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Does Transport Infrastructure Benefit Gdp Growth?

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DOES TRANSPORT INFRASTRUCTURE BENEFIT GDP GROWTH?

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Abstract

This paper examines how transport infrastructure affects GDP growth by reducing trade costs. Our empirical analysis confirms that improving transport infrastructure quality lowers trade costs, and we estimate the elasticity of trade costs relative to transport infrastructure quality. Specifically, a 1% improvement in average transport infrastructure quality between an emerging and a developed economy can reduce bilateral trade costs by up to 0.71%. To estimate the net effect of changes in infrastructure on GDP growth via trade cost, we used the Computational General Equilibrium framework. Our results demonstrate significant potential for improving GDP growth in different groups of countries based on economic development (i.e., developing countries, emerging countries, and developed countries). We identify and examine the broader implications of transport infrastructure development for the global economy.

Keywords: transport; infrastructure; growth; markets

1. Introduction

The COVID-19 pandemic has led to a global recession and historically low nominal interest rates. When there is fiscal space, discretionary fiscal policies can more effectively close the negative output gap through a larger fiscal multiplier (Christiano, Eichenbaum, and Rebelo, 2011; Eggertsson, 2011; Woodford, 2011). Improving infrastructure through investment is one fiscal policy response to weak growth that is being hotly debated among economists and policymakers. Numerous theoretical and empirical studies (e.g., Bleaney et al., 2001; Maparu and Mazumder, 2017; Arbués et al., 2015; Berechman et al., 2006; Donaldson, 2018) have recognized the crucial role played by transport infrastructure in economic development. However, some empirical research has shown that large transport infrastructure projects often fail to deliver the expected benefits (Cantarelli et al., 2010;

Locatelli et al., 2017), and the relationship between transport infrastructure and economic growth is still unclear (Duranton et al., 2020).

Most studies in literature are based on endogenous growth theory and focus on local growth. Few explicitly explore the channels of international trade. In the era of globalization, the competitive advantage of each economy depends on an efficient transport system, which can reduce trade costs to increase international trade and thus stimulate economic growth. The lack of high-quality transport infrastructure can be the key obstacle to economic development; there is a large infrastructure gap that exists around the globe, which constrains international trade and potential prosperity, particularly in the Asia Pacific region and Africa. According to a recent Asian Development Bank report, the Asia Pacific region alone, including China, requires up to US$1.7 trillion in infrastructure investments per year until 2030 (Asian Development Bank, 2017). China's Belt and Road Initiative (BRI) aims to close this "infrastructure gap" by improving transport infrastructure and boosting global economic links. Most studies on the impacts of infrastructure on economic growth in the international economics field use Computational General Equilibrium (CGE) analysis, assuming infrastructure improvement will reduce trade cost by a certain arbitrary amount; little research quantifies how big this impact is using recent data. Previous research usually focuses on a certain type of transport infrastructure such as roads or airports, not comparing the impacts of various types of infrastructure. Moreover, most prior studies employed either transportation investment or roadway length to measure infrastructure endowment, making it difficult to capture the effect of infrastructure quality.

To fill these gaps and address the conflicting observations about transport infrastructure effects, this paper examines the potential impact of improving infrastructure quality on multilateral trade cost and economic growth using empirical evidence from developed economies, emerging economies, and developing economies. The literature on transport and infrastructure (Berechman et al., 2006; Donaldson, 2018; Januário, Costa, Cruz, Sarmento, & e Sousa, 2021) provides conflicting findings about the effects of infrastructure quality on multilateral trade cost. Hence, this study attempts to address this issue by utilizing readily verifiable data from publicly accessible sources including World Economic Forum data, World Bank country economic data, and CEPII distance data, as well as data on country characteristics, and integrating them into a panel database that covers both developed economies and emerging markets. By deducing insights from the data, we confirm that an improvement of transport infrastructure quality by 1% can significantly reduce trade cost by 0.88%. We then utilize a CGE analysis to estimate the impacts of the resulting trade cost reduction on economic growth and obtain results showing that one percentage increase in infrastructure quality can increase the GDP by 0.14% to 0.99%. The study further provides deep insights on the net effect of changes in infrastructure on countries' GDP growth via trade cost.

This paper is organized as follows. Section 2 discusses the theoretical background and related literature. Section 3 presents the database and methodology used to measure the impact of infrastructure quality on trade costs, and the estimated results. The measurement of trade cost on economic growth in the CGE model is presented in Section 4. Conclusion and potential practical implications for policy makers follow.

2. Theoretical background

Trade intensity depends on the "friction" associated with trade, i.e. the bilateral trade costs (BTCs) between partner countries. Anderson and Van Wincoop's (2004) bottom-up estimate of trade cost includes trade facilitation, transport infrastructure, policy barriers (tariffs and non-tariff barriers), access to trade finance, network infrastructure, information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs in both exporting and importing countries. The drawback of this method is that it may miss relevant cost factors and introduce omitted variable bias. The opposite approach, the top-down approach, is to include all observed and unobserved trade costs by implementing an inverse gravity model to calculate trade costs given the observed pattern of trade and production (Novy, 2013). This is the measure used by the UNESCAP-World Bank Trade Costs database, where trade costs are expressed in ad valorem equivalent terms as the ratio of international to domestic trade costs and are bilaterally symmetrical. Arvis et al. (2013) used this top-down approach and found that compared to developed countries, the developing countries have much higher trade costs, and a slower rate of lowering trade costs due in large part to logistics and trade facilitation. Their results indicate that the combined effect of trade facilitation and logistics performance has an impact almost as strong as distance on trade costs. Infrastructure services play a major role in trade costs by decreasing distribution margins, reducing prices, and lowering transaction costs (Brooks and Hummels, 2009). There are four aspects to infrastructure that affect trade costs: charges for infrastructure services, timeliness, risk of damage, and market access (Nordas and Piermartini, 2004). Previous empirical evidence using both approaches has shown that infrastructure quality is one of the prime determinants of transport costs, with a negative linkage between them. Limão and Venables (2001) constructed an infrastructure measure to measure the costs of shipping in and through a country, which is an average of the density of the road network, the paved road network, the rail network, and the telephone main lines. They showed that the quality of transport and communication infrastructures are qualitatively important in determining transport costs: for coastal countries, own infrastructure accounts for 40% of transport costs, and for landlocked countries, own and transit country infrastructure accounts for 60% of transport costs. Focusing on the Asia-Pacific region, Wilson et al. (2003) observed that improving port and airport efficiency has a considerable and large positive impact on intra-APEC trade. Clark et al. (2004) approximated port efficiency by a general measure of infrastructure and an index of seaport infrastructure. They demonstrated that port efficiency is an important determinant of ocean freight costs, and improvements of port efficiency can lower trade costs significantly. Additionally, Hummels (2001) found that the time cost of a day in transit for United States imports was equivalent to an ad-valorem tariff rate of 0.8%. Hence, when improved infrastructure services reduce transport time, it will lower trade costs, which then increase the country's propensity to trade.

While trade costs do not explain economic growth on their own, they are an important factor in understanding why some countries struggle to grow or take advantage of their comparative advantages. In prominent trade models, trade costs can have a significant impact on a country's economic development. High trade costs make exports uncompetitive, raise prices, and limit the products available to households and businesses, which distorts resource allocation. Research from the OECD (2015) shows that richer countries tend to have lower trade costs, and countries that make an effort to lower their trade costs usually grow faster than others. This is mainly due to the burden of high costs, which reduces the gains from trade and limits trade. The literature on trade and economic growth provides overwhelming evidence of a positive statistical correlation between them: Ann Harrison (1996), Frankel and Romer (1999), Alcalá and Ciccone (2004), and Feyrer (2009) are among the many cross-country studies that have estimated the effect of trade flows on standards of living by regressing real GDP levels on trade liberalizations (defined in various ways). Therefore, reducing trade costs through infrastructure development could greatly increase each region's opportunities for trade and boost real income in trading regions.

3. Measuring impacts of improving infrastructure quality on trade cost

As previously mentioned, the infrastructure has been evaluated using a variety of broad-based metrics. We incorporate some of these measurements into a regression model to calculate their influence on trade costs. First, we review the existing research on gravity models and explain how to estimate BTC from a reverse gravity model. We then present empirical models with explanations. Finally, we measure the potential trade effects on emerging and developed countries that could result from an improvement in transport infrastructure quality.

3.1 Inferring BTC from inversed gravity model

According to Newton's Law of Universal Gravitation, "any particle in the universe attracts any other particle as a result of a force that is directly proportional to the product of the particles' masses and inversely proportional to the square of the distance between them" (Lu et al., 2018, p. 27). So, we believe that in international trade, countries trade in proportion to their market size (e.g. GDP) and proximity (distance between the countries). In the model, consumers have preferences for different goods based on their origin, with a constant elasticity of substitution. The trade costs are proportional to the goods being shipped and reflect the notion that only a fraction of the goods shipped will reach their destination.

Some past studies have focused on an exploration of the economic foundations underlying gravity equations (see Anderson and van Wincoop, 2003; Arkolakis et al., 2012; Eaton and Kortum, 2002).

$$\boldsymbol{X_{ij}} = \frac{Y_i Y_j}{Y}\left(\frac{t_{ij}}{K_i P_j}\right)^{(1-\sigma)} \qquad (1)$$

$$\boldsymbol{K_i} = \sum_{j=1}^{N}\left(\frac{t_{ij}}{P_j}\right) \wedge (\mathbf{1}-\boldsymbol{\sigma})\frac{Y_j}{Y} \qquad (2)$$

$$\boldsymbol{P_j} = \sum_{i=1}^{N}\left(\frac{t_{ij}}{K_i}\right) \wedge (\mathbf{1}-\boldsymbol{\sigma})\frac{Y_j}{Y} \qquad (3)$$

Where $\boldsymbol{X_{ij}}$ refers to exports from country i to country j, $\boldsymbol{Y_i}$ represents the GDP of country i, $\boldsymbol{Y_j}$ is the GDP of country j, Y refers to the world's GDP, σ is the elasticity of substitution between product varieties and $\boldsymbol{t_{ij}}$ is the BTC of sending products from country i to country j. $\boldsymbol{K_i}$ and $\boldsymbol{P_j}$ are outward and inward multilateral trade resistance (MTR) terms. The MTR represents trade barriers which country i and country j face in the trade with all their trading partners (involving internal trade). For example, trade between countries such as Germany and China are predicated on the costs for each of them in trading with all other countries. A decrease in a BTC between China and a third country such as Belgium would reduce China's MTR. Although the BTC between China and Germany remains unchanged, the decline in China's MTR (attributed to reduction of trade cost between China and Belgium) would culminate in a diversion of trade away from China–Germany to trade between China and Belgium (spill-over effect). Failure or inability to account for the multilateral resistance effects would culminate in upward bias in the estimates of gains from improvements.

Because of its multiplicative nature, the gravity equation outlined in (1) can be altered by taking logarithms to a log-linear form demonstrated as follows:

$$\boldsymbol{lnX_{ij} = lnY_i + lnY_j - lnY + (1-\sigma)(lnt_{ij} - lnK_i - lnP_j)} \qquad (4)$$

Owing to the lack of a direct measure of trade cost, t_{ij} is usually specified empirically as a function of observable variables that are seen as directly correlated to trade cost. In past studies, a loglinear specification is often applied as follows (e.g., Mayer and Zignago 2011):

$$\boldsymbol{lnt_{ij} = \beta_1 ln(distance_{ij}) + \beta_3 ln(contig_{ij}) + \beta_4 ln(comlang_{ij}) + \beta_5 ln(colony_{ij})} \quad \mathbf{(5)}$$

We take distance to denote the geographical distance between countries i and j, contig is a categorical variable equal to one if the countries share a common land border, comlang equals one if the country pairs share the same language and colony is equal to one if countries i and j were in a past colonial association. Accordingly, these aspects reflect the assumptions that transport costs improve with distance and are lower for neighbouring nations. Indicators for common language or colonial history are related to information costs with regard to trade, where search costs are presumably lower for trade between countries whose culture and business practices are familiar to each other.

Lu et al. (2018) proposed one hypothesis that infrastructure quality can change the trade costs $\boldsymbol{t_{ij}}$, and thus also on the bilateral trade flows. Following the hypothesis from Lu et al. (2018), we suggest one hypothesis that infrastructure quality can change the trade costs $\boldsymbol{t_{ij}}$ that could contribute to economic growth. This leads to the specification of trade costs:

$$\boldsymbol{Trade\ cost} = \boldsymbol{\beta_1}(\boldsymbol{infrasquality_i}) + \boldsymbol{\beta_2 ln}(\boldsymbol{distance_{ij}}) + \boldsymbol{\beta_3}(\boldsymbol{contig_{ij}}) + \boldsymbol{\beta_4}(\boldsymbol{comlang_{ij}}) + \boldsymbol{\beta_5}(\boldsymbol{colony_{ij}}) \quad (6)$$

Infrastructure can be decomposed into the quantity and the quality of infrastructure. In our study, we use the density, length, connectivity, or efficiency of transport infrastructure to represent the quality of infrastructure index. Additionally, we use the infrastructure overall score provided by the World Bank to represent the quality of infrastructure. After quantifying the impact of transport infrastructure on BTC, we will use it as a critical input for the CGE analysis in the next stage.

3.2 Measurement of trade costs

We employ the measurement of BTCs, T_{ij}, in manufactured and agricultural goods from 178 countries in the world. It is estimated by reversing the gravity model and inferring BTCs from the observed productions and trade flows across countries (Novy, 2013; Arvis et al. 2016). In our regression we take the natural log of T_{ij} to alleviate the concern from outliers and measurement errors. This measurement is available from the database of ESCAP-World Bank. Following the same method, we compute another measurement of BTCs by excluding the tariffs between countries, $T_{ij}\_extariff$. We conduct robustness tests to use this alternative measure of the BTCs.

3.3 Measurement of transport infrastructure

To measure the transport infrastructure of each country-pair in a given year, we follow Arvis et al. (2013) to calculate the geometric average of country i's and j's scores on the overall infrastructural quality ($Infras_{ij}$), while the annual infrastructural quality score of each country is available from World

Bank's World Development Indicators. In our regression we take the natural log of $Infras_{ij}$ to alleviate the concern from outliers and measurement errors. $Infras_{ij}$ is an integrated measure which comprehensively considers the quality of the infrastructure in terms of transportation and communication. According to Francois and Manchin (2013), using integrated overall infrastructural proxy is superior to incorporating several dimensional factors into the gravity model, since these dimensional factors are highly correlated.

To confirm our inferences are not sensitive to the measurement of transport infrastructure, we employ two sources of alternative measurements. First, we select the other three integrated infrastructure proxies from World Bank's World Development Indicators: LPT_{ij} is the geometric average of country i's and j's scores on the logistic performance index; $LSCI_{ij}$ is the geometric average of country i's and j's scores on the linear shipping connectivity index; $Port_{ij}$ is the geometric average of country i's and j's scores on the quality of port infrastructure. These three measures are all related to the quality of traffic infrastructure across countries.

Second, while the integrated proxies are advocated by some scholars, other literature also promote individual measurements of traffic connectivity (Lu et al. 2018), because the improvement of the ports, airports, and trainlines will significantly reduce the cost and time of the transportation (Ansar, Flyvbjerg, Budzier and Lunn, 2016). Specifically, we select the following proxies to represent the overall connectivity in terms of aviation, railway, roadway and maritime transportation: $Aird_{ij}$ is the geometric average of country i's and j's number of airports scaled by the area of each country i.e. average of airport density of each country pair i and j; $Raild_{ij}$ is the geometric average of country i's and j's length of railway scaled by the area of each country; $Roadd_{ij}$ is the geometric average of country i's and j's length of roads scaled by the area of each country; $Containerd_{ij}$ is the geometric average of country i's and j's flows of containers from land to sea (or vice versa), scaled by the area of each country. Number of airports, and length of roads are obtained from CIA's World factbook by each year. The container flows are obtained from World Bank's World Development Indicators. The source of the length of railway is twofold. We first obtain the railway data from World Bank's World Development Indicators, then we complement the missing values from CIA's World factbook.

3.4 Determinants of trade costs

To examine the determinants of BTCs our model takes the following form:

$$\begin{aligned} \text{Ln}(T_{ij}) = {} & a_0 + a_1 \text{Ln}(Infras_{ij}) + a_2 \text{Ln}(Dist_{ij}) + a_3\, Common\ border_{ij} + a_4\, Comlang\_off_{ij} \\ & + a_5\, Comlang\_ethno_{ij} + a_6\, Colony_{ij} + a_7\, Colonizer_{ij} + a_8\, Same\ country_{ij} \\ & + a_9\, Landlocked_{ij} + a_{10}\, RTA_{ij} + a_{11} \text{Ln}(Entry\ cost_{ij}) + e_{ij}; \qquad (7) \end{aligned}$$

Since the BTCs are symmetric, in our estimations we drop half country-pairs (i.e. U.S exports to China and China exports to U.S. are regarded as repetitive country pairs since the BTCs will be the same for each pair) to avoid the potential underestimated standard errors due to the duplicate country pairs. In unreported tests we confirm that our inferences are robust without removing the duplicate country-pairs. In the baseline model we employ the OLS model to run the regression. However, considering omitted variables which may bias our inferences, we consider two forms of the estimations to address the model specification. First, we control for the imported, exported and year fixed effects to control the omitted determinants of BTCs at the country level that are time-invariant. Second, we also choose the Poisson Maximum Likelihood Estimation (PPML), which has been advocated by literature (Lu et al. 2018).

The dependent variable (BTCs) and the main independent variable (traffic infrastructure) have been introduced in Section 1.1 and 1.2. Prior literature argues that there are also other determinants to affect the BTCs, which could be either "policy" or "natural". Following the literature (Arvis et al. 2016; Novy and Chen, 2011; Limao and Venables, 2001) we select the following control variables: $Dist_{ij}$ is the geodesic distance between the exporting and importing countries, using the largest (by population) city in each; $Common\ border_{ij}$ is a dummy = 1 if both countries are geographically contiguous; $Comlang\_off_{ij}$ and $Comlang\_ethno_{ij}$ are dummy variables equal to 1 if both countries have common official or ethnographic language; $Colony_{ij}$ is a dummy = 1 if one country used to be a colony of another; $Colonizer_{ij}$ is a dummy = 1 if both countries used to be colonized by another country; $Same\ country_{ij}$ is a dummy = 1 if the two countries used to be part of the same country; $Landlocked_{ij}$ is a dummy = 1 if both countries are landlocked; RTA_{ij} is a dummy = 1 if both the importer and exported benefit from the same regional trade agreement; $Entry\ cost_{ij}$ are the cost of starting a business. Following the logic to create infrastructure measure for each country pair, we take the geometric average for the country i's and j's entry cost and use the log form to avoid outliers.

3.5 Data and Sources

The definition and data source of our variables are summarized in Table 1 as below.

Table 1: Data and Sources

Variable	Definition	Source
T_{ij}	BTC between importing and exporting countries	ESCAP-World Bank
T_{ij}*_extariff*	BTC between importing and exporting countries, excluding tariff	ESCAP-World Bank
$Infras_{ij}$	Geometric average of country i's and j's scores on the overall infrastructural quality	World Economic Forum
LPT_{ij}	Geometric average of country i's and j's scores on the overall logistic performance index	World Bank
$LSCI_{ij}$	Geometric average of country i's and j's scores on the linear shipping connectivity index	World Bank
$Port_{ij}$	Geometric average of country i's and j's scores on the port quality index	World Bank
$Aird_{ij}$	Geometric average of country i's and j's number of airports scaled by the area of each country i.e. average of airport density of each country pair i and j	CIA World Factbook. We obtain the legacy data by years from 2010 to 2015
$Raild_{ij}$	Geometric average of country i's and j's length of railway scaled by the area of each country	World Bank; CIA World Factbook
$Roadd_{ij}$	Geometric average of country i's and j's length of roads scaled by the area of each country	CIA World Factbook
$Containerd_{ij}$	Geometric average of country i's and j's flows of containers from land to sea (or vice versa), scaled by the area of each country	World Bank
$Dist_{ij}$	Geodesic distance between the exporting and importing countries, using the largest (by population) city in each	CEPII
$Common\ border_{ij}$	Dummy = 1 if both countries share a common land border	CEPII
$Comlang\_off_{ij}$	Dummy = 1 if both countries share the same official language	CEPII
$Comlang\_ethno_{ij}$	Dummy = 1 if both countries share the same ethnographic language	CEPII
$Colony_{ij}$	Dummy = 1 if one country used to be a colony of another	CEPII
$Colonizer_{ij}$	Dummy = 1 if both countries used to be colonized by another country	CEPII
$Same\ country_{ij}$	Dummy = 1 if the two countries used to be part of the same country	CEPII
$Landlocked_{ij}$	Dummy = 1 if both countries are landlocked	CEPII
RTA_{ij}	Dummy = 1 if both the importer and exported benefit from the same regional trade agreement	Personal website of Prof. De Sousa
$Entry\ cost_{ij}$	Geometric average for the country i's and j's entry cost	Doing Business (via World Bank)

Our sample stems from 2010 to 2015, which allows us to cover a maximum range of data availability across various databases. Our sample covers 143 countries, including both developed and developing countries.

3.6 Empirical findings

3.6.1 Baseline results

Table 2 presents the baseline results. Column 1 employs the OLS model where the dependent variable is T_{ij}. The benefits of improving transport infrastructure quality are statistically and economically significant: 1 percent increase of the overall infrastructure quality for a country pair will on average reduce the BTC by 0.88 percent ceteris paribus. The coefficient signs of the control variables within our regression model are generally in line with the expectation from prior literature. In Column 2 we control the exporter, importer, and year fixed effect to alleviate the effect of omitted variables to our inferences, and in Column 3 we employ the PPML model[1]. The results from Column 2 and 3 confirm the negative relationship between improved traffic infrastructure and BTCs, albeit with smaller elasticities. Column 4 to 6 repeat the estimations from Column 1 to 3 by employing the BTCs excluding tariff. Again, our inferences are robust.

[1] Because the dependent variable cannot be negative in the PPML model, in Column 3 and 6 we do not take the natural log of the BTCs.

Table 2: Impacts of Improving Transport Infrastructure on BTCs

	(1)	(2)	(3)	(4)	(5)	(6)
Estimation Method	OLS	FE	PPML	OLS	FE	PPML
Dependent Vars	Ln (T_{ij})	Ln (T_{ij})	Ln (T_{ij})	Ln (T_{ij}_*Extariff*)	Ln (T_{ij}_*Extariff*)	Ln (T_{ij}_*Extariff*)
Ln (Infras$_{ij}$)	**-0.8843*** **	**-0.2005*** **	**-0.2001*** **	**-0.8218*** **	**-0.2241*** **	**-0.1862*** **
	(-53.23)	**(-4.64)**	**(-45.79)**	**(-48.06)**	**(-5.01)**	**(-41.48)**
Ln (Dist$_{ij}$)	0.1922***	0.3281***	0.1606***	0.1924***	0.3357***	0.1643***
	(46.96)	(94.15)	(35.10)	(45.87)	(92.10)	(35.15)
Common border$_{ij}$	-0.5736***	-0.2773***	-0.6272***	-0.5889***	-0.2745***	-0.6483***
	(-33.14)	(-16.84)	(-32.36)	(-33.57)	(-16.16)	(-34.08)
Comlang_off$_{ij}$	0.0679***	-0.0583***	0.0765***	0.0703***	-0.0502***	0.0759***
	(5.76)	(-6.55)	(5.48)	(5.82)	(-5.46)	(5.35)
Comlang_ethno$_{ij}$	-0.0987***	-0.0414***	-0.0879***	-0.1102***	-0.0403***	-0.0993***
	(-8.51)	(-4.64)	(-6.42)	(-9.24)	(-4.36)	(-7.08)
Colony$_{ij}$	-0.3920***	-0.2248***	-0.4889***	-0.3887***	-0.2400***	-0.4784***
	(-24.13)	(-15.65)	(-24.62)	(-23.11)	(-16.52)	(-23.47)
Colonizer$_{ij}$	0.1806***	-0.0672***	0.2036***	0.1636***	-0.0789***	0.1905***
	(14.44)	(-6.57)	(14.07)	(12.72)	(-7.49)	(12.92)
Same country$_{ij}$	-0.1525***	-0.1237***	-0.1758***	-0.1465***	-0.1247***	-0.1725***
	(-15.32)	(-15.97)	(-14.40)	(-14.36)	(-15.67)	(-13.88)
Landlocked$_{ij}$	0.2687***	-0.2082***	0.2651***	0.2892***	-0.2057***	0.2778***
	(18.01)	(-15.52)	(16.54)	(19.16)	(-15.04)	(17.45)
RTA$_{ij}$	-0.2559***	-0.1497***	-0.2568***	-0.1989***	-0.0986***	-0.2023***
	(-34.18)	(-27.81)	(-28.90)	(-26.13)	(-17.93)	(-22.45)
Entry cost$_{ij}$	0.0634***	0.0083	0.0598***	0.0502***	0.0113	0.0466***
	(23.56)	(1.21)	(19.33)	(18.16)	(1.61)	(14.71)
Constant	5.0149***	2.9269***	5.0023***	4.8356***	2.8029***	4.8281***
	(112.34)	(32.71)	(106.47)	(105.68)	(30.86)	(100.05)
Fixed Effect	No	Exporter, Importer, year	No	No	Exporter, Importer, year	No
Obs	36047	36047	36047	35701	35701	35701
Adj R2 (Pseudo R2)	0.3840	0.7630	0.4488	0.3387	0.7425	0.4184

t-statistics are in the parentheses; ***, **, and * represents statistical significance at 1% , 5%, and 10% level, respectively (two-tailed test).

3.6.2 *Baseline results by Developed and Emerging countries*

We further examine the baseline results by looking at the subsamples where (1) both importing and exporting countries are developed countries (DLC), (2) the bilateral trades occur between developed and emerging countries and (3) the bilateral trades occur within emerging countries (EGC). For brevity we only report the results employing the OLS model where dependent variable is Tij2. We define a country as developed one if it simultaneously satisfies the criteria of developed countries criteria set by the following organizations: United Nations, World Bank, International Monetary Foundation (IMF) and CIA. There are 31 developed countries within our sample. The results are presented in Table 3 as follows: We document that the negative relationship between infrastructure quality and BTCs is consistent within the subsample of DLCs, the subsample of EGCs and the subsample where bilateral trades occur between DLCs and EGCs. Specifically, 1 percent increase of the average overall infrastructure quality for a pair of DLCs will on average reduce the BTC by 0.25 percent ceteris paribus (Column 1), while 1 percent increase of the average overall infrastructure quality for a pair of EGCs will on average reduce the BTC by 0.46 percent ceteris paribus (Column 3). The difference between the coefficients of Ln (Infrasij) is statistically significant in the seemingly unrelated estimation (SUEST) which is used to compare the coefficients of the same variable across subsamples (Chi 2 = 5.87, p-value = 0.0152). Therefore, compared with the bilateral trades within the pair of developed countries, the impact of infrastructure improvement on BTC is more pronounced within the pair of emerging countries.

Table 3: Impacts of Improved Infrastructure on BTCs: Developed (DLC) and Emerging (EGC) Countries

[2] The results are robust when we use alternative regression models. These results are available upon requested.

	(1)	(2)	(3)
Estimation Method	OLS	OLS	OLS
Dependent Vars	Ln (T_{ij})	Ln (T_{ij})	Ln (T_{ij})
Subsample	**Within DLC**	**Cross DLC-EGC**	**Within EGC**
Ln (Infras$_{ij}$)	**-0.2528*** **	**-0.7142*** **	**-0.4622*** **
	(-2.78)	**(-23.96)**	**(-19.60)**
Ln (Dist$_{ij}$)	0.3209***	0.2195***	0.1576***
	(23.94)	(34.03)	(27.50)
Common border$_{ij}$	-0.3394***	-0.5936***	-0.5911***
	(-8.69)	(-6.70)	(-31.60)
Comlang_off$_{ij}$	0.0551	0.1219***	0.0024
	(1.60)	(7.30)	(0.14)
Comlang_ethno$_{ij}$	-0.3768***	-0.1333***	-0.0162
	(-14.18)	(-8.43)	(-0.93)
Colony$_{ij}$	-0.0662**	-0.3689***	-0.3388***
	(-2.19)	(-18.27)	(-7.14)
Colonizer$_{ij}$	0.2832***	0.3099***	0.1458***
	(4.39)	(14.17)	(9.01)
Same country$_{ij}$	0.1476***	-0.0756***	-0.2490***
	(4.47)	(-5.11)	(-17.27)
Landlocked$_{ij}$	0.2673***	0.2719***	0.3845***
	(5.69)	(13.63)	(18.14)
RTA$_{ij}$	0.1090***	-0.1472***	-0.3130***
	(4.12)	(-14.44)	(-26.60)
Entry cost$_{ij}$	-0.0216***	0.0228***	0.0762***
	(-2.62)	(5.65)	(19.34)
Constant	2.4279***	4.5004***	4.7917***
	(10.69)	(59.65)	(78.87)
Obs	1895	14768	19384
Adj R^2	0.6060	0.2519	0.3383

t-statistics are in the parentheses; ***, **, and * represents statistical significance at 1 percent, 5 percent, and 10 percent level, respectively (two-tailed test).

3.6.3 Alternative measures of traffic infrastructure

To verify whether our findings are sensitive to the choice of traffic infrastructure measures, we conduct several robustness tests by employing seven alternative measures specified in Section 3.3. The results are reported in Table 4. Column 1 shows that, ceteris paribus, an improvement of 1 percent in the logistical performance index is associated with a reduction of the BTC by 2.40 percent. This is in line with the findings of Arvis et al. (2016) who documented an elasticity of -1.61 between LPT and BTCs. Column 2 and 3 show that our findings remain robust when employing other two integrated infrastructure proxies.

In Columns 4 to 7, we use single traffic connectivity measures for aviation, railway, roadway, and maritime transportation. On average, an increase of 1 percent in the airport density for the country pair is associated with a 0.15 percent reduction in BTCs. Similarly, increasing 1 percent of the railway density, roadway density, and container flows capacity is associated with a reduction of BTCs by 0.13 percent, 0.04 percent, and 0.24 percent, respectively. Finally, we look at the impacts of the alternative traffic infrastructure measures on BTCs by considering the developed and emerging countries separately and interactively. The results are presented in Table 5. Again, the negative relationship between alternative traffic infrastructure measures and the BTCs is robust within each subsample..

Table 4: Impacts of Improving Transport Infrastructure on BTCs: Alternative Infrastructure Measures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Estimation Method	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Dependent Vars	Ln (T_{ij})	Ln (T_{ij})	Ln (T_{ij})	Ln (T_{ij})	Ln (T_{ij})	Ln (T_{ij})	Ln (T_{ij})
Integrated indicators							
Ln (LPT_{ij})	**-2.4040*** **						
	(-108.64)						
Ln ($LSCI_{ij}$)		**-0.4381*** **					
		(-87.84)					
Ln ($Port_{ij}$)			**-0.9201*** **				
			(-63.44)				
Single traffic connectivity							
Ln ($Aird_{ij}$)				**-0.1507*** **			
				(-42.71)			
Ln ($Raild_{ij}$)					**-0.1263*** **		
					(-40.59)		
Ln ($Roadd_{ij}$)						**-0.0401*** **	
						(-13.67)	
Ln ($Containerd_{ij}$)							**-0.2433*** **
							(-109.23)
Other Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	6.2038***	4.1890***	4.8145***	3.6225***	3.6359***	3.3245***	5.8984***
Obs	(149.13)	(104.65)	(119.28)	(86.71)	(100.75)	(74.37)	(125.64)
Adj R^2	33537	26402	36774	26874	38832	38832	26223

t-statistics are in the parentheses; ***, **, and * represents statistical significance at 1 percent, 5 percent, and 10 percent level, respectively (two-tailed test).

Table 5: Impacts of Improving Transport Infrastructure on BTCs: Alternative Infrastructure Measures: Developed (DLC) and Emerging Countries (EGC)

	Panel A: Within DLC				Panel B: Cross DLC and EGC				Panel C: Within EGC			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<u>**Single traffic connectivity**</u>												
Ln ($Aird_{ij}$)	**-0.1209*****				**-0.1284*****				**-0.0511*****			
	(-7.74)				**(-21.64)**				**(-9.98)**			
Ln ($Raild_{ij}$)		**-0.0248****				**-0.0843*****				**-0.0369*****		
		(-2.02)				**(-16.23)**				**(-7.88)**		
Ln ($Roadd_{ij}$)			**0.0246****				**-0.0220*****				**0.0175*****	
			(2.29)				**(-4.84)**				**(4.29)**	
Ln ($Containerd_{ij}$)				**-0.1596*****				**-0.2244*****				**-0.2414*****
				(-23.88)				**(-69.15)**				**(-74.16)**
Other Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.7817***	2.0009***	2.1361***	4.1994***	3.6460***	3.4013***	3.1696***	5.6006***	4.2129***	4.1015***	4.3029***	6.0952***
	(15.66)	(17.23)	(15.77)	(31.09)	(55.97)	(60.10)	(46.48)	(78.64)	(68.84)	(81.31)	(66.57)	(85.63)
Obs	1610	2049	2049	1752	11151	16107	16107	10981	14113	20676	20676	13490
Adj R^2	0.6736	0.6036	0.6039	0.7106	0.2637	0.2334	0.2221	0.4971	0.3594	0.3240	0.3226	0.5277

We examine the impacts of improving traffic infrastructure on BTCs within the subsample of developed countries (Panel A), the subsample between developed and emerging countries (Panel B) and within the subsample of emerging countries (Panel C). We use the OLS model where dependent variable is the natural log of T_{ij}. We present the results of the individual traffic connectivity proxies in terms of aviation, railway, roadway, and maritime transportation. We do not tabulate the results using other integrated infrastructure proxies such as LPI, LSCI and port quality. They are available upon requested. The *t*-statistics are in the parentheses; ***, **, and * represents statistical significance at 1 percent, 5 percent, and 10 percent level, respectively (two-tailed test).

3.6.4 *Summary*

Based on the literature discussing the determinants of BTCs, we conduct a regression to reveal the impact of improving traffic infrastructure on BTCs. Our results confirm that improving infrastructure (either proxied by integrated traffic quality or single traffic connectivity) is significantly associated with lower BTCs, and this finding is robust within developed and emerging countries.

4. Measuring the impact of trade cost shock on economic growth

In the above, we have estimated the effects of enhancing transport infrastructure on trade costs. To model the relationship between the alteration of trade costs and economic growth, we first analyze the theoretical basis of a CGE model, then utilize the estimated results from the prior section as suppositions for trade cost change in the CGE model. We provide an estimation of the trade cost impacts on GDP growth across various economic regions.

4.1 Baseline CGE model

Our projections are based on version 10 of the standard Global Trade Analysis Project (GTAP) computable general equilibrium (CGE) model featuring imperfect competition. Generally, CGE model consists of production side and consumption side described by production functions, income functions, price equations, payment functions and macro closure equations (Robinson, 1999). The first four groups of functions represent the characteristics of the economic system described by CGE model, while the macro-closed functions are the reflection of the CGE model's theoretical basis-Walras general equilibrium theory. Production generates income for the regional households, and then this income is distributed across three broad categories of expenditure: private consumptions, investment, and government spending. Each category of expenditure comprises both domestic and imported goods and services, thereby generating both domestic and export sales by firms.

4.2 Data source

The GTAP 10 database features 2014 reference years as well as 141 regions and countries for all 65 GTAP sectors. This paper, based on the Global Trade Analysis Project 10 (GTAP 10) database, uses standard GTAP CGE model to estimate the impact of improving transport infrastructure to a total 141 countries /regions in the world. This paper aggregates this data into 3 countries in terms of country classification including developed country, emerging country, and developing country (Appendix 1). Also, our model covers 32 sectors and these sectors details can be seen in the aggregation level of the CGE structure (Appendix 2).

4.3 Assumptions in CGE model

In this study, we have provided robust evidence about the impacts of improving transport infrastructure on trade cost. In this section, we further explore the impacts of reduction of trade cost on economic growth. We regard trade cost as an exogenous shock to simulate the cost changes and trace the impact on key economic variables, including real GDP and nominal GDP growth. Specifically, the model simulation needs to identify and quantify the initial shocks in exogenous variables. In the case of trade facilitation as an initial shock to a CGE model, researchers can use a so-called iceberg specification as a standard approach. In the latest GTAP model, the parameter (ams), import-augmenting technical change, is adopted as the exogenous shock variable for the simulation of the importing cost reduction, particularly that from trade facilitation measures

(Walmsley and Minor, 2016). Kleitz (2002) also indicates that the benefits of trade facilitation can be typically viewed as equivalent to trade costs that can be saved.

Shocks to ams(i,r,s) refer to the negative of the rate of decay on imports of commodity or service i from region r imported by region s (the arguments in the parentheses represent as follows: i; commodity, r: exporting region, and s: importing region). Take an example, when one percent increase in ams(i,r,s) takes place for all exporters, then the price of the imported goods in the region declines by one percent. We use a scenario analysis, and each scenario puts forward a separate assumption to reflect the impacts of trade facilitation (or trade cost) on economic growth (see Table 6). Indeed, in scenario 1, based on the estimator, 1 percent increase of the overall infrastructure quality for a country pair will on average reduce the BTC by 0.88 percent ceteris paribus. Therefore, we estimate the impacts of a decrease of 0.88 percent of the BTC on GDP growth by employing a CGE model. Given the fixed effects estimator in scenario 2, 1 percent growth of the overall infrastructure quality for a country pair could averagely reduce the BTC by 0.2 percent ceteris paribus. So, we test the impacts of 0.2 percent decrease of trade cost on GDP Growth. Also, we employ estimations of the PPML model as our assumption in scenario 3. Specifically, 1 percent growth of the overall infrastructure quality for a country pair could averagely reduce the BTC by 0.2 percent ceteris paribus. Scenario 4 to 6 repeat the estimations from scenario 1 to 3 by employing the BTC excluding tariff.

Table 6 Assumptions with scenario analysis

Scenario	Assumptions
scenario 1	Based on the estimations of OLS model, a country pair could averagely reduce the BTC by 0.88 percent
scenario 2	Based on the fixed-effect estimator, a country pair could averagely reduce the BTC by 0.20 percent
scenario 3	Based on the estimations of PPML model, a country pair could averagely reduce the BTC by 0.20 percent
scenario 4	Based on the estimations of OLS model, a country pair could averagely reduce the BTC by 0.82 percent (excluding tariff)
scenario 5	Based on the fixed-effect estimator, a country pair could averagely reduce the BTC by 0.22 percent (excluding tariff)
scenario 6	Based on the estimations of PPML model, a country pair could averagely reduce the BTC by 0.19 percent (excluding tariff)

4.4 Model estimations

Our estimations, based on the GTAP CGE model, provide evidence on the impacts of improving transport infrastructure on economic growth. Our findings show reducing trade cost contributes to a rise of the real GDP in all economies. Specifically, in scenario 1, the developing country could gain the most (0.99 percent) in real GDP growth. Developed countries would enjoy 0.86 percent for its real GDP growth. Emerging countries could gain 0.66 percent in GDP growth. In scenario 2, our findings show developing countries still could enjoy the most for its economic growth with a 0.22 percent rise of its real GDP growth. Developed countries could experience a rise of 0.19 percent in real GDP growth. In scenario 3, our estimations show the developing country could gain the most (0.92 percent) for its economic growth. Also, developed countries could gain 0.18 percent for their GDP growth. Emerging economies could enjoy a rise of 0.14 percent for its GDP growth. Similarly, scenario 4 to 6 show the developing country would gain the most followed by developed country and emerging country.

Table 7 Changes percent in real GDP of the world in the long term

Scenario	Developed country (Real GDP percent)	Emerging country (Real GDP percent)	Developing country (Real GDP percent)
scenario 1	0.86	0.66	0.99
scenario 2	0.19	0.15	0.22
scenario 3	0.19	0.15	0.22
scenario 4	0.80	0.16	0.92
scenario 5	0.21	0.16	0.25
scenario 6	0.18	0.14	0.21

5. Discussion and Conclusions

The current scholarly literature has paid limited attention to understanding the relationship between infrastructure quality, GDP growth, and trade costs. This study takes a step forward in enriching our understanding of this important issue by examining the impact of infrastructure quality on trade costs for both developed and emerging markets. Using a CGE analysis, we shed light on the potential benefits of improving infrastructure quality on GDP growth, through the trade-cost channel, across different economies. The key findings are that improving transport infrastructure quality can significantly reduce the trade costs by 0.46% between emerging economies, 0.25% between developed economies, and 0.71% between emerging and developed economies, for every 1% increase in infrastructure quality. In addition, our estimations provide evidence of the impacts of improving overall infrastructure quality on trade costs and economic growth, through the trade-cost reduction channel. Our findings show that reducing trade costs leads to an increase in real GDP in all economies, with the greatest gains in real GDP being seen in developing countries (0.21-0.99%). Developed countries and emerging countries could also expect to see their GDPs grow by

0.16-0.86 and 0.14-0.66, respectively. Thus, improved transport infrastructure quality can play an important role in economic success, suggesting that fiscal policies aimed at improving transport infrastructure can have a considerable impact in promoting economic growth. Moreover, such investments in East Asia and the Pacific may have even higher growth payoffs than initially expected. These results also support initiatives such as the Belt and Road Initiative and the expansion of 5G networks. By enabling goods to move faster and more efficiently through the markets, the positive spillovers from the BRI may be greater than initially thought. However, this is a topic which requires further investigation.

<u>Theoretical and practical Implications</u>

From a theoretical standpoint, this paper adds to the existing literature by quantifying the impact of infrastructure investment on BTCs (Bilateral Trade Costs). Arvis et al. (2013) discussed the influence of infrastructure on the BTC within developing countries, but this study updates their research by employing a sample period after the onset of BRI (Belt and Road Initiative). Additionally, this analysis extends the examination of infrastructure-trade cost to the bilateral partners between emerging and developed economies. While the past literature has revealed the theoretical relationship between infrastructure and GDP growth, and alluded to trade cost as a channel to connect them, this study is the first to quantify the impact of such a channel. Furthermore, by using newly available data from the World Bank database and other sources, this research fills gaps which the previous literature could not. Specifically, by combining regression models, neural network analysis and computable general equilibrium models to estimate the impacts of improving transport infrastructure on trade cost and economic growth, the impact of infrastructure improvements on macro and global scales can be traced.

Limitations and Directions for Further Research

By comparing the cost of improving infrastructure quality with our estimated benefits, there is a vast scope for future research. Our study is limited, however, by our specific focus on transport infrastructure, which restricts the generalizability to other industrial settings. This presents a promising new area for future research to explore. Additionally, it is worth examining the relationship between transport infrastructure improvement due to major transport infrastructure projects and the economic performance of the participating economies, such as those associated with the Belt and Road Initiative (BRI). Not only is this evidence essential for the development of future projects, but BRI can serve as an example for other infrastructure investments that can boost economic links.

Data Availability

Raw data required to construct the variables of our study were obtained via publicly available datasets specified in the article. The data underlying this article are available in the article and in its online supplementary material.

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Appendix

Appendix 1: Sectorial aggregation

Sector aggregation	Previous sector	Code in modelling
Automotive	Motor vehicles and parts	mvh
Beef	Bovine meat products	cmt
BeverTobac	Beverages and tobacco	b_t
BusiServs	Business services nec	obs
CerealGrns	Paddy rice, Wheat, Cereal grains nec, Processed rice	pdr, wht, gro, pcr
CheRubPlas	Chemical, rubber, plastic products	crp
Communicat	Communication	cmn
Construct	Construction	cns
Dairy	Raw Milk, Dairy products	rmk, mil
ElectronEq	Electronic equipment	ele
Ferrous	Ferrous metals	i_s
FinanServs	Financial services nec, Insurance	ofi, isr
Fishing	Fishing	fsh
FoodProd	Food products nec	ofd
ForestWood	Forestry, Wood products, Paper products, publishing	frs,lum,ppp
FossilFuel	Coal, Oil, Gas, Petroleum, coal products	coa, oil, gas,p_c
FruitVege	Vegetables, Fruits, Nuts	v_f
MachinEq	Machinery and equipment nec	ome
MetalProd	Metal products	fmp
MinralProd	Minerals nec, Mineral products nec	omn, nmm
NonFerrous	Metals nec	nfm
OilSVegOil	Oil seeds, Vegetable oils and fats	osd, vol
OthFarming	Plant-based fibers, Crops nec, Bovine cattle, Sheep and goats, Horses, Animal products, Wool, Silk-worm cocoons	pfb, ocr, cti, oap, wol
OthManufac	Manufactures nec	omf
OthServs	Public Administration, Defense, Education, Health, Dwellings	osg, dew
PorkPoul	Meat products nec	omt
Recreation	Recreational and other services	ros
Sugar	Sugar cane, Sugar beet, Sugar	c_b, sgr
TextApparl	Textiles, Wearing apparel, Leather products	tex, wap, lea
Trade	Trade	trd
TranspEq	Transport equipment nec	otn
Transport	Transport nec, Water transport, Air transport	otp,wtp,atp

Appendix 2: Regional/National code & aggregation

Regions/Countries	Code in modelling
China, Hong Kong, Taiwan. Russian Federation.India United States of America Kazakhstan, Kyrgyzstan, Armenia, Azerbaijan, Georgia, Iran Islamic Republic of Iran Japan, Korea, Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Philippines, Singapore, Thailand, Viet Nam, Rest of Southeast Asia, Mongolia Bangladesh, Nepal, Pakistan, Sri Lanka, Rest of South Asia, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia, Albania, Bulgaria, Belarus, Croatia, Ukraine, Rest of Eastern Europe, Bahrain, Israel, Oman, Qatar, Saudi Arabia, Turkey, United Arab Emirates, Egypt Kenya, Tanzania Australia, New Zealand, Rest of Oceania, Rest of East Asia, Canada, Mexico, Rest of North America, Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela, Rest of South America, Costa Rica, Guatemala, Guatemala, Honduras, Nicaragua, Panama, El Salvador, Rest of Central America, Jamaica, Puerto Rico, Trinidad and Tobago, Caribbean, Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Spain, Sweden, United Kingdom, Switzerland, Norway, Rest of EFTA, Romania, Rest of Europe, Rest of Former Soviet Union, Jordan, Kuwait, Rest of Western Asia, Morocco, Tunisia, Rest of North Africa, Rest of North Africa, Benin, Burkina Faso, Cameroon, Cote d'Ivoire, Ghana, Guinea, Nigeria, Senegal, Togo, Rest of Western Africa, Central Africa, South Central Africa, Ethiopia, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Uganda, Zambia, Zimbabwe, Rest of Eastern Africa, Botswana, Namibia, South Africa, Rest of South African, Customs, Rest of the World	chn, hkg, twn, rus. Ind, usa,kaz, kgz, arm, aze, geo, irn, Jpn, kor, brn, khm, idn, lao, mys, phl, sgp, tha, vnm, xse, mng bgd, npl, pak, lka, xsa, cze, est, grc, hun, lva, ltu, pol, svk, svn, alb, bgr, blr, hrv, ukr, xee, bhr, isr, omn, qat, sau, tur, are, egy ken, tza, aus, nzl, xoc, xea, can, mex, xna, arg, bol, bra, chl, col, ecu, pry, per, ury, ven, xsm, cri, gtm, hnd, nic, pan, slv, xca, jam, pri, tto, xcb, aut, bel, cyp, dnk, fin, fra, deu, irl, ita, lux, mlt, nld, prt, esp, swe, gbr, che, nor, xef, rou, xer, xsu, jor, kwt, xws, mar, tun, xnf, ben, bfa, cmr, civ, gha, gin, nga, sen, tgo, xwf, xcf, xac, eth, mdg, mwi, mus, moz, rwa, uga, zmb, zwe, xec, bwa, nam, zaf, xsc, xtw

No.	Code	Description	Old regions
1	ddc	developed economies	aus nzl hkg jpn kor can usa aut bel cyp dnk fin fra deu grc irl ita ltu lux nld prt esp swe gbr

2	ems	emerging economies	chn twn idn mys phl sgp tha vnm ind pak lka mex xna arg bra chl col ecu per ury ven cze est hun lva mlt pol svk svn xef bgr hrv rou rus ukr xee xer kaz arm aze geo bhr irn isr kwt omn qat sau tur are egy mar tun nga sen ken zaf
3	dpc	developing economies	xoc mng xea khm lao xse bgd npl xsa bol pry xsm cri gtm hnd nic pan slv xca xcb che nor alb blr kgz xsu xws xnf ben bfa cmr civ gha gin tgo xwf xcf xac eth mdg mwi mus moz rwa tza uga zmb zwe xec bwa nam xsc xtw