}$$

Proposition 3: No only will developing countries face higher trade costs (Proposition 2), but their exports will also be affected more by these trade costs.

Since we assume $k^h < k^m < k^l$ (this is supported by the data), then even if per-product trade costs are the same ($d^h_{jl} = d^m_{jl} = d^l_{jl}$), the effect of such costs will be greater on exports from developing countries as $(d^h_{jl})^{k^h} < (d^m_{jl})^{k^m} < (d^l_{jl})^{k^l}$.

II.e From theory to empirics

Taking logs of the Equation above we see that bilateral trade is a function of the transportation/trade costs:

$$\ln(V_{jl}) = -k_j \ln(d_{jl}) + \psi_j + \phi_l + \eta_{jl} \tag{4}$$

Where $\psi_j = \ln\left[N_j(a^m_j)^{-k_j}\lambda\left(\frac{\sigma k_j}{k_j-(\sigma-1)}\right)\right]$ are origin-specific variables.[4] $\phi_l = \ln\left[(A_l)^{\frac{k_j}{\sigma-1}}\right]$ are importer specific components that vary by export destination, product, and time; to ease the discussion of the results. Finally, $\eta_{jl} = \ln\left[F_{jl}^{-\frac{k_j}{\sigma-1}+1}\right]$ are exporter-importer bilateral elements that do not vary with time, e.g, distance, language and time-difference.

III Data and Descriptives

III.a Data

We use a combination of two data sources – the BACI dataset for trade between countries at the detailed HS6 product level, and the UNCTAD Trade Costs Database. The BACI dataset allows us to measure diversification at the detailed product level by showing the value of trade between country pairs and how the number of products and destinations change over time. To merge the datasets, we concorded the HS6 categories in the UNCTAD data (2012 HS defintions) to the definitions used for the BACI data (1992). n. The BACI data is well described in prior work (e.g., Gaulier and Zignago, 2010; Cadot et al., 2011; Mora and Olabisi, 2021).

The trade costs database from the United Nations Conference on Trade and Development (UNCTAD) uses details from the trade data to construct estimates of trade costs – from the exporters' side, the reported costs are freight-on-board (FOB), and from the importer's side the costs are reported to include Cost-Insurance and

[4]Firm entry doesn't change in the assumed single sector model, see Spearot (2016).

Freight (CIF). The difference between the costs reported at border points provides a proxy for the freight and insurance costs related to trade for specific product categories between country pairs. The cost data for UNCTAD is available for only the year 2016.

Most of our analysis is limited to 2016 (the only year with cost data), and 1996, 20 years earlier – to estimate long-run growth. 1996 is also one of the earliest years for which we have BACI data on trade values and volumes. Transport costs, as measured in the UNCTAD dataset capture the port-to-port cost of moving goods across countries, as reported in customs forms, not necessarily the full cost of getting goods from producers to buyers. For our purpose, it appears to be a sufficient proxy for identifying differences between products, and country-pairs.

We define country groups based on the World Bank categories for economic development: low-income (LDC), middle-income (MIC), or high-income (HIC). Note, however, not all countries have transportation costs data as so we end up with the following: 1) 46 low-income countries, 2) 144 middle-income countries, and 3) 34 high-income countries.

III.b Descriptives

Table 1 sketches the outlines of the stylized fact motivating our paper: export diversification, defined as having broader portfolio of export linkages, is primarily a feature of high-income (and some middle-income) economies. The table shows more than one way to define an export linkage – as the number of products exported by a country, as the number of destination countries that an origin exports to, and as the triad of destinations, products and origin countries. (An example of the latter would be the Colombia-Coffee-USA triad, that captures exports from one country of a specific product in a given year to another country).

Table 1 shows that the number of export linkages (no matter how they are defined) increases with economic development. So in 2016 for example, LDCs on average had about 740 products exported per country, while high-income counties exported over a range almost four times wider, about 2,700 products per country. If linkages are defined as destination countries for that year, LDCs served 92 countries on average, MICs exported to 105 and the HICs sent goods to 146 countries. The combination of countries and products is even more stark, with LDCs having 2,700 country-product combinations on average per country in 2016, while HICs had 65,700. Dividing the numbers suggests an average of 30 products exported to each export destination for LDCs, compared with 450 products per destination for the average high-income economy. Middle-income income countries generally lie between HICs and LDCs for the count-measures of diversification.

Table 1: Summary: High-Income Countries Have More and Bigger Export Linkages

Country group		Count (per country) 1996	2016	USD bn/link 1996	2016	Growth in: count	value
[1] LDC	Orig-Prod	403.62	739.57	1.21	4.92	1.83	4.06
[2] MIC	Orig-Prod	1,317.88	1,589.07	6.31	28.88	1.21	4.58
[3] HIC	Orig-Prod	2,580.04	2,693.97	19.94	45.94	1.04	2.30
[1] LDC	Orig-Dest	57.34	91.91	8.52	39.59	1.60	4.65
[2] MIC	Orig-Dest	74.88	104.56	111.05	438.88	1.40	3.95
[3] HIC	Orig-Dest	119.01	146.19	432.18	846.52	1.23	1.96
[1] LDC	Orig-Prod-Dest	839.36	2,700	0.58	1.34	3.22	2.32
[2] MIC	Orig-Prod-Dest	9,397.77	21,214.07	0.88	2.16	2.26	2.44
[3] HIC	Orig-Prod-Dest	47,831.82	65,704.57	1.08	1.88	1.37	1.75

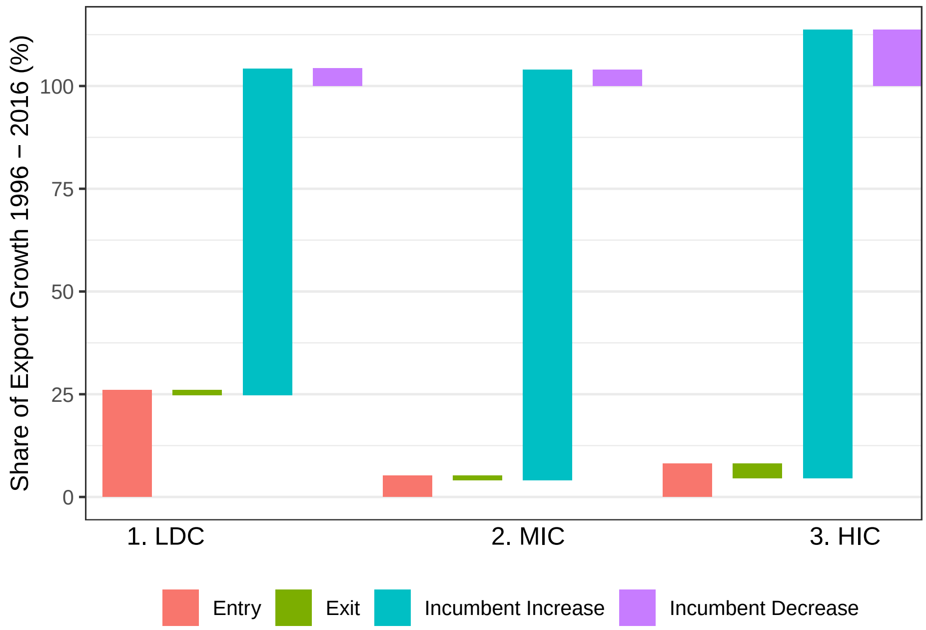
Source: BACI Data, years 1996 and 2016. The numbers are calculated as country averages, with each group's total being divided by the number of countries. The number of countries per group are: HIC (36), MIC (113), LDC (47). The last two columns are ratios of columns 3 to 4, and columns 5 to 6 respectively.

In dollar terms, the trade linkages are also larger for high-income countries. The average product shipped from a HIC in 1996 (or 2016) had exports to the tune of \$20 bn (or \$46 bn), while the comparable number for LDCS was \$1.2bn (or \$4.9bn). The growth in the strength of linkages was higher for LDCs, but it was primarily because they started from a small base. In fact, when linkages are measured either as products or product-destination combinations, MICS grew faster on average over those two decades than LDCs, even as MICs started from a larger base. In terms of simple counts of linkages, the highest ratios observed for 2016 to 1996 were for LDCs, and with higher growth ratios for MICs than HICs.

The snapshots of two years (1996 and 2016) in Table 1 does not fully account for the differences in export diversification between countries at different levels of economic development. In the first place, it does not account for how export diversification drives export growth. Second, the growth ratios for export linkages do not contrast the contribution of new versus existing linkages to export growth.

Figure 1 illustrates the relative proportion of growth in exports between 1996 and 2016 for each of the country groups that came from product diversification (as indicated by the adds/drops of products). The share of export growth from the intensive margin, (either as increases or decreases for products exported in both years) is also shown in the figure. The figure is arranged in a waterfall format, with each of the four margins stacked in cumulative steps that add up to 100%. (The margins that decreased trade – i.e., exits and decreases for incumbent linkages are shown as a reduction in the cumulative height of the bars in the figure.)

Figure 1: Growth in Export Value: 1996 to 2016



Note: Data Source: BACI UN Trade Data.

The main point in the figure is that diversification - adds and drops, or diversification at the extensive margin – to be precise, contributed notably more to the export growth of LDCs, compared to countries with higher income levels. (Comparable figures that define linkages as countries, or country-product combinations also show similar patterns – although those figures are not included in the paper to conserve space). About 25% of the export value in 2016 for LDCs were for products that each country did not export in 1996, compared with less than 8% for MICS and HICs. The growth of products exported in the earlier period was most prominent for high-income countries, even if it accounted for the greatest share of growth across all three country groups. (We will gladly provide equivalent graphs for the other definitions of trade linkages on request.)

Table 2 further supports the evidence in Figure 1, showing that more of the export diversification for poorer countries happens on the extensive margin. Looking at just the count of linkages for 1996 and 2016, we see that about two thirds of the linkages present in either 1996 or 2016 (for links defined as product exports), were additions for LDCs, compared to 38% and 22% for MICs and HICs. Dropped links were a smaller share of the product linkages for LDCs compared to MICs, but HICs had the smallest share on this measure. On the contrary, increases and decreases of exports from incumbent linkages is a higher proportion of linkages for high-income countries, and least for LDCs, across most definitions of export linkages.

Table 2: Poorer Countries Diversify More at the Extensive Margin

		Adds	Drops	Incr.	Decr.	HHI	Theil
[1] LDC	Orig-Prod	65.8	11.4	13.6	9.2	250.4	5.2
[2] MIC	Orig-Prod	37.9	13.6	32.0	16.5	23.9	4.3
[3] HIC	Orig-Prod	21.6	10.6	43.4	24.4	9.5	3.3
[1] LDC	Orig-Dest	52.3	9.5	26.7	11.4	129.9	3.1
[2] MIC	Orig-Dest	42.8	9.0	37.9	10.3	145.8	3.6
[3] HIC	Orig-Dest	31.2	7.1	50.6	11.1	47.8	2.9
[1] LDC	Orig-Prod-Dest	82.6	11.4	3.6	2.5	73.5	5.1
[2] MIC	Orig-Prod-Dest	68.0	13.1	12.4	6.6	3.8	4.7
[3] HIC	Orig-Prod-Dest	49.7	16.6	19.0	14.8	1.8	4.5

Source: BACI Data, years 1996 and 2016. The adds are links in 2016 that did not exist in 1996. The drops are links in 1996 that were not 2016, the *incr* and *decr* columns represent links that existed in 1996 and 2016, while increasing or decreasing respectively. The HHI and Theil numbers are for 2016.

Looking at the other definitions for export linkages, we see similar patterns with high-income countries having more diversification or growth on the intensive margin, and poorer countries having less on the intensive margin and more on the extensive margin. The notable break in the pattern is how MICs had the lowest share of continuing linkages with reduced trade volumes, when linkages are defined as export destinations. As expected, when linkages are defined as product-country combinations, more of the linkages move to the extensive margin, with 83$ of linkages for LDCs being additions, compared with roughly half of the linkages for HICs (or two thirds of linkages for MICs). Dropped linkages, as well as linkages that changed on the intensive margin, broadly increased with economic development with this detailed measure.

Without accounting for the margin at which export growth took place, the last two columns of Table 2 show formal measures of the intuition in Table 1, that exports for LDCs are highly concentrated, as measured by the HHI of exports (or the Theil Index). The pattern applies across all definitions of export linkages, with the exception of origin-destination country linkages, where MICs have the highest concentration or lowest diversification indexes. The break in the pattern is expected to be due for the most part, to how high-growth MICs like China rely on a few large high-income countries for most of their exports.

Sector Analysis

Looking at the trade data by sector, we see important differences across the country groups. For LDCs the greatest increase (13%) in export value shares is in SITC sector 8 (Miscellaneous manufactured articles) and the largest decrease (-9.9%) is in SITC sector 0 (Food and live animals). This contrasts with changes in the triad linkages, especially for new linkages; there we see that the share of triad counts for Sector 8 actually decreases (-3.5%), and it is Sector 7 (Machinery and transport equipment) that has the largest increase (7.6%).

MIC countries have significant differences in their sector composition over time; this is a reason why we do not group low and middle income countries together. For these countries, is is Sector 7 that see the largest increase (9.6%) in the share of export value. LDCs might be moving in the direction, as seen in the changes to the linkages counts, but the value has not caught up. The actual linkage composition, for MICs, has not changed much; Sector 8 did see a decrease in importance (1.5%).

While the importance of manufacturing exports has increased for developing countries, we see a decrease in high income countries. The largest decreases for HICs are in the three manufacturing sectors. The largest increase (4.8%)in export share, on the other hand, is in Sector 5 (Chemicals and related products). The linkage composition hasn't share much, with the largest drop (-1.8%) in Sector 7, and the largest increase (1.1%) in Sector 0.

Transportation costs

Once we merge the two datasets we can compare export diversification, economic development, and transportation costs. Our measurement of transportation costs is the difference between Cost, Insurance, and Freight (CIF) values and the Free on Board (FOB) values divided by the FOB value: $\frac{[CIF-FOB]}{FOB}$. In this way, transportation costs appear in the same way as ad valorem tariffs, or the iceberg costs in most trade models. Developing countries pay slightly higher transportation costs on average: 9% HICs, 10% MICs, and 11% for LDCs. The small *observed* differences in transportation costs is not the point of this paper, our goal is to show that similar costs have different impacts on export diversification and growth, depending on the level of economic development.

One challenge from the data, is that, especially for developing countries, there is a considerable number of triads foe which we observe no trade (and by extension no trade costs) in 2016. As a result, we are unable to observe the relationship between transportation costs and products dropped (between 1996 and 2016). Given this constraint, we expect our estimates to be biased towards zero, as we omit triads that are indeed zero because of high transport costs, but are by definition unobserved. Such zeros for trade linkages are more prevalent in developing countries (as shown in Table 2).

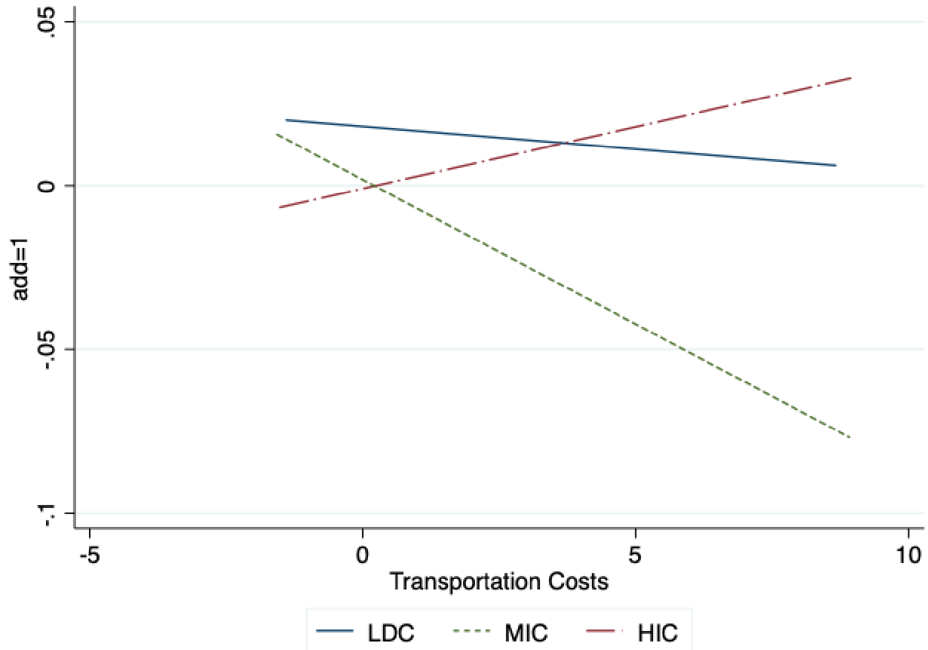
Export Diversification and Economic Development and transportation costs

Figure 2 presents the first descriptive evidence linking transportation costs to the added linkages that define the extensive margin of export diversification. The units of observation are origin-destination-product triads. The y-axis represents the share of trade linkages that were added from 1996-2016, and the x-axis shows the average costs of transportation for each triad. The data is demeaned by country, product, and destination.

In Figure 2, we see a negative association between trade costs and adding a new trade linkage for MICs and LDCs. The pattern is less strong for LDCs, but is negative all the same. This sets up our plan in section IV, to test whether country-product destinations with high costs were less likely to be added by lower-income countries. In contrast, the association is positives for HiCs, suggesting an inquiry into whether HICs were more likely to add country-product destinations with higher transport costs. Whether this is a feature of the data that reflects the comparative advantage in production costs for HICs, or whether it is the mechanical result of HICs having only high-cost destinations left to add, is not clear at this point.

Figure 3 shows how the probability of an increase in export volume for a link that existed in 1996, changes with transport costs. Higher transport costs in the figure are associated with a lower probability of increased trade for LDCs. For MICs and HICs, there is no clear direction - the probability of an increase in export value is near zero (for the demeaned variable) across most of the range of trade costs in

Figure 2: Origin-Dest-Prod. Added: 1996 vs 2016



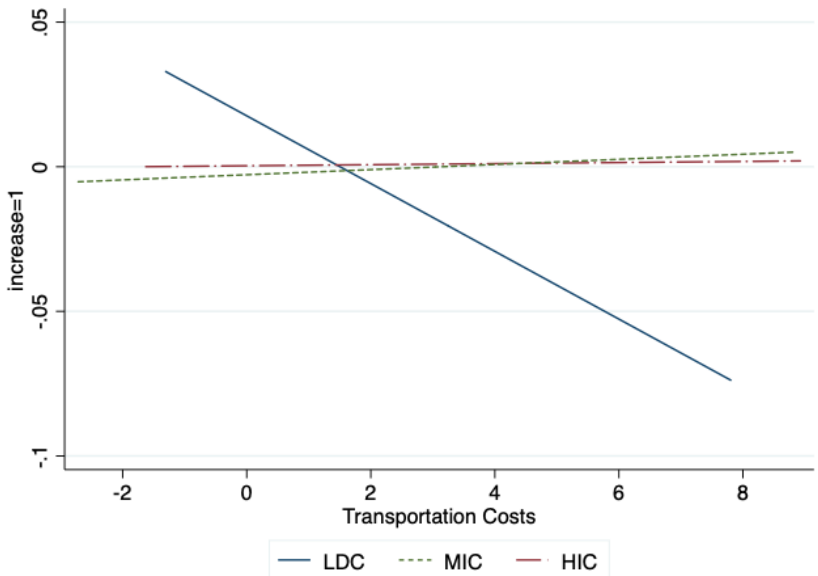
Note: These are fitted values. "Add" equals one if there is an new origin-prod-destination item in 2016 compared with 1996. In the second, We excluded drops in this figure, because the triads that were dropped, had missing cost data in 2016. ("Drop" equals one if there was a trade linkage that existed in 1996, but not 2016.) Transportation costs is $\frac{[CIF-FOB]}{FOB}$. Data is demeaned by country, product, and destination.
Data Source: BACI UN Trade Data.

the data. The figure suggests more work on the intensive margin of diversification – that is, whether the concentration of exports on a few products, is mitigated by countries with higher export values for other existing trade linkages. Such increases can balance out the export portfolio, effectively leading to lower values for measures like the HHI or Theil Index.

From Figure 3, one could infer that higher transports are more likely to prevent export growth for existing linkages in LDCs, arguably because only a small number of exporters in those countries have productive margins that cover the costs. On the other hand, conditional on the costs being low enough to meet the zero-profit condition for one firm in the other country groups, there is a greater likelihood that more firms can expand the volume of trade, or that incumbent firms can scale up trade by selling to more customers through that channel.

In sum, trade costs affect LDC decisions both in the decision to enter (the extensive margin) or grow (the intensive margin) export linkages. For MIC, it affects the

Figure 3: Probability of an Increase in Export Value: 1996 v. 2016



Note: These are fitted values for transportation costs and the probably of the triad increasing in export value. Only triads with a positive value of trade in 1996 were included. Transportation costs is $\frac{[CIF-FOB]}{FOB}$. Data is demeaned by country, product, and destination, (as the unit of observation is an Origin-Dest-Prod triad.).
Data Source: BACI UN Trade Data.

probability of adding products (the extensive margin). Lastly, for HIC, the figures indicate little-to-no association between either margin and transportation costs.

IV Empirics

IV.a Methods

We use high-dimensional fixed effects regressions to estimate how countries diversify exports through adds/drops to their export portfolios.

We adopt the following empirical specification:

$$Var_{ijk} = \beta_0 + \beta_1\tau_{ijk} + \beta_2\tau_{ijk} * LDC + \beta_3\tau_{ijk} * MIC + \phi_i + \theta_j + \mu_k + \epsilon_{ijk} \quad (5)$$

Where i is the export origin country, j is the destination, and k is the product at the detailed HS6-level. In Equation (5), the key explanatory variable is the transport cost (τ_{ijk}), defined as $\frac{[CIF\ Value - FOB\ Value]}{FOB\ Value}$. We interact this term with the dummy variables for middle income countries (MIC) and less developed countries (LDCs). ϕ_i and θ_j represent origin and destination country fixed effects, μ_k represents product fixed effects, and ϵ_{ijk} is the error term. The key outcome variables (Var_{ijk}) will be an indicator of whether the linkage was added ($Add = 1$), whether the linkage's export value increased ($Inc = 1$), and the change in export value between 1996 and 2016. We should note that *dropped* and *survival* indicators were not included, as the transport cost data is conditional on positive trade in 2016. A *decrease* variable was not included to conserve space – the results are simply the opposite sign of those of the *increased* variable. (Furthermore, the number of linkages for which trade decreased between 1996 and 2016 without going to zero is particularly small, as seen in Table 2). We also use specifications that consider increases and decreases of trade for incumbent linkages. Lastly, we separate the estimates using 10 SITC sectors.

We use high-dimensional fixed effects to partial out the list of variables with respect to the listed set of fixed effects – origin-country, destination-country and product. The high-dimensional fixed effects procedure we use is explained in related papers (Correia, 2016; Guimaraes and Portugal, 2010). Errors are clustered at the country-product level. The approach gives a linear probability model (LPM) approximation for the dependent variables that are dummy variables.

IV.b Results

The main finding in Table 3 is that transportation costs, (not just fixed costs alone), matter for the exporting decisions of firms in developing countries. The same effect for transportation cost do not appear to matter for HICs. The table shows linear regressions of dummy indicators for the addition of (or increased of trade in) origin-destination-product linkages on trade costs. The trade costs, measured as the share of FOB trade value that is accounted for by the CIF-FOB difference, is also interacted with dummies for the developing country-groups, leaving HICs as the baseline.

Column 1 of Table 3 shows that LDCs, relative to HICs, are negatively affected by transportation costs. For these countries, higher transpiration cost will result in a lower probability of adding a product, a lower probability of increasing export values, and lower export growth. The estimated effects, are roughly 2% lower probability of adding new linkages, but the size of the coefficients should be considered next to the large number of possible linkages facing countries. The intuition here is based on the

Table 3: Origin-Destination-Product Regressions

	All Observations			Incumbents	
Dep. ⇒	**add**	**inc**	**val**	**inc**	**val**
Trans.	0.01***	0.00***	0.01***	0.00***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Trans.*LDC	-0.02***	-0.01***	-0.04***	-0.02	-0.04
	(0.00)	(0.00)	(0.01)	(0.01)	(0.03)
Trans.*MIC	-0.02***	-0.01***	-0.05***	-0.00***	-0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Obs.	6,136,821	6,136,821	6,136,821	2,521,365	2,521,365
Clusters	376,215	376,215	376,215.	203,727	203,727
Adj. R2	0.320	0.130	0.202	0.116	0.163
Origin FE	Yes	Yes	Yes	Yes	Yes
Dest. FE	Yes	Yes	Yes	Yes	Yes
Prod. FE	Yes	Yes	Yes	Yes	Yes

Note: .01 - ***; .05 - **; .1 - *; Transportation costs (Trans) is equal to (CIF Val- FOB Val)/FOB Val. Dependent variables ADD (traid added in 2016) and INC (Increased in export value in 2016, relative to 1996) equal 1 if true. Dependent variable VAL is the percentage change in the export value from 1996 to 2016 using the midpoint average. LDC equals one if a country is classified as least developed country, and MIC equals one if a is classified as middle income.

6 million observations in the first three columns, and the fact that about 3.6 million of them were zero in 1996 (i.e., the difference between the observations in columns 3 and 4).

The estimated difference-in-difference effect for MICs is similar to LDCs. In the same way, columns 2 and 3 of the table show that the estimated effect of transport costs on (the probability of) increased trade value in a linkage are broadly similar in sign and significance to the findings for new links in column 1. On the contrary, transportation costs and the variables of interest are not strongly linked for HICs. In fact, for these countries, there is a slight positive impact of transport costs on the probability of adding a product and increasing values. We expect that the positive sign on the coefficients reflect the lower competition for HICs in country-product markets with high transportation costs.

The estimated effects are muted for the specifications that are limited to incumbent linkages – that is, origin-destination-product trade channels that had non-zero trade in 1996. For this subset of the data, in column 4 and 5, the regression results follow the pattern of the previous columns, except that the estimates for LDCs are not statistically significant, and the size of the estimated effects are generally smaller.

Estimates by SITC sector

To understand how consistent the finding are across sectors, we run identical specifications of Table 3, but each column represents observations that fit in a given sector category The sectors are based on the top-digit SITC codes for the traded products, (after concording the HS6 products to SITC categories). See Table 7 for SITC Sector names and codes.

Table 4 presents the sector-level findings, with the specification identical to column 1 of Table 3. The results show that the estimated effects on diversification vary by sector, as expected. For our baseline category of high-income countries, Sectors 2, 3, 5, 6 and 9 have negative estimated effects of costs on the addition of new trade linkages. (Sectors 4 and 8 – Oils, fats, waxes and Miscellaneous manufactured articles, have positive and statistically significant estimates for the same). Few estimates for LDCs appear statistically significant, possibly because of the low number of observations.

The estimated effects in Table 4 imply that diversifying trade through new linkages is particularly unlikely for LDCs in SITC sector 1 (Beverages and tobacco), which covers a large share of exports for economies that specialize in products like coffee, cocoa and tea. Two other sectors with notably negative and statistically significant estimates for LDCs are: Miscellaneous manufactured articles (sector 8) and Goods not classified elsewhere (sector 9). In principle, the sectors offer high potential for export diversification in economies that could benefit the most from growth.

Compared with HICs, higher transport costs predict lower trade linkage additions for MICs across all sectors except for sector 3 (Mineral fuels, lubricants and related materials), where the estimated effect is positive and statistically significant (but not at the 5% level). The high and positive coefficient for sector 3 (Mineral fuels, lubricants and related materials) in LDCs and MICs, suggest that as an exception to the pattern of costs hindering diversification, more developing countries are shipping coal, crude oil and other energy-related commodities to new destinations, as demand from countries like China and India soared in those two decades. Published work suggests that economic diversification is more challenging for resource-dependent countries, especially ones that specialize in the fossil fuels sector (Djimeu and Omgba, 2019; Wiig and Kolstad, 2012). Diversification by LDCs and MICs in this sector affirms, rather than contradicts these findings - as it shows how demand for commodities spurs expansion into new markets by commodity-producers, without necessarily leading to diversification in other sectors of the commodity-producers' economies.

Table 4: SITC Sector Regressions: Addition = 1

Dep. ⇒ Add	SITC Rev. 3 Chapter									
	0	1	2	3	4	5	6	7	8	9
Trans.	0.00***	0.01***	-0.02***	-0.11***	0.00	-0.01***	-0.01***	0.02***	0.01***	-0.01***
	(0.00)	(0.01)	(0.00)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Trans.*LDC	0.01	-0.17***	0.01	0.39***	-0.16	0.01	-0.01	-0.03***	-0.02***	-0.09***
	(0.01)	(0.04)	(0.01)	(0.08)	(0.13)	(0.01)	(0.01)	(0.01)	(0.00)	(0.03)
Trans.*MIC	-0.00	-0.04***	-0.01	0.04*	-0.00	-0.05***	-0.01***	-0.01***	-0.00	-0.03***
	(0.00)	(0.01)	(0.00)	(0.02)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Obs.	443,175	39,717	178,032	23,498	29,498	773,767	1,540,240	1,420,957	1,454,861	232,981
Clusters	38,282	2,596	19,819	2,406	2,909	49,704	98,742	73,849	73,821	13,992
Adj. R2	0.253	0.315	0.268	0.281	0.252	0.322	0.314	0.369	0.353	0.338
Origin FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dest. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prod. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: .01 - ***; .05 - **; .1 - *; Transportation costs (Trans.) is equal to (CIF Val- FOB Val)/FOB Val. The dependent variable is whether or not the triad $add = 1$ did not exist 1996, but it did in 2016; for new triads $add = 1$. LDC equals one if a country is classified as least developed country, and MIC equals one if a is classified as middle income.

Table 5 presents the sector-level equivalent of column 2 in Table 3. The same empirical specification was adopted, with each column showing sector subsets of the data. The estimates mirror the pattern in Tables 3 and 4, with a positive coefficients for HICs, and most estimates for LDCs being statistically insignificant. In this table, fewer variables are statistically significant, even for other country-groups. Nevertheless, as in the previous table, there is a strong pattern of transport costs lowering diversification across a broad set of sectors for MICs. Once again the exception is sector 3, even when the dependent variable is a dummy that indicates increased trade from 1996 to 2016.

Table 6 links the sector-level estimates to growth, with the dependent variable being the percentage change in the export value from 1996 to 2016 (as in column 3 of Table 3). Once again, the estimates follow the pattern in previous tables, but with fewer statistically significant coefficients on the variables. The estimates, which we expect to explore further with additional tests, could be taken to imply that export growth rates were for the most part, lower for middle income countries in destination-country-product markets with high transport costs.

Table 5: SITC Sector Regressions: Increase = 1

Dep. ⇒ Inc	SITC Rev. 3 Chapter									
	0	1	2	3	4	5	6	7	8	9
Trans.	0.00	0.00	-0.00	-0.03***	0.01***	-0.00***	-0.00***	-0.00	0.00**	0.00
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Trans.*LDC	-0.01	-0.02	-0.01	0.13***	0.01	-0.00	0.00	0.01	-0.01***	-0.04**
	(0.01)	(0.04)	(0.01)	(0.05)	(0.05)	(0.01)	(0.01)	(0.01)	(0.00)	(0.02)
Trans.*MIC	-0.01***	-0.02**	-0.01***	0.02*	-0.02***	-0.01***	-0.01***	-0.00	-0.00	-0.02***
	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Obs.	443,175	39,717	178,032	23,498	29,498	773,767	1,540,240	1,420,957	1,454,861	232,981
Clusters	38,282	2,596	19,819	2,406	2,909	49,704	98,742	73,849	73,821	13,992
Adj. R2	0.080	0.085	0.119	0.093	0.091	0.123	0.148	0.143	0.138	0.151
Origin FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dest. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prod. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: .01 - ***; .05 - **; .1 - *; Transportation costs (Trans) is equal to (CIF Val- FOB Val)/FOB Val. Dependent variable is whether the export value increased in 2016 relative to 1996; if the value was greater in 216, the $inc = 1$. LDC equals one if a country is classified as least developed country, and MIC equals one if a is classified as middle income.

Table 6: SITC Sector Regressions: change in export value

Dep. ⇒ Val	SITC Rev. 3 Chapter									
	0	1	2	3	4	5	6	7	8	9
Trans.	0.00	0.02	-0.01*	-0.12***	0.03**	-0.02***	-0.01***	0.01	0.01***	-0.00
	(0.00)	(0.01)	(0.01)	(0.04)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Trans.*LDC	-0.02	-0.13	-0.02	0.59***	-0.19	-0.00	-0.00	0.01	-0.03***	-0.14***
	(0.02)	(0.12)	(0.03)	(0.17)	(0.18)	(0.02)	(0.02)	(0.02)	(0.01)	(0.05)
Trans.*MIC	-0.02***	-0.09***	-0.03***	0.08*	-0.06***	-0.06***	-0.03***	-0.02**	0.00	-0.05***
	(0.01)	(0.03)	(0.01)	(0.05)	(0.02)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Obs.	443,175	39,717	178,032	23,498	29,498	773,767	1,540,240	1,420,957	1,454,861	232,981
Clusters	38,282	2,596	19,819	2,406	2,909	49,704	98,742	73,849	73,821	13,992
Adj. R2	0.138	0.154	0.177	0.149	0.144	0.196	0.215	0.232	0.215	0.227
Origin FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dest. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prod. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: .01 - ***; .05 - **; .1 - *; Transportation costs (Trans) is equal to (CIF Val- FOB Val)/FOB Val. Dependent variable is the percentage change from 1996 to 2016 using the midpoint average. LDC equals one if a country is classified as least developed country, and MIC equals one if a is classified as middle income.

V Conclusion

In this paper we look at the link between transportation costs and diversification through the extensive margin (adding new origin-destination-product linkages) and the intensive margin (export values increasing/decreasing from 1996 to 2016). More importantly, we analyze how these associations depend on countries' levels of economic development.

We find that transportation costs – which fall in the category of variable costs for most trade models, matter for the exporting decision of developing countries. Diversification into new destination-product markets is less likely, and growth in linkages that could balance the countries' export portfolios is lower on average, where transportation costs are higher. Transportation cost do not appear to have the same effect on diversification decisions in high-income countries (HICs). On the contrary, trade from HICs appear to be slightly more likely for product-market destinations with high-costs, possibly because of less competition from developing economies. These associations are most significant in a statistical sense for the manufacturing sectors.

The findings remain largely consistent even when we repeat our analysis on a sector-by-sector basis. The main difference being that the sector-by-sector analysis shows more statistically significant estimates for MICs than for LDCs. (We plan to explore this further, but anticipate that the fewer results with statistical significant simply reflects lower observations per sector for LDCs). Notable in our sector-level estimates is an exception in sector 3 (Mineral Oils), to the pattern of lower export diversification with transportation costs. The period under review was of high demand for commodities like crude oil, and we expect to do further work to test the hypothesis that the rising diversification with higher transport costs for this sector by LDCs and MICs simply captures exporters' response to the global trend.

Our findings imply that models that explain patterns of trade – and the differences between economies in those patterns, should consider both fixed costs – as they traditionally do, and variable items like transportation cots. Transportation costs may limit the ability of developing countries to grow exports on both the extensive margin (creating new linkages) and the intensive margin (growing exciting linkages). The role of transport costs may be even bigger than tariffs, given that tariffs on average are now below 5%, while transport costs as a share of trade are almost double that rate, in the data.

We expect to extend the work in this version of the paper in the following ways: First a revised version will include robustness checks with instrumental variables – the variables will address the possibility of endogenous transport costs. We will also use alternative definitions of transportation costs, as well as additional control variables that account for more of the drivers of export diversification.

We expect several of our findings to be under-estimates, given the notable share of missing linkages in international trade. The data as well as previous work imply that the zeroes or missing linkages are more likely to occur where trade costs are high (c.f., Helpman, Melitz, and Rubinstein, 2008; Baldwin and Harrigan, 2011). Given earlier work on fixed trade costs and their impacts on trade, we are interested in future work that compares the impact of variable costs – like transport costs, with the impacts of fixed costs on the margins of trade growth.

References

Agosin, Manuel R, Roberto Alvarez, and Claudio Bravo-Ortega (2012), “Determinants of export diversification around the world: 1962–2000.” *World Economy*, 35, 295–315.

Baldwin, Richard and James Harrigan (2011), “Zeros, Quality, and Space: Trade Theory and Trade Evidence.” *American Economic Journal: Microeconomics*, 3, 60–88.

Beverelli, Cosimo, Simon Neumueller, and Robert Teh (2015), “Export diversification effects of the wto trade facilitation agreement.” *World Development*, 76, 293–310.

Cadot, Olivier, Céline Carrère, and Vanessa Strauss-Kahn (2011), “Export Diversification: What’s Behind the Hump?” *Review of Economics and Statistics*, 93, 590–605.

Cook, Nathaniel PS and Jason Cannon Jones (2015), “The African Growth and Opportunity Act (AGOA) and Export Diversification.” *Journal of International Trade & Economic Development*, 24, 947–967.

Correia, Sergio (2016), “Hdfe: Stata module to partial out variables with respect to a set of fixed effects.”

Daruich, Diego, William Easterly, and Ariell Reshef (2019), “The surprising instability of export specializations.” *Journal of Development Economics*, 137, 36–65.

Dennis, Allen and Ben Shepherd (2011), “Trade facilitation and export diversification.” *World Economy*, 34, 101–122.

Djimeu, Eric W and Luc Désiré Omgba (2019), “Oil windfalls and export diversification in oil-producing countries: Evidence from oil booms.” *Energy Economics*, 78, 494–507.

Eicher, Theo S and David J Kuenzel (2016), “The elusive effects of trade on growth: Export diversity and economic take-off.” *Canadian Journal of Economics/Revue canadienne d’économique*, 49, 264–295.

Gaulier, Guillaume and Soledad Zignago (2010), “BACI: International Trade Database at the Product-Level (The 1994-2007 Version).” *CEPII Working Paper 2010-23*.

Gnangnon, Sèna Kimm (2021), “Export product diversification, poverty and tax revenue in developing countries.” *Journal of International Trade & Economic Development*, 1–31.

Guimaraes, Paulo and Pedro Portugal (2010), “A simple feasible procedure to fit models with high-dimensional fixed effects.” *The Stata Journal*, 10, 628–649.

Hanson, Gordon H (2012), “The rise of middle kingdoms: Emerging economies in global trade.” *Journal of Economic Perspectives*, 26, 41–64.

Helpman, Elhanan, Marc Melitz, and Yona Rubinstein (2008), "Estimating Trade Flows: Trading Partners and Trading Volumes." *Quarterly Journal of Economics*, 123, 441–487.

Hummels, David (2007), "Transportation Costs and International Trade in the Second Era of Globalization." *Journal of Economic Perspectives*, 21, 131–154.

Hummels, David and Peter J Klenow (2005), "The Variety and Quality of a Nation's Exports." *American Economic Review*, 95, 704–723.

Jetter, Michael and Andrés Ramírez Hassan (2015), "Want export diversification? educate the kids first." *Economic Inquiry*, 53, 1765–1782.

Jongwanich, Juthathip (2020), "Export diversification, margins and economic growth at industrial level: Evidence from thailand." *World Economy*, 43, 2674–2722.

Kaitila, Ville (2019), "Export product range and economic growth in the eu countries." *World Economy*, 42, 711–737.

Lincoln, William F and Andrew H McCallum (2018), "The rise of exporting by us firms." *European Economic Review*, 102, 280–297.

Mau, Karsten (2016), "Export diversification and income differences reconsidered: The extensive product margin in theory and application." *Review of World Economics*, 152, 351–381.

Mora, Jesse and Michael Olabisi (2020), "Export Growth Drivers and Economic Development." *Working Paper*.

Mora, Jesse and Michael Olabisi (2021), "Economic Development and the Margins of Trade: Are the Least Developed Countries Different?" *Economic Inquiry*, 59, 600–621.

Mullings, Robert and Aruneema Mahabir (2018), "Growth by destination: The role of trade in africa's recent growth episode." *World Development*, 102, 243–261.

Nicita, Alessandro and Valentina Rollo (2015), "Market access conditions and subsaharan africa's exports diversification." *World Development*, 68, 254–263.

Onder, Ali Sina and Hakan Yilmazkuday (2016), "Trade Partner Diversification and Growth: How Trade Links Matter." *Journal of Macroeconomics*, 50, 241–258.

Parteka, Aleksandra and Massimo Tamberi (2013), "What determines export diversification in the development process? empirical assessment." *World Economy*, 36, 807–826.

Persson, Maria and Fredrik Wilhelmsson (2016), "Eu trade preferences and export diversification." *World Economy*, 39, 16–53.

Regolo, Julie (2013), "Export diversification: how much does the choice of the trading partner matter?" *Journal of International Economics*, 91, 329–342.

Saslavsky, Daniel and Ben Shepherd (2012), *Facilitating international production networks: The role of trade logistics*. The World Bank.

Spearot, Alan (2016), "Unpacking the Long-run Effects of Tariff Shocks: New Structural Implications from Firm Heterogeneity Models." *American Economic Journal: Microeconomics*, 8, 128–67.

Wiig, Arne and Ivar Kolstad (2012), "If diversification is good, why don't countries diversify more? the political economy of diversification in resource-rich countries." *Energy Policy*, 40, 196–203.

Appendix A

Table 7: Economic Development and SITC Sectors: 1996 vs. 2016

		Share of Export Value			Share of Triad Count		
Sector		2016	1996	Diff	2016	1996	Diff
	Low-Income Country						
0	Food and live animals	8.0	17.9	-9.9	9.9	15.1	-5.2
1	Beverages and tobacco	0.9	0.9	0.0	0.9	1.0	-0.1
2	Crude materials, inedible, except fuels	5.7	9.1	-3.5	4.1	6.3	-2.2
3	Mineral fuels, lubricants and related materials	23.7	30.5	-6.8	0.3	0.4	-0.1
4	Animal and vegetable oils, fats and waxes	0.1	0.4	-0.3	0.4	0.2	0.1
5	Chemicals and related products, n.e.s	0.7	1.0	-0.4	3.5	1.6	1.9
6	Manufactured goods	10.9	10.7	0.2	15.0	13.8	1.1
7	Machinery and transport equipment	1.8	0.5	1.3	12.7	5.1	7.6
8	Miscellaneous manufactured articles	39.3	26.2	13.1	50.2	53.7	-3.5
9	Goods not classied elsewhere	8.9	2.6	6.2	3.1	2.7	0.4
	Middle-Income Country						
0	Food and live animals	6.2	8.6	-2.4	7.6	7.3	0.3
1	Beverages and tobacco	0.5	0.8	-0.3	0.7	0.6	0.0
2	Crude materials, inedible, except fuels	3.5	4.2	-0.7	3.0	2.8	0.2
3	Mineral fuels, lubricants and related materials	14.5	21.6	-7.2	0.4	0.4	0.0
4	Animal and vegetable oils, fats and waxes	0.8	1.0	-0.2	0.5	0.4	0.1
5	Chemicals and related products, n.e.s	6.8	4.2	2.5	10.8	10.0	0.7
6	Manufactured goods	11.7	11.2	0.6	24.6	24.7	0.0
7	Machinery and transport equipment	28.9	19.2	9.6	21.9	21.6	0.3
8	Miscellaneous manufactured articles	15.7	17.8	-2.0	26.8	28.2	-1.5
9	Goods not classied elsewhere	11.3	11.2	0.1	3.8	4.0	-0.2
	High-Income Country						
0	Food and live animals	6.7	6.4	0.4	7.0	5.9	1.1
1	Beverages and tobacco	1.1	1.2	-0.1	0.6	0.6	0.0
2	Crude materials, inedible, except fuels	3.7	3.5	0.2	2.8	2.5	0.3
3	Mineral fuels, lubricants and related materials	5.8	4.0	1.8	0.4	0.4	0.0
4	Animal and vegetable oils, fats and waxes	0.3	0.3	0.1	0.5	0.4	0.1
5	Chemicals and related products, n.e.s	15.6	10.7	4.8	14.1	13.5	0.6
6	Manufactured goods	11.0	13.5	-2.5	25.7	25.5	0.2
7	Machinery and transport equipment	37.1	38.5	-1.4	24.2	26.0	-1.8
8	Miscellaneous manufactured articles	10.9	11.2	-0.2	20.9	21.3	-0.4
9	Goods not classied elsewhere	7.7	10.8	-3.1	3.8	4.0	-0.1

Figure A.1 shows the trend of export diversification over time, measured as the Theil Index. The index for each country group represents the export-weighted average across countries in each group. The plot also shows export concentration/diversification for each of the product groups, within each country group.

Table 8: Origin-Product-Destination Level Regressions: Value Change 1996 vs 2016

Dep. Val ⇒	**m1**	**m2**	**m3**	**m4**	**val**	**m5**
Trans.	-0.011***	-0.009***	-0.004***	-0.000	0.010***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Trans*LDC			-0.003	-0.003	-0.017***	-0.018***
			(0.003)	(0.003)	(0.003)	(0.003)
Trans*MIC			-0.015***	-0.014***	-0.021***	-0.023***
			(0.001)	(0.001)	(0.001)	(0.001)
LDC		0.370***	0.371***			
		(0.001)	(0.001)			
MIC		0.235***	0.238***			
		(0.000)	(0.000)			
Obs.	6,136,821	6,136,821	6,136,821	6,136,821	6,136,821	6,136,821
Adj R2	0.000	0.041	0.041	0.112	0.174	0.202
Origin FE	No	No	No	Yes	Yes	Yes
Dest. FE	No	No	No	No	Yes	Yes
Prod. FE	No	No	No	No	No	Yes

Note: "Trans" is the transportation costs, calculated as $\frac{[CIF-FOB]}{FOB}$ and the dependent variable is the mid-point change in export value between 1996 and 2016.

Table 9: Origin-Product Level Regressions: Margins

Dep. ⇒	**val**	**add**	**drop**	**inc**	**dec**	**dhhi**
Trans.	0.023***	0.014***	0.000	0.012***	-0.012***	0.041***
	(0.003)	(0.003)	(0.000)	(0.002)	(0.002)	(0.006)
Trans*LDC	-0.028***	-0.026***	-0.000	-0.012***	0.012***	-0.063***
	(0.007)	(0.006)	(0.000)	(0.004)	(0.004)	(0.014)
Trans*MIC	-0.027***	-0.005	-0.000	-0.015***	0.015***	-0.001
	(0.004)	(0.003)	(0.000)	(0.003)	(0.003)	(0.008)
Obs.	376,215	376,215	376,215	376,215	376,215	376,215
Adj R2	0.286	0.502	0.073	0.135	0.135	0.431
Origin FE	Yes	Yes	Yes	Yes	Yes	Yes
Prod. FE	Yes	Yes	Yes	Yes	Yes	Yes

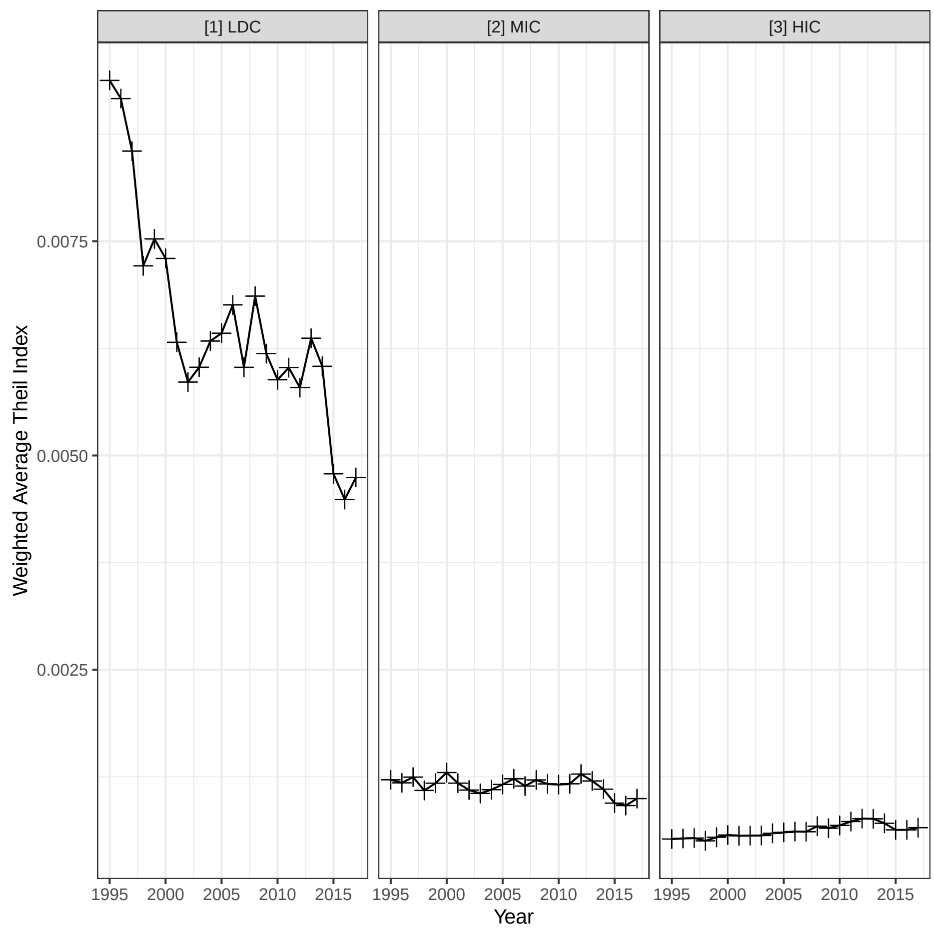
note: .01 - ***; .05 - **; .1 - *; CIF is equal to 100*(CIF Val- FOB Val)/FOB Val. Dependent variable is percentage change from 1996 to 2016 using the midpoint average. ADD, Drop, INC (Increase), and Dec (Decrease) all equal 1 if true. HHI is the percentage change in HHI from 1996 to 2016 using midpoint.

Table 10: Origin-Destination Level Regressions: Margins

Dep. ⇒	**val**	**add**	**drop**	**inc**	**dec**	**dhhi**
Trans.	0.014	0.033	0.000	0.010	-0.010	0.008
	(0.013)	(0.028)	(0.000)	(0.008)	(0.008)	(0.023)
Trans*LDC	-0.003	-0.011	-0.002	-0.014	0.014	-0.010
	(0.031)	(0.038)	(0.001)	(0.023)	(0.023)	(0.031)
Trans*MIC	-0.002	-0.020	-0.001	-0.002	0.002	-0.018
	(0.015)	(0.030)	(0.001)	(0.009)	(0.009)	(0.025)
Obs.	13,801	13,801	13,801	13,801	13,801	13,801
Adj R2	0.343	0.543	0.061	0.076	0.076	0.643
Origin FE	Yes	Yes	Yes	Yes	Yes	Yes
Dest. FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: .01 - ***; .05 - **; .1 - *; CIF is equal to (CIF Val- FOB Val)/FOB Val. Dependent variable is percentage change from 1996 to 2016 using the midpoint average. ADD, Drop, INC (Increase), and Dec (Decrease) all equal 1 if true. HHI is the percentage change in HHI from 1996 to 2016 using midpoint. LDC equals one if a country is classified as least developed country, and MIC equals one if a is classified as middle income.

Figure A.1: Export Diversification Trend: 1996 to 2016



Note: Data Source: BACI UN Trade Data.

The figure shows that across country groups, raw materials have the highest export concentration (lowest export product diversification). Nevertheless, LDCs have the highest export concentration in each product category, and the export concentration for all product groups for LDCs are higher than any product group in the other countries, except for raw materials.

That said, as predicted in Cadot et al. (2011), we see in Figure A.1 a trend to export diversification in LDCs for capital goods, consumer goods, and to some extent, intermediates.

For comparison, we also included Figure A.2, which shows the same trend, but with export concentration measured as the Herfindahl Hirschmann Index (HHI).

We must note that the product categories in Figures A.1 and A.2 carry different weights in the export portfolios of different countries and country groups. Raw materials only accounted for 17% of global exports, compared with 25,26 and 30% respectively for capital goods, intermediates and consumer goods. In principle, the level of export diversification in each country, or the average for each country group will tend to fall closer to the diversification observed for consumer goods, even though this will vary by country.

Figure A.2: Export Diversification Trend (HHI): 1996 to 2016

Note: Data Source: BACI UN Trade Data.

This figure, like the previous, shows that across country groups, raw materials have the highest export concentration (lowest export product diversification). LDCs have the highest export concentration in each product category, with export concentration for raw materials being particularly high.