Differential Effects of Internal and External Distances on Trade Flows: The Case of Pakistan

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Abstract

This paper examines the differential effects of domestic and international transportation distances on firm-level exports of Pakistan. It uses novel datasets that identify the locations of firms in the hinterland, ports of entry/exit and modes of shipment (air, land or sea) over time and contain transaction-level details for exports, imports and domestic trade. The study exploits the information on domestic sales and purchases along with the historical pattern of entry of these firms into exporting to circumvent the potential endogeneity of manufacturing location choice. The paper finds that access to trade-processing facilities is a key limiting factor in trade flows. On average, the marginal effect of domestic distance to port of exit is almost three-folds than that of international distance to ports of entry in export markets. Both segments of distance have heterogeneous effects along trade margins: domestic distance impedes exports primarily through extensive margins (EM) of firms and product, whereas international distance restricts these mainly through quantity margins, in addition to constricting the EM. The results are robust to alternative measures of distances as well as to the deconstruction of these effects across sectors and over time.

Keywords: Trade costs, inland distance, structural gravity, trade margins, Pakistan

JEL Codes: F1, F14, O18, R12

1 Introduction

During the last two decades, the fall in tariffs, improvement in maritime transport and increased access to communication technologies have reduced the cost of transacting business internationally. Despite the reduction in the international elements of trade costs, the integration of most developing countries in the world trading system is very low, which has drawn attention to barriers impeding trade flows within countries, especially prohibitive costs of transporting goods from factories and farms to gateway ports and airports. These domestic trade costs are quite high: for example, Anderson and van Wincoop (2004) argue that domestic costs in the US are more than twice as high as the cost of international transportation. Limao and Venables (2001) show that the per unit cost of overland transport in the US is higher than that of the sea leg. Rousslang and To (1993) find that domestic freight costs for US imports are of the same order as their international component.

This domestic component of trade cost is particularly high in developing countries: Atkin and Donaldson (2014) find that intra-national costs in Ethiopia and Nigeria are 4 to 5 times larger than that for the US. In the developing world, these costs – inter-alia – are usually induced by the remoteness of trade-processing infrastructure from firms' production facilities and are further compounded by poor transport networks (ODI, 2015). Theoretically, all firms are within the same country, but in practice firms may be located thousands of miles away from export-processing stations[1]. These within country haulages, in some cases, could be longer than international maritime voyages to the markets of trading partners.

Since a typical trade consignment involves both domestic and international transportation, from firms manufacturing facilities to trade-processing facilities and from gateway ports to export markets, this paper investigates the differential effects of both segments on firm-level trade flows. It exploits the rich information on the locations of firms' in Pakistan's hinterland, ports of entry and exit and modes of shipments, to compute the inland distances from manufacturing locations to sea ports. This domestic component of transportation distance is used as an additional regressor in gravity estimations together with the international component of distance (to markets of trading partners). Following estimation of the overall trade-impeding effects of both components of distances, the paper deconstructs the estimated coefficients along the relative responses of extensive margins (EM) of firms and products as well as margins of prices and quantities. Finally, it explores the heterogeneity in the responses of trade margins along firms' trade orientation, sectoral distribution and over time.

The paper finds that, on average, the marginal effect of internal distance (from factory location to sea ports) is almost three-folds than that of international distance (to export markets). Both elements of

[1]The inland transportation distances from manufacturing locations to main sea ports for some economies vary from 500 Kilometres (km) to more than 1,000 km (see Table A1 in the appendix). The average inland distances in Pakistan to gateway sea ports is 555km, it however varies from 50 km to more than 2500 km across industrial regions (Table 4).

distance have heterogenous effects along trade margins: internal distance shrinks mainly the EM of firms and products, whereas external distance, besides restricting trade flows along the EM, has a relatively large effect through quantity margins. The relatively large trade-impeding effect of inland distance is robust to various specifications but its magnitude is sensitive to firms' trade orientation; the effect is larger for exports than for imports and much larger for intra-country trade than for both exports and imports. Although the distance effect has dropped over time, the drop is relatively smaller for domestic than international segment.

A main challenge in this kind of analysis is to overcome the issue of endogeneity arising from firms' potential choice of manufacturing locations. Exporting firms may decide to build a plant at a particular location to serve the domestic market (in addition to exporting) or use local inputs or benefit from externalities of industrial clusters. Although these issues have no definitive solution, this paper attempts to circumvent them by using the rich datasets on domestic sales and purchases by firms, along with information on the historical pattern of entry of firms into exporting. Till late, Pakistan has been a relatively protectionist economy[2]. Most firms were established near major population centres in the hinterland to serve the domestic market in the restrictive trade policy regime. However, many firms started exporting in the early 2000 following the economic reforms of military regime, which came to power by toppling the elected government in 1999. This paper exploits this change in trade policy regime together with information on cultural and ethnic factors to show that potential endogeneity arising from the manufacturing location choice is unlikely to bias our findings. We show that the locations of firms in the hinterland is driven mainly by ethnic and historical factors rather than on participation into exporting or efficiency concerns.

The key contribution of this paper lies in its comparison of the trade-restricting effects of internal and external distances together, which remains under-researched in the micro-literature on firms. Quantitative models of international trade use mainly distance between countries in gravity estimations and find robust evidence of its trade-impeding effect (for a survey see Head and Mayer, 2014). Existing micro literature in this stream (e.g. Bernard et al., 2007; Eaton et al., 2004; Mayer and Ottaviano, 2008) also focuses mainly on the responses of trade margins to the international component of distance. Some studies examine the role of the domestic component of transportation and show that the inland distance effect is larger and is particularly large in developing countries (Coşar and Demir, 2016; Donaldson, 2015; Van Leemput, 2016) [3]. In this line of literature, Coşar and Demir (2016) explore the effect of improvements in transportation infrastructure on regional access to international markets in Turkey and show that the effect is transmitted through extensive margins. In related work, Hillberry and Hummels

[2] Although the country has gradually opened to trade, its import tariffs are the highest in the region.

3 In another related paper, Crozet and Koenig (2010) use domestic transportation distances for French firms' exports to adjacent countries to compute the structural parameters of Chaney's (2008) model.

(2008)[4] focus on the effects of domestic spatial frictions on trade margins for intra-national shipments in the US, and Limão and Venables (2001) examine the effect of geography on transportation costs and trade volume across countries. These two streams of literature focus on international and domestic components of distance in isolation, whereas this paper examines the differential effects of both elements in tandem. Moreover, it informs on the differential effect of each element of distance on trade margins and explores the heterogeneity of the distance effect along multiple dimensions of firm and product characteristics, which the above studies do not examine.

The examination of responses of trade margins improves our understanding of the mechanisms of influence of domestic and international trade costs. Existing literature shows that these costs inhibit the entry of firms into export markets (ADBI, 2009; Albarran et al., 2013), affect the pattern of regional specialisation (Coşar and Fajhelbaum, 2016) and impede firms from moving up the value chain ladder (OECD/WTO, 2015). In extension of these studies, this paper shows that the internal and external components of trade costs have heterogeneous effects on trade margins. The internal element operates primarily through the extensive margins of firms and products and thus impedes the entry of firms and diversification of exports, whereas the external element restricts mainly the quantities of shipment.

The second main contribution of this paper is to extend the literature on (i) market access and (ii) transportation infrastructure. In the first stream, Atack and Margo (2011) and Banerjee, Duflo and Qian (2012) estimate the relative impact of improvement in transportation infrastructure in the US and China, respectively. These studies compare the effect of market access for the counties that received railroad access with those that did not. In the same vein, Donaldson and Hornbeck (2015) estimates the aggregate effect of railroads on the price of land in the US while Emran and Hou (2013) explore the effect of access to markets on household consumption in China. In contrast to these studies, this paper investigates the effect on firm-level trade flows of distance to trade-processing infrastructure, and measures these distances at more micro level, at the level of town.

In the transportation literature, Hummels (2007) provides detailed accounting of the time-series pattern of shipping costs and shows that the ad-valorem impact of ocean shipping costs is not much lower today than in the 1950s. In the earlier work, Limão and Venables (2001) show that per unit cost of overland transport in the US is higher than that of the sea leg. In extension of these studies, this paper shows that the marginal effect of road distances is much larger than sea distance and both segments have heterogenous effects on trade margins. These findings not only corroborate the results of above studies but also inform on the transmission mechanisms.

4 In contrast to Hilburry and Hummels (2008), this paper examines the implications of internal and external distance for international shipments originating from a developing economy and reveals the precise channels of their influence.

Finally, the findings regarding variation in the distance effect over time add to the literature on "Distance Puzzle", a well-known challenge in international trade[5]. This phenomenon is also referred to as the "missing globalisation puzzle" (Coe, Subramanian, and Tamirisa, 2007; Coe, Subramanian, Tamirisa, and Bhavnani, 2002), or "the conservation of distance in international trade" (Berthelon and Freund, 2008). The debate is still unsettled: for instance, Brun et al. (2005) argue that "distance has died", while Carrere and Schiff (2005), state that "it is alive and well" and Anderson and Van Wincoop (2004) state that "the report of death was an exaggeration." This paper adds another dimension to this debate. It generates some evidence on the decline in the trade-impeding effect of international element of distance over time while showing that the domestic distance effect has changed little during the last 15 years.

In terms of methodology, Atkin and Donaldson (2014), Donaldson (2015) and Van Leemput (2016) examine the effect of domestic transportation through price channels, whereas Coşar and Demir (2016) use gravity type estimations. This paper follows a similar estimation approach to Cosar and Demir (2016), but it conducts estimations at the firm-level, rather than at the district level. Moreover, compared with the US, France and Turkey (explored in the above studies), Pakistan is a relatively under-developed country with poor infrastructure and long inland haulages from export-processing stations, varying from 50 km to 2500 km. This empirical setting is typical of a developing economy and the results have wider application for countries with similar geography and levels of infrastructure and stage of development (Fernandes et al., 2016).

This paper thus contributes to the literature as the first study (to the best of our knowledge) that explicitly investigates the differential effect of trade flows to domestic and international elements of distance by using unique datasets from a developing country. This analysis has development policy implications as it informs on the precise channels of influence of these costs, in addition to estimating their magnitude.

Section 2 introduces the data and presents preliminary evidence. Section 3 discusses the empirical strategy and contains the main estimation results. Section 4 presents detailed robustness checks. Section 5 decomposes the responses of trade flows along trade margins while section 6 examines the heterogeneity of the distance effect along several dimensions. Section 7 concludes and highlights the policy implications of this work.

[5] Levinsohn (1995, 1387–1388) stated that the effect of distance on trade patterns is not diminishing over time.

2 Data Description and Preliminary Analysis

2.1 Background

Pakistan is the 36th largest country in terms of geographical size (with an area 340,509 square miles), 6th largest in terms of population (200 million) and 25th largest in terms of purchasing power parity (PPP)[6]. It is a semi-landlocked country and is bordered by India to the east, Afghanistan to the west, Iran to the southwest and China to the far northeast.

Manufacturing and exporting activities are unevenly distributed in the economy with a clear division between the coastal belt and hinterland. These regions house population of around 20 million (m) and 180m, respectively (for detailed description of population distribution see Figure A 1 in the appendix). The coastal belt includes Karachi and other neighbouring towns, most of which are within 50 miles of sea ports. The hinterland comprises several large cities, namely, Lahore, Faisalabad, and Multan, and other provincial, district and Tehsil headquarters. Most of the hinterland towns are more than 1,000 km far from the sea ports.

Pakistan's coastline along the Arabian Sea in the south has two sea ports, Karachi and Qasim, which handle 90% of export cargo. Exporting firms based in hinterland regions either directly transport goods to sea ports or use inland export-processing stations that are linked to sea ports through road network (Figure 1). A large fraction of firms use sea ports, both for exports and imports and the use of dry ports is quite limited. In 2014, dry ports catered for less than 5% of exports and 10% of imports. Since road transport is the primary mode of inland transportation[7] and road distances from industrial areas in the hinterland to the sea ports range from 50 km to more than 2,000 km (Table 4), domestic transportations an essential element of trade costs.

The large fraction of manufacturing is concentrated around big cities in the hinterland for historical and cultural reasons. These towns flourished along the Grand Trunk (GT) road which connected parts of Pakistan, India and Bangladesh in the pre-partition period. The GT road served as a main trade route that was disrupted following the partition into several countries.

[6] https://en.wikipedia.org/wiki/Economy_of_Pakistan.
[7] The country has North-South rail network, which is in dilapidated condition and caters for freight share of 4% only: http://trtapakistan.org/wp-content/uploads/2015/12/Export-Potential-in-Transport-Services-3.pdf

Figure 1: Export-Processing Infrastructure in Pakistan

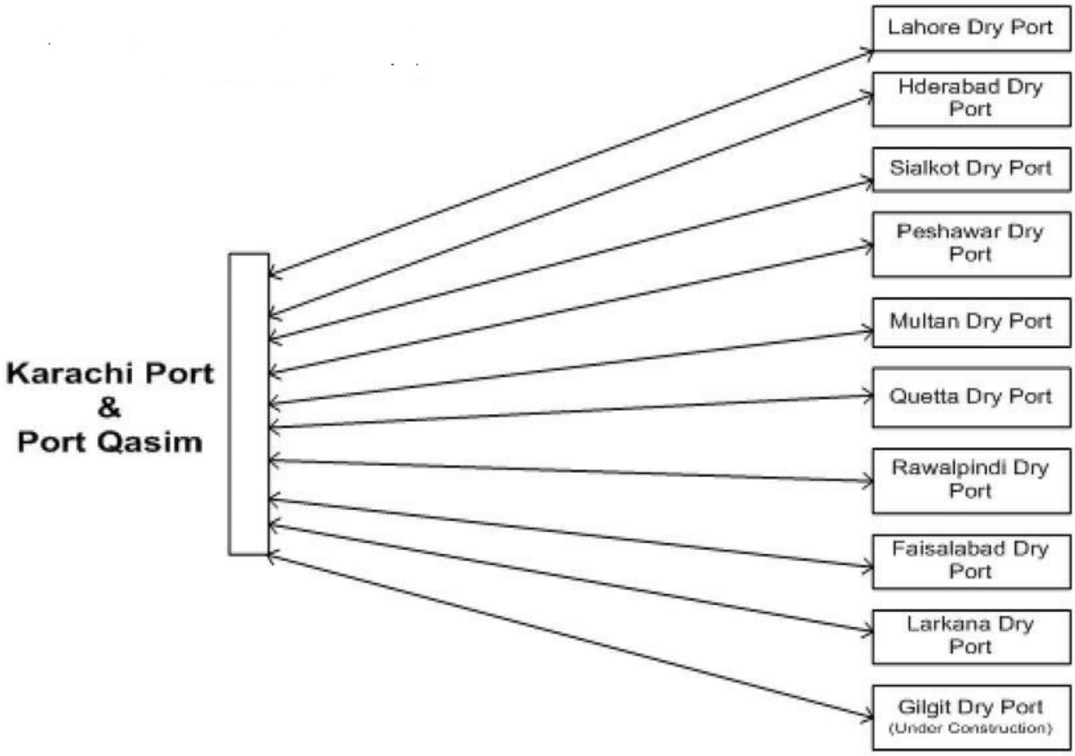


Table 1: Snapshot of Pakistan's Exporting Sectors in 2014

Category		Exports Value	Exports %	Firms #	Firms %	Products #	Products %	Markets #	Markets %
Spatial distribution of manufacturing for exports	Hinterland	1,235	50	7,362	44	3,496	83	182	96
	Coastal region	1,228	50	9,283	56	3,194	76	186	98
Modes of shipment	Sea	2,204	89	12,335	74	3,690	88	179	95
	Air	246	10	9,701	58	2,650	63	183	97
	Land	13	1	429	3	108	3	11	6
	All	2,463		16,645		4,200		189	

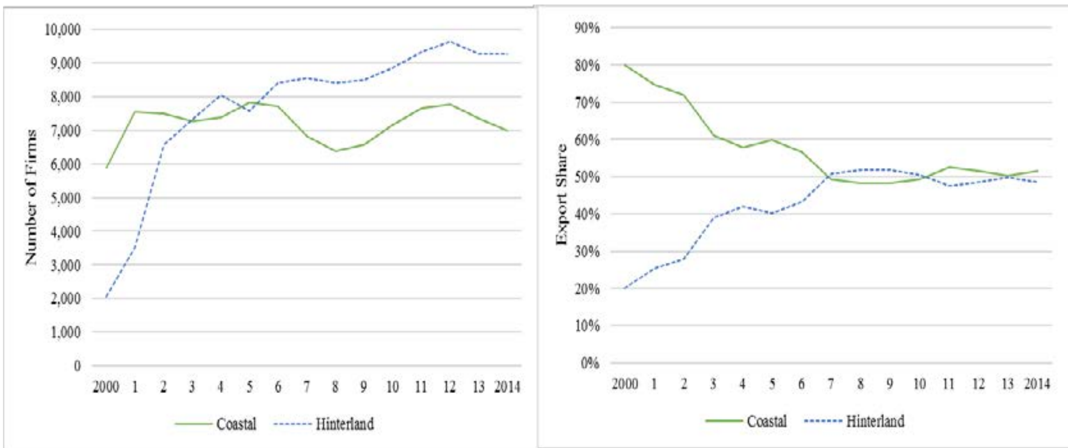
Notes: The data presents the distribution of exports, firms and products along spatial dimensions, as well as along modes of shipment for the most recent year (2014). Export values are in PKR billions. Products are identified at an eight-digit level of the Harmonised System (HS). Coastal region indicates manufacturing areas near the sea ports including industrial zones in five districts of Karachi, and hinterland represents all up-country regions of Pakistan. The nearest hinterland industrial region (Hyderabad) is 150 KM from the sea port of Karachi.

After independence in 1947, Pakistan pursued a highly protectionist trade policy aimed at import substitution and the growth of infant industries. In this period, the firms established in the remote areas mainly served the domestic market. As explained in detail in the following paragraphs, historical, cultural and ethnic factors mainly determined their location choice, rather than access to export markets.

As of 2014, around 50% of exports originate from the coastal belt and the remainder 50% from the hinterland (Table 1). However, as recently as 2000, the hinterland accounted for 20% of exports and coastal belt for 80% only (Figure 2). Having primarily focused on domestic demand many hinterland firms started exporting gradually after the policy change in 1999. In this year, military staged a successful coup, toppled the elected government and initiated a range of trade and economic policy reforms to garner legitimacy on the basis of economic performance, which incentivised many already established firms to export[8].

Figure 2: Evolution of Exports from the Hinterland and Coastal Regions

A: Exporting Firms B: Export Share



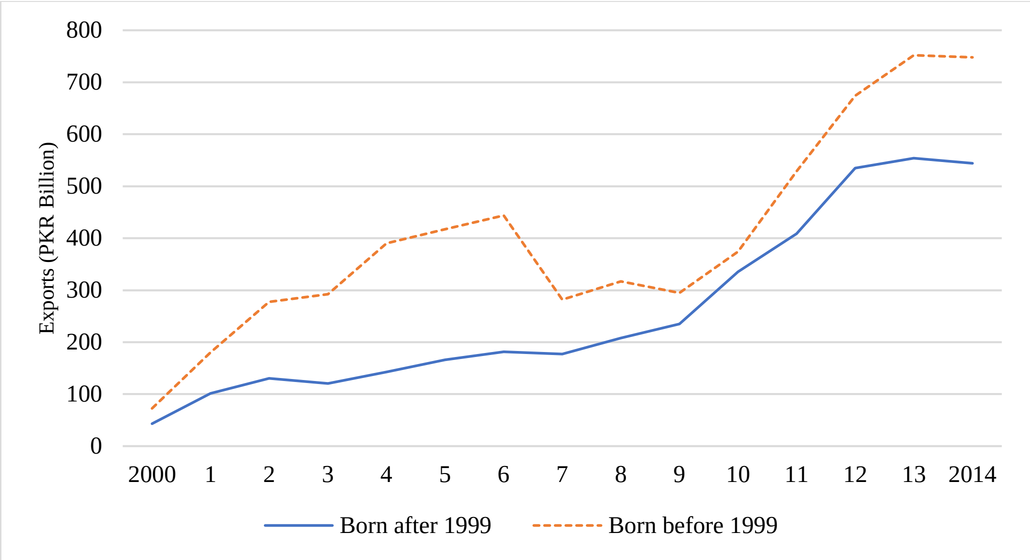
Notes: Coastal region indicates the areas near the sea ports of Karachi and the hinterland represent all up-country parts of Pakistan. Panel B shows that, prior to 2000, Pakistan's exports were dominated by firms based near the sea ports. However, the export share of hinterland firms increased gradually as a result of trade policy reforms in this period.

Following the economic reforms by military establishment, many established firms entered exporting and some new firms were born. As a result, the proportion of exports originating from the hinterland increased gradually. Figure 3 presents the age-wise distribution of exports for two cohorts of firms: those born prior to policy change in 1999 (old firms), and born in the latter period (new firms). The former cohort (old firms) comprises relatively large firms that handled around 70% of export originating from hinterland in 2014. It seems that even after the policy change, this cohort remained largely focused on domestic sales for a couple of years and gradually entered exporting. The other cohort, new firms, is relatively smaller and their contribution to aggregate exports remained relatively limited for several years.

Pakistan has eight export processing zones (EPZ) in various part of the country but their export contribution is limited. EPZs established in the hinterland in the 1980s did not flourish and have become dysfunctional. In 2014, the combined exports from all EPZs valued US $516.389 million, which is around 2% of country's total exports. Currently, the largest operational EPZ is located in in the coastal belt near Karachi.

[8] Among other measures to promote trade, such as generous duty drawback scheme on imported inputs, the government cut import tariffs from 47.4% (in sample average terms) in 1999 to 17.3% in 2003 (Sara, 2015). Amjad (2007) notes that growth and confidence of the private sector improved by more liberal trade regime for imports of machinery and other inputs. Some of these policy changes were highlighted on international media: http://news.bbc.co.uk/1/hi/business/1944567.stm

Figure 3: Evolution of Exports by Firm Age



Source: Author's construction using VAT and Customs datasets.

The hinterland' topography is relatively flat, with a moderate gradient from the coastal region up to a distance of around 2,000 km. The areas further north are mountainous but they do not have much manufacturing and exporting activities, either. Therefore, the variability in terrain is not a relevant factor in driving inland transport costs (as considered in some earlier studies for instance, Giuliano et al. (2014)).

2.2 Firm-Level Trade Data for Exports and Domestic Trade

Micro-level information on various margins of firms and products is retrieved from Pakistan Customs' export dataset. This dataset contains export values, product codes, prices and quantities, port of exit and mode of shipment for the universe of exporting firms for 190 export markets. Together with export data, this paper also uses firm-level imports and intra-country trade data in robustness checks. The import data has similar variables as that in the export data and has similar spatial and temporal coverage and is sourced from Pakistan Customs. Most of the variables in the import and export datasets are relatively standard, but those in the intra-country trade (VAT) data are quite unique and novel. This dataset records firm ID (National Tax Number), date of incorporation, address of manufacturing location, and ID of firm's suppliers and buyers along with the value of trade at monthly frequency. It is sourced from Pakistan Inland Revenue Services (IRS). The IRS has territorial jurisdiction and firms are required to register with regional VAT offices and file VAT returns on a monthly basis. This is the first study, to the best of our knowledge, that uses firm-level information of inland trade of a developing country.

Details on the firms' spatial locations come from the VAT records of the IRS. Both datasets (Customs and IRS) identify firms by the same unique identification code, their National Tax Number (NTN), which facilitates their merger. The merged dataset informs on the location of firms' production facilities, port of exit and modes of shipments (sea, air and land). The three unique features allow examining the effect of internal distance on exporting arising from the dispersion of production and exporting activities within the country.

Since exports through sea ports are a major component of the overall exports of the country (Table 1), this paper restricts the analysis to shipments through sea only[9]. The export data of shipment through sea contains 15.4 million transactions for the period 2000–2014. For ease of estimation, the data is collapsed at a firm-product-market-year level, with products defined at the HS2 level[10]. This transformation generates 809,242 observations. The analysis is restricted to the manufacturing sector. The exports of agricultural products are dropped as a large fraction of these is shipped by air due to their perishable nature. However, in the robustness checks, it is shown that the differential effects of inland and international distances hold for agricultural products shipped through sea also.

2.2.1 Measurement of Inland and International Distances

This paper computes the distances from the manufacturing locations of firms to sea ports in two ways: straight-line distance with geographical coordinates and road distance from Google Maps. These measurements are precise up to the town level, the smallest unit of administration[11]. The VAT dataset identifies the location of exporting firms in 1,323 towns across Pakistan. The latitudes and longitudes for these towns are retrieved from Google Maps and straight-line distances to sea ports computed using Stata command 'geodist'. This command provides the length of the shortest curve between two points along the surface of a mathematical model of the earth. The same approach is applied to compute intra-town distances within the country to run a domestic gravity model, used as a robustness check for baseline estimates. In another variant of this approach, the shortest road distance from the centre of towns to sea ports are computed from Google Maps. A comparison of these two approaches indicate that the straight-line distances (computed from coordinates) are smaller, on average, than road distances to the tune of 20-32%, suggesting that the former might bias the effect of inland distances downwards.

Table 2: Variation in Straight-line and Road Distances (KM) for Selected Towns

Town Name	Straight-line distance (km)	Shortest road distance (km)	Difference (km) (2)-(3)	Difference (%) (2)-(3)
(1)	(2)	(3)	(4)	(5)
Hyderabad	148	178	-30	-20
Multan	737	936	-199	-27
Lahore	1,034	1,245	-211	-20
Rawalpindi	1,131	1,488	-357	-32
Peshawar	1,106	1,365	-259	-23

[9] Sea ports handle around 90%of Pakistan's exports and remainder 9% transacts through air and 1% through land routes.
[10] This size of data (15.4 million transactions and 4GB size) is difficult to handle in Stata, especially with a demanding set of time-varying fixed effects. The aggregation at the HS2 level generates 809,242 observation, which are still large but manageable. This aggregation might be an issue for a diversified economy but Pakistan's export basket is quite narrow, with textiles having a dominant share.
[11] Pakistan consists of four provinces, one federal capital territory and one autonomous region (Kashmir). These administrative units are divided into 34 divisions, 149 districts, 588 sub-districts or tehsils (roughly equivalent to counties) and several thousand towns.

Source: Authors Construction

Changes in road distances or transportation time from the up-grade of inland road infrastructure is not a key factor in this context as the country has been in political and economic turmoil during the last two decades and has not made significant public investment to improve North-South road or rail network, other than improvement of intra-province roads mainly in the Punjab province. There are few alternative routes to access the sea ports[12]. This use of a constant measure of inland distance over time is consistent with the measurement of other key explanatory variable, international distance, which is also assumed to be time-invariant.

As discussed above, a small fraction of exports is processed at inland dry ports. Usually small firms use dry ports to complete documentation and customs procedures and then despatch the shipments to sea ports. This inland transportation, from dry ports to sea ports, occurs through the same road network. Since dry ports are situated in major industrial towns and deal with very limited export volume, this analysis uses the road distances from manufacturing locations to sea ports, rather than through dry ports. This approach might underestimate the effect of inland distance for some firms; therefore, these estimates might be considered as lower bound.

This chapter uses two measures of international distance, straight-line distances between capitals of countries, which is quite standards in the gravity literature, and sea distance between ports. Sea distance is a measure of the shortest maritime distance between two countries. These distances have been extracted from the Vesseltracker.com (2014) for the largest port of each country (two ports when the country is flanked by two different oceans). For each country-pair, the shortest maritime distance between any of the ports of both countries is reported. For landlocked countries, the closest foreign port is used. Table 3 reports a comparison of international distance measured with both approaches.

Table 3: Summary Statistics of International Distance

Distance	Obs	Mean	Std. Dev.	Min	Max
Between capitals	197	7,372.90	4,124.57	805.97	16,334.90
Between sea ports	197	10,394.07	4,834.30	1,075.52	20,731.02

Source: Distance between capitals is retrieved from CEPII and distance between ports is collected from UNCTAD.

2.3 Preliminary Evidence and Empirical Motivation

2.3.1 Descriptive Evidence

Table 4 shows the spatial distribution of exports across various geographical regions of Pakistan (sorted by order of distance from sea ports) and decomposes this into the number of firms, products and

[12] Pakistan has recently initiated a large infrastructure development programme with the cooperation of Asia Infrastructure Development Bank (AIIB). This $65 billion-dollar Chinese investment (the largest Chinese investment in any country) aims to overhaul road and rail network and thus improve connectivity with sea ports.

markets. This dispersion presents some preliminary evidence on how the export performance of firms based in the hinterland is different from that of those located near sea ports. It indicates that, although major exporting activity tends to agglomerate in Karachi (42% of firms and 50% of exports), there is considerable spatial variation within the country. Following Karachi, the three main export manufacturing regions are Lahore, Sialkot and Rawalpindi, all of which are more than 1,000 km from sea ports.

Second, firms located in Karachi (near the sea ports) export a large set of products to a large number of markets (columns 7 and 9). By contrast, the set of exported products is quite narrow for firms located in distant regions and they appear to ship to fewer destinations. This heterogeneity in trade margins across the spatial distribution highlights, inter alia, the potential trade-impeding effect of the internal distance from trade-processing facilities.

Table 4: Spatial Distribution of Pakistan's Exports in 2014

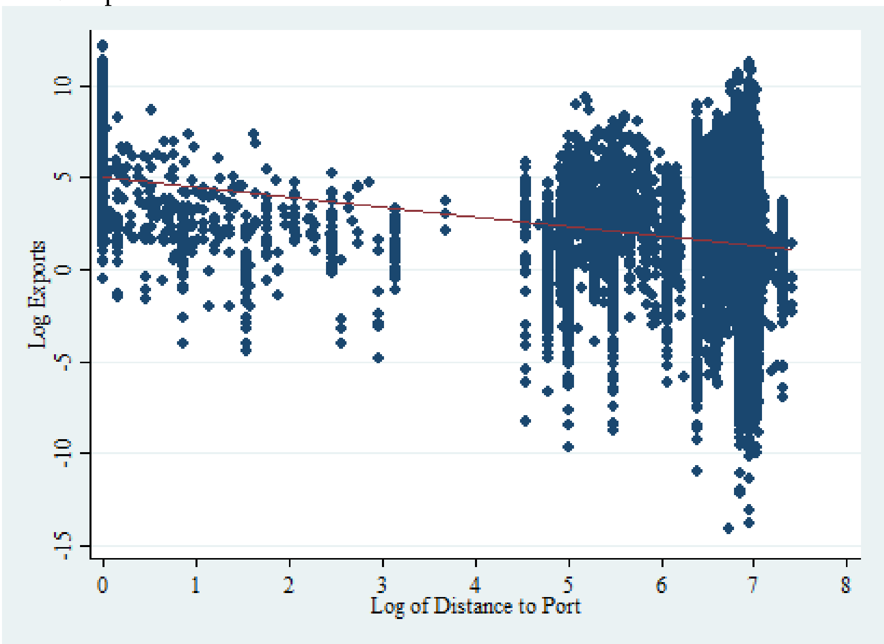
Inland Dist. <=km	Exports (Bn)		Firms		Products		Markets		Region
	Value	%	#	%	#	%	#	%	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
50	1,235.5	50.1	7,273	42.8	3,497	82.6	182	96.3	Karachi
162	23.9	0.9	63	0.4	122	2.9	83	43.9	Hyderabad
490	3.8	0.2	34	0.2	13	0.3	15	7.9	Sukkur
715	39.4	1.4	153	0.9	296	7	72	38.1	Quetta
876	0.3	0	8	0	14	0.3	16	8.5	Bahawalpur
958	64.2	2.5	174	1	406	9.6	84	44.4	Multan
1,203	272.9	11	691	4.1	782	18.5	141	74.6	Faisalabad
1,280	465.0	19.2	3,405	20	2,362	55.8	163	86.2	Lahore
1,360	34.0	1.3	341	2	629	14.9	99	52.4	Gujranwala
1,390	146.0	5.9	3,940	23.2	1,096	25.9	178	94.2	Sialkot
1,411	6.9	0.3	45	0.3	129	3	45	23.8	Sargodha
1,516	17.6	0.7	277	1.6	552	13	82	43.4	Rawalpindi
1,521	21.7	1.4	124	0.7	371	8.8	86	45.5	Islamabad
1,605	2.7	0.1	26	0.2	47	1.1	23	12.2	Abbottabad
1,616	129.0	5.1	442	2.6	845	20	103	54.5	Peshawar
2,500	0.1	0	6	0	60	1.4	16	8.5	Sust
All	2,463		16,645		4,200		189		

Notes: The data shows the spatial distribution of exports across geographical regions of Pakistan and decomposes exports by firms, products and markets. Distance is measured in km from the sea port of Karachi. Export values are in PKR billions. Products are identified at the eight-digit level of the Harmonised System (HS). Source: Constructed using administrative dataset of Pakistan Customs.

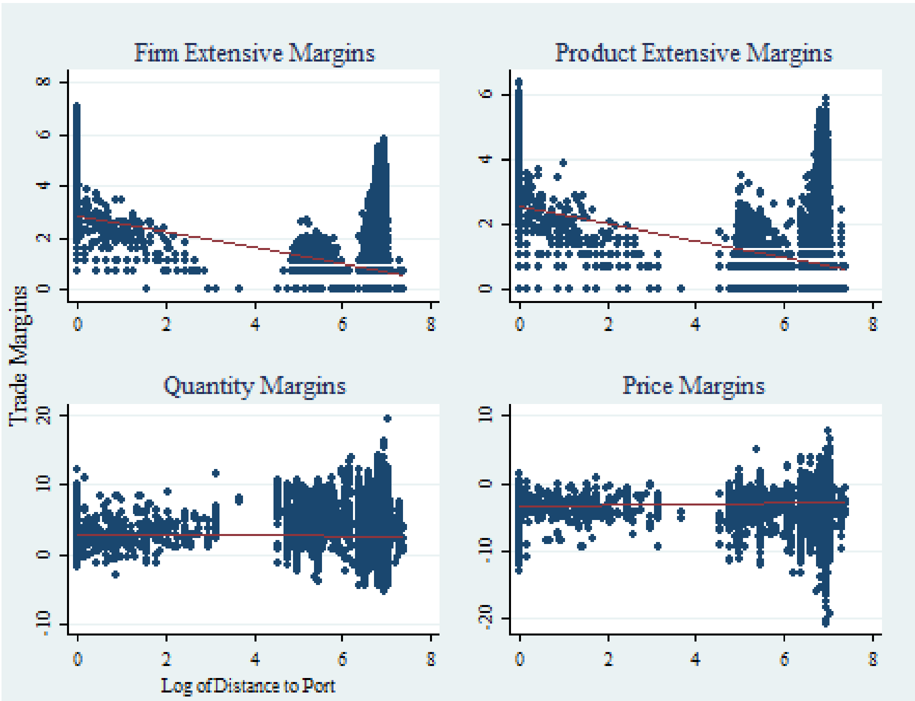
Figure 4 presents the distribution of exports according to distance from sea ports and decomposes them along four trade margins: extensive margins (EM) of firms and products, and margins of price and quantity.

Figure 4: International Sales with Distance from Sea Ports

A: Exports



B: Trade Margins



Notes: Panel A represents the variation in export with inland distance from sea ports and panel B shows the effect along four elementary margins. Following Mayer and Ottaviano (2008), the overall trade flow is decomposed to firm EM (number of exporting firms), product EM (number of products per firm) and quantity margins (quantity exported per product per firm, and price margins (price per product per firm). The clustering of data points at the upper end reflects exports originating from two large cities, Lahore and Faisalabad, and other adjoining regions. These regions, although relatively far from sea ports, are major centres of production of textiles.

These charts suggest that the value of exports fall with distance from sea ports, and the main action appears to come from the extensive margins (EM) of firms and products. This pattern is quite intuitive as firms located in the hinterland face more transport costs compared with those located in coastal areas.

For example, shipping a standard 20-feet container from the port of Karachi to the US involves a freight charge of $700, but the internal transportation of the same container from the industrial area of Rawalpindi (1,500 km from sea ports) to Karachi incurs almost the same charges[13]. The charts also show a large clustering of data points at the upper end, which reflect exports originating from two large hinterland cities, Lahore and Faisalabad, and their adjoining regions. These areas, although relatively far from sea ports, are major centres of textile production.

2.3.2 Empirical Motivation

To examine the heterogeneity of the international distance effect for firms based in various regions a typical gravity model following the estimation approach of Bernard et al. (2007) and Mayer and Ottaviano (2008) is estimated (equation 1).

$$ln(X)_{jkt} = \alpha_0 + \beta_1 \, ln\,(dist)_j + \beta_2(GDP)_{jt} + \beta_3(contig)_j + \beta_4(lang)_j + \beta_5(PTA)_{jt} + \varepsilon_{jkt} \quad \ldots\ldots\ldots(1)$$

In this equation, the dependent variable is log of exports at region-market-year level. The gravity variables are retrieved from CEPII and bear the definitions contained therein. The regression results in Table 5, show that distance negatively affects trade flows, while GDP of trading partner, contiguity, common language and FTA affect it positively. All gravity controls have the expected sign and the magnitude of their coefficients is in the range of those found in earlier studies (Head and Mayer, 2014).

Table 5: Gravity Estimates at Aggregate Level

Dependent variable is log of export at region-market-year level

	(1)
International distance	-0.831***
	(0.036)
Dest. GDP	0.742***
	(0.008)
Contiguity (0,1)	0.361***
	(0.137)
Language (0,1)	0.714***
	(0.039)
PTA (0,1)	1.188***
	(0.141)
R^2	0.43
Observations	21,808

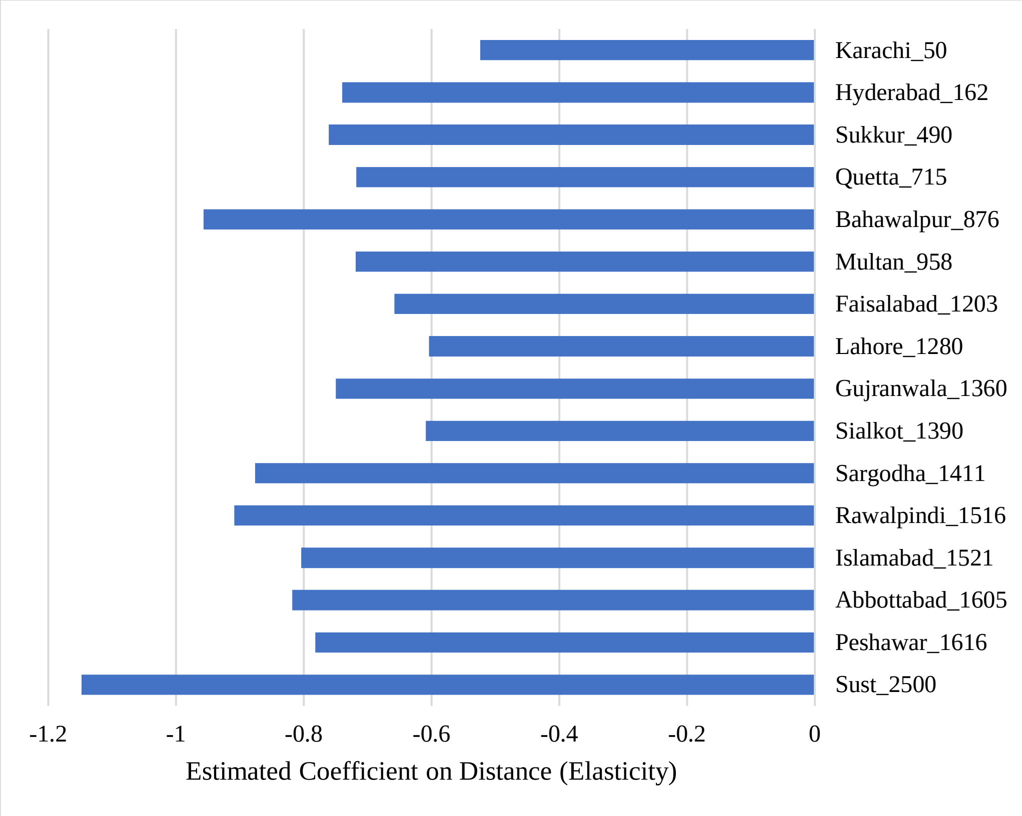
Notes: Standard errors clustered at market level are in parentheses * p<0.10, ** p<0.05, *** p<0.01. The estimation method is OLS using Stata 13 SE.

Using the same estimation equation (1) the international distance effect is decomposed across various industrial regions. Figure 5 presents heterogeneity of the distance effect in the order of the distance of regions from sea ports. The chart shows that the trade-impeding effect of distance is relatively larger for firms located in the hinterland compared with for those located in coastal belt (Karachi). Within the

[13] Figures on domestic freight collected from transporters' association and those on international freight are retrieved from the Customs' dataset.

hinterland, the effect is quite heterogenous: it is particularly large for regions having poor connectivity with trade-processing infrastructure (Bahawalpur and Sust).

Figure 5: Decomposition of International Distance Effect along Spatial Distribution



Notes. The figure decomposes the distance effect on trade flows for various regions in Pakistan. It shows that the trade-impeding effect of distance is relatively larger for hinterland firms compared with those located in coastal region of Karachi. The estimation method is OLS using regression equation (1) above.

The above estimates indicate the relatively large distance effect for exports originating from hinterland regions. There might be some other factors affecting exports of the hinterland firms but a part of this difference could be attributed to internal transportation costs.To investigate this effect further, Table 6 compares three dimensions of export performance of firms located in hinterland and coastal regions by using the following equation.

$$ln(X)_{ijt} = \alpha_0 + \beta_1 (D) + \gamma_{jt} + \varepsilon_{ijt} \ldots\ldots\ldots(2)$$

where *i* denotes firm and *j* export market. The dependent variables are intensive margins (value of exports per firm by market) and extensive margins (the number of HS8 products per firm by market, and number of markets by firm). The explanatory variable, D, is a dummy that takes the values of '1' for hinterland firms and '0' for costal. γ_{jt} are market-year fixed effects. The regressions include control for firm size.

The negative and statistically significant coefficient on the dummy variable indicate that, on average, exports of firms located in hinterland (further from shipping facilities) are lower to the tune of 15% (column 1). Moreover, these firms ship a narrower set of products and serve a smaller number of markets. Distance from sea ports, therefore, seems to negatively affect both IM (column 1) and EM (columns 2 and 3).

Table 6: Differential Export Response from Coastal and Hinterland Firms

Dependent variables	Exports per firm by market (1)	Products per firm by market (2)	Markets per firm (3)
Hinterland region (1, 0)	-0.152***	-0.039***	-0.048***
	(0.006)	(0.004)	(0.003)
Market-year FE	Y	Y	Y
Firm Size $_{t-1}$	Y	Y	Y
R-squared	0.281	0.265	0.326
Observations	742,029	742,029	239,359

Notes: The table shows the regressions on a dummy variable that takes the value of '1' for firms based in the hinterland and '0' for firms in coastal regions. Coastal region indicates manufacturing areas near the sea ports that comprise industrial zones in five districts of Karachi, and hinterland represents all up-country regions of Pakistan. The nearest hinterland industrial region (Hyderabad) is 150 KM from Karachi. The dependent variable is described at the head of each column. All estimations are in log. Standard errors clustered at market level are in parentheses * p<0.10, ** p<0.05, *** p<0.01. Y indicates the inclusion of fixed effects. Firm fixed effects are not included as they absorb the effect of the location dummy.

3 Empirical Strategy and Estimation Results

The availability of information on the internal locations of exporting firms makes it possible to identify the heterogeneity of the distance effect indicated in the previous section. To investigate formally the differential effects of internal and external distances on trade flows the following equation (3) is estimated:

$$ln(X^f)_{ijkt} = \beta_0 + \beta_1 \, ln\,(dist.)_i + \beta_2 \, ln\,(dist.)_j + \beta \, Z'_{ijt} + \gamma_{kt} + \alpha_{it} + \varepsilon_{ijkt} \quad \text{.. .(3)}$$

The subscript *f* denotes firm, *i* town, *j* export market, *k* product and *t* time (year). The dependent variable, X^f_{ijkt}, is the value of exports per firm at a product-market-year level.

The main explanatory variable, $dist._i$, is the distance from the location of firms in Pakistan to the sea port. The construction of this variable is explained above in Section 2. The inland distance varies across and within firms depending upon the port of shipment, which is determined mainly by export destination as these ports specialise in handling cargo for different markets (for details see section 6) The second explanatory variable, $dist._j$, measures the international distance to the market of trading partner. It measures the sailing distance from the ports of exit in Pakistan to port of entry in exports markets The coefficients β_1 and β_2 are expected to be negative.

γ_{kt} are time-varying fixed effects for products, which account for heterogeneity across different product groups and also soak up any supply shocks that might vary over time. α_{it} is a set of region-year fixed effects, which control for differences in physical and human infrastructure and the nature of economic activities across various administrative regions, like growth in GDP, population or income. The country is divided into five regions following the administrative set-up discussed in Section 2. These products- and region-specific fixed effects account for time-invariant and time-varying unobservable that could potentially affect trade flows from various parts of Pakistan.

Z' is a set of controls. The specification incorporates standard gravity controls, such as GDP of trading partners, and a dummy variable identifying whether the trading partners have a common border, share a common official language and are a member of a preferential trade agreement. The common language and adjacency dummies are used to capture information costs. Search costs are probably lower for countries whose business climate, language and institutional structures are similar. These gravity variables are taken from CEPII and follow the definitions therein. In addition, all regressions include controls for firm size. In the absence of information on turnover, employment or capital for the universe of Pakistan's exporters, the study relies on export-based measures of firm characteristics. Namely, it uses the total value of exports (across firm's destinations) as a proxy for firm size. Melitz and Redding (2014) argue that the total amount of export is a plausible proxy for firm size and productivity. Its lagged values are used to avoid a simultaneity problem.

In an alternative specification (equation 4), both internal and external components of distance are added (as in Crozet and Koenig (2010)) and their combined effect is estimated. The modified regression equation is as follows.

$$ln(X^f)_{ijkt} = \beta_0 + \beta_1 \, ln\,(dist.)_{ij} + \gamma_{kt} + \lambda_{jt} + \alpha_{it} + \varepsilon_{ijkt} \ldots\ldots(4)$$

In this revised form, the variable of interest, $dist._{ij,}$ becomes the total distance from the location of firm *i* in Pakistan to export market *j*. λ_{jt} are market-year fixed effects. These dummies allow for a better control for destination market's multilateral resistance. The coefficient β_1 represents the combined effect of domestic and international elements of distance[14]. This alternative estimation approach is used to verify the robustness of the baseline results obtained from equation (2).

The estimation method is Ordinary Least Squares (OLS); however, to account for heteroskedasticity in trade data and the presence of zero trade flows, the Poisson Pseudo Maximum Likelihood (PPML) estimator, as suggested in Silva and Tenreyro (2006), is also used in robustness checks. The model with high dimensional fixed effects is estimated with the Stata command, 'reghdfe', suggested in Guimaraes and Portugal (2010). Standard errors are clustered at town-destination level. Following the baseline estimations, and robustness checks, the heterogeneity of the effect across sectors and over time is investigated and, finally the estimated distance coefficient is decomposed to the responses of different trade margins.

[14] Addition of the internal and international elements of distances allows the bilateral distance to trading partners to vary depending on the location of firm in Pakistan. This modified specification therefore permits incorporating market-year fixed effects, which could otherwise soak up the effect of international distance.

3.1 Main Results

Table 7 presents the baseline estimation results for equation (3). Row (1) contains the coefficients for inland distance to sea ports and row (2) for international distance to export markets.

Column (1) contains the estimated coefficient on inland distance, which is negative and statistically significant at a 1% significance level, showing that remoteness from trade-processing facilities negatively affects trade, as transportation costs are higher for exports originating from distant towns. Column (2) incorporates both distances (internal and external) in the estimation. The effect of external distance is also negative as expected but the magnitude of both components of distance varies. The coefficient on inland distance (in row 1) is larger than that for external distance (in row 2). In terms of relative effect, the marginal effect of inland distance is almost double than that of international distance. Columns (1) and (2) show pure variation in the data, but the subsequent regressions incorporate controls for potentially omitted variables.

Column (3) adds product-year effects, which absorb product specific factors affecting trade flows, for instance, any supply shocks that might vary over time. This leads to adjustment in the magnitude of coefficients; the effect of the external component increases (becomes more negative) while that of internal segment drops slightly. Column (4) adds region-year effects that control for potentially omitted factors that vary across administrative regions and over time. Pakistan comprises five administrative regions and these regions vary widely in terms of physical infrastructure, human resources and the level of development. Punjab is the most developed province with a high quality intra-province road network followed by Sindh and KPK. The region-year dummies control for this heterogeneity. As the results in column (4) indicate, the estimated effect of both components of distance remain negative and statistically significant. The magnitude of the coefficient on internal distance variable increases in magnitude: the coefficient on inland distance is now almost three times than that for international distance. This increase in the coefficient on inland distance reflects the importance of controlling for heterogeneity in factor endowments across various geographical region of Pakistan.

These results show that the effect of domestic distance is almost three folds than that of international distance. Since these estimations are in logs, the coefficients correspond to an elasticity measure. The coefficient in column (4), for example, suggests that, on average, an increase of 10% in the inland distance is associated with a decline in exports by 4.6%. The corresponding effect of international distance is 1.05% only.

Table 7: Trade-Impeding Effect of Remoteness – Main Results

Dependent variable is log of exports at firm-product-market-year level

	Regression Eq.-3 (Columns 1 to 6)					Straight-line Distances	Total Distance. (Eq.-4)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\ln(\text{Distance})_{domestic}$	-0.177***	-0.182***	-0.161***	-0.460***	-0.447***	-0.256***	
	(0.002)	(0.002)	(0.002)	(0.023)	(0.025)	(0.070)	
$\ln(\text{Distance})_{international}$		-0.076***	-0.109***	-0.105***	-0.123***	-0.127***	
		(0.004)	(0.004)	(0.004)	(0.006)	(0.004)	
$\ln(\text{Dist.}_{domes.} + \text{Dist.}_{int.})$							-0.575***
							(0.054)
Additional controls							
Firm Size $_{t-1}$	Y	Y	Y	Y	Y	Y	Y
Product-year effects			Y	Y	Y	Y	Y
Region-year effects				Y	Y	Y	Y
Gravity variables					Y	Y	
Market-year							Y
R2	0.236	0.237	0.323	0.326	0.336	0.237	0.351
N	809,242	809,242	809,242	809,242	809,242	809,242	809,242

Notes: Robust standard errors clustered at town-market level are in parentheses, * p<0.10, ** p<0.05, *** p<0.01. Columns (1) to (6) contain the results of specification (3), and column (7) contains those for specification (4). The estimates in column (5) are used as a baseline. Y indicates the inclusion of fixe effects. The coefficients on fixed effects and other gravity variables are not reported since they are not of direct interest.

Column (5) adds gravity variables. These covariates affect the magnitude of the coefficient on the external distance component but the coefficient on inland distance remains unaffected, which as quite intuitive as the gravity variables differ across export markets only. The estimates in column (5) are used as a baseline.

Columns (6) and (7) present initial robustness checks. Column (6) uses an alternative measure of inland distance. Rather than using road distances, it replaces them with straight-line distance computed using geographical coordinates. This transformation reduces the magnitude of effect for inland distance by 40% but the effect of external component is virtually the same. This drop in the magnitude of coefficient reflects the problem of measurement error in computing inland distances as shown in Table 2 above. As the straight-line routes may well not exist, the measurement error could lead to downward bias in the estimates. Moreover, the road distances also capture the effect of domestic spatial frictions, in addition to remoteness from trade-processing stations, whereas the estimates with crow-fly distance assume frictionless conditions. Therefore, the estimated coefficient on road distance is significantly larger compared with that for straight-line distance (-0.407 against -0.256). The same is true for the international component of distance.

Column (7) estimates the combined effect of both internal and external distances (equation 4 above). This estimation includes market-year fixed effect as well, which absorb other factors that vary across markets and over time. The estimated coefficient represents the combined effect of inland and external elements of distance. The effect of combined distance is negative as expected and is statistically significant. The magnitude of combined effect is similar to the sum of individual coefficients estimated in the baseline regression (column 5).

These estimates imply that the trade-impeding effect of domestic transportation is much larger than that of their international component. These results are in line with the findings of earlier studies. The magnitude of the effect is sensitive to inclusion of product, region and market-year fixed effects. In our preferred specification that controls for both product and region year fixed effects the effect of inland distance is almost three times that of international distance.

4 Robustness Checks

One of the major empirical challenges in the present analysis is the potential endogeneity of firms' manufacturing location choice. To overcome this, we exploit the fact that these firms in the empirical modelling were established primarily to serve domestic market during the period of restrictive trade policy but started exporting subsequently following the trade policy reforms launched by military establishment. We further show that historical, cultural and ethnic factors drive the choice of manufacturing locations, rather than decision to exporting. A predominantly influential role of these two factors means that their location choice and hence internal distance to ports is potentially exogenous to their exporting decisions. In addition, we show that exploiting the exogenous variation in inland distance that occurred because of launch of Integrated Cargo Containers Control Programme (IC3) at Qasim Port in 2007, yields comparable results.

4.1.1 Effect of Changes in Trade Policy Regime on Exporting

As explained in earlier the agglomeration of manufacturing in hinterland occurred in the era of restrictive trade policies[15]. We therefore decompose the effect of inland distance for two sets of firms: those born before the policy change and those born after the policy change in 1999. For the set of firms that served the domestic market in the earlier period but entered exporting in the later years, the location choice is potentially exogenous to exporting decision, as engagement in export markets was not their primary concern at the time of establishment. However, for the other cohort (born after 1999), the inland distance effect could be biased because they might have chosen optimal location to benefit from the policy reforms.

Table 8: Robustness Checks

Effects of Ethnicity and Policy Change

	Effect of Policy Change in 1999 on Exports (1)	Effect of Ethnicity on Domestic Trade (2)
Intra-town distance		-0.848***
		(0.043
Domestic distance x		
Born after 1999	-0.420***	
	(0.025)	
Born before 1999	-0.314***	
	(0.025)	
International distance	-0.139***	
	(0.004)	
R2	0.222	0.566
N	809,242	103,494

Notes: The table shows the heterogeneity of inland distance effect along firm age, and also examines the effect of intra-town distance on for domestic trade. Dependent variable in column (1) is log of exports at firm-product-market-year level and in column (2) is log of domestic trade at firm-product-town level. Regression (1) contain product-year and region-year fixed effects and regression (2) contains product fixed effects. The coefficients on fixed effects and other covariates are not reported since they are not of direct interest. Robust standard errors clustered at market level are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

The decomposition of inland distance effect for these groups in column (1) of Table 9 shows that the estimated coefficient on inland distance is negative and statistically significant for both groups. The magnitude of the effect is smaller however for older firms (the cohort born before trade policy reforms). The estimated coefficient in the baseline results on the inland distance may therefore be somewhat

[15] Similar argument regarding the effect of restrictive trade policies has been many earlier studies ((for instance, see Karayalcin and Yilmazkuday, 2015)

biased upwards, but we still find a much large trade-impeding effect of domestic distance than that for international distance.

4.2 The Role of Ethnic Factors in Location Choice

To demonstrate the effect of cultural and ethnic factors on location choice, we explore the pattern of firms' domestic sales in various administrative regions. Pakistan is very diverse country internally. Its four main provinces (KP, Punjab, Sindh and Baluchistan) are geographically contiguous but differ in terms of language and culture. Three provinces, KP, Sindh and Baluchistan have their own official languages, which are medium of instructions in schools as well as medium of government businesses, in addition to a national language (Urdu). These regional languages are based on dissimilar scripts[16] and are hard to understand for residents of other regions. An attempt by federal government to merge these regions into one administrative unit failed mainly due to stiff resistance by regional ethnic groups and had to be undone after a few years

Table 8 shows that for comparable inland distances domestic sales are highly skewed towards trading partners located in the same ethnic region. For instance, firms based in Kohat (an administrative district of KP[17] province but very close to the border of Punjab) conduct relatively more trade with firms based in Peshawar and Haripur, towns in the same province, rather than with firms located in Nowshera and Islamabad that are at comparable inland distances but in the other province.

Table 9: Orientation of Domestic Sales of Firms Located in Kohat

Location of Trade Partners	Trade (PKR M)	Ethnic Region of Trade Partner	Distance from Kohat (km)
Banda Daud Shah	10.90	Different	42
Peshawar	440.68	Same	50
Nowshera	0.43	Different	69
Chota Lahore	4.86	Different	101
Bannu	10.90	Different	102
Haripur	210.63	Same	147
Islamabad	19.72	Different	155
Sheikhupura	0.35	Different	316
Lahore	103.15	Different	355
Lahore City	0.04	Different	340
Lahore Cantt.	2.31	Different	365
Malir	7.32	Different	1,046
Karachi South	66.52	Different	1,058

Note: Data sorted in the order of distance between towns. Kohat is a town in KPK province near the border of Punjab province.

[16] http://www.omniglot.com/writing/pashto.htm and http://www.omniglot.com/writing/sindhi.htm

[17] KP stand for Khyber Pakhtunkhwa province.

This pattern of internal trade appears to hold for other parts of the country (for details see Table A 5 in the appendix). The firms located in Rahim Yar Khan (a town in Punjab near the border of Sind province) trade largely with those based in Lahore (a town in the same province) compared with those located in Malir or Peshawar (towns in other provinces, Sindh and KP, respectively), although they are at similar distances. The same pattern holds for firms located in Sukkur (a town in Sindh near the border of Punjab province), which conduct relatively large trade with Karachi-based firms, rather than with those based in Hub, a town at the same distance but located in Baluchistan province.

These ethnic differences are reflected in large trade-impeding effects of domestic distance. Column (1) of Table 9 empirically examines the effect of inland distances on domestic trade flows. As the estimates indicate, the effect is negative and statistically significant but the magnitude of the coefficient is much larger compared with the estimates for exports (reported above in Table 7). A main reason for this relatively trade-resisting effect of inland distance seems to be the concentration of internal trade within the specific geographical regions for the ethnic and cultural factors discussed above. These estimates provide support to large trade-impeding effect of domestic distance and also inform on dominant role of ethnicity in manufacturing location choice. This pattern of domestic trade suggest that these firms are located in various hinterland regions for historical, cultural and ethnic reasons, rather than for efficiency concerns. The likely endogeneity of firms' location choice is diminished in the current setting.

4.2.1 Exploiting Exogenous Variation in Domestic Distance

In 2007, a US-led security initiative namely Integrated Cargo Containers Control Programme (IC3), stipulated intrusive scanning and live monitoring of Pakistan's exports before being shipped to the US. The scanning technology was provided at Qasim Port only and the scanning was mandatory to access the US market. This shift in the US security policy forced switching of US-bound exports from Karachi Port and inland dry ports to Qasim Port, which increased inland transportation distances ranging from 10 km to 86 km (55 km on average), depending upon firms' geographical location and previous port use. IC3 was primarily a security initiative and imposed on Pakistan following the events of 9/11 to thwart potential exploitation of cargo containers for the smuggling of weapons of mass destruction. Therefore, the resulting changes in inland transportation distance to ship through Qasim Port are potentially exogenous for exporting firms. The trade effect of this increased component of inland distance on US-bound exports is estimated using the regression equation (4).

$$ln(\Delta X)_{ikt} = \beta_0 + \beta_1 \, ln\,(\Delta \; dist.)_i + \varepsilon_{ikt} \quad \text{.(4)}$$

where i denotes firm, k product and t time (year) and $\Delta \; dist._i$ is change is inland distance caused by switching of port in the post-IC3 period. The model is estimated on the first-differenced data to soak up any time-invariant factors affecting trade flows. As the results in Table 10 indicate, the distance effect is negative and statistically significant; the magnitude of effect is relatively smaller than that estimated earlier. These estimates show the negative effect of inland distance on trade but might not be directly comparable with earlier estimates as the sample is restricted to US-bound exports in the post-IC3 period only.

Table 10:Effect of Change in Inland Distance on US-bound Exports, 2007-14

Dependent variable change in exports at firm-product-year level

	(1)
$\ln(\Delta \text{ Distance})_{inland}$	-0.172***
	(0.011)
R2	0.144
N	37,149

Notes: Standard errors in parentheses, * p < 0.10, ** p < 0.05, *** p < 0.01. The estimation sample contain US-bound exports through Qasim Port from 2007 to 2014.

Further robustness check by aggregating the information at the region-sector-market-year level yield identical results (column 1 of Table 12). Moreover, collapsing the data to a single period to overcome any potential problem of serial correlation in error terms generates estimates that are comparable to the baseline specification.

4.2.2 Robustness to other Factors Affecting Location Choice

Literature suggests that several other factors, such as engagement in sales at home (the demand effect), access to domestic inputs (linkage effect) or benefit from externalities (agglomeration effect), could influence the choice of manufacturing location. Table 11 empirically examines the effect of these factors on the baseline estimates.

Access to the domestic market may affect the location choice for firms that simultaneously engage in domestic and international sales. In column (1) the home-market effect is controlled for by incorporating domestic sales of these firms by year as an additional regressor, which leaves results unaffected[18]. Column (2) controls for domestic inputs by incorporating domestic purchases in the estimations. As the results in column (1) and (2) indicate, the sign and statistical significance of the coefficient on the regressors of interest remain almost unaffected in these estimations. Both domestic sales and purchases positively affect trade flows. The positive effect of domestic sales may reflect the benefit of scale economies in production when serving domestic and international markets simultaneously. Similarly, the positive effect of domestic purchases (in column 2) suggests a linkage effect. These additional controls do not affect relative trade resisting effects of domestic and international distances.

[18] This approach inherently assumes that domestic sales are a proxy for local population size.

Table 11: Robustness to Other Factors Affecting Location Choice

Dependent variable is log of exports at firm-product-market-year level

Additional controls	Domestic Sales (1)	Domestic Inputs (2)	Agglomeration Effect (3)
Domestic distance	-0.768***	-0.657***	-0.530***
	(0.030)	(0.011)	(0.010)
International distance	-0.170***	-0.190***	-0.125***
	(0.005)	(0.006))	(0.008)
Domestic sales	0.074***		
	(0.002)		
Domestic purchases		0.106***	
		(0.007)	
R2	0.199	0.110	0.210
N	538,718	538,924	483,772

Notes: Robust standard errors clustered at market level are in parentheses. * p<0.10, ** p<0.05, *** p<0.01. These estimations follow specification 5 of Table 7 above. The estimations contain product-year and region year fixed effects. The sample size in these estimations is smaller as the information for domestic sales and purchases is not available for all firms.

Column (3) explores the effect of agglomeration by using an instrumental variable (IV) strategy. It uses the output of all existing firms as an IV for the location choice of new entrants. Pakistan has various industrial clusters in different regions. For instance, Faisalabad is a hub for textiles, Sialkot is a centre for sports goods and Wazirabad is a manufacturing base for surgical equipment. This spatial distribution alludes to the role of the agglomeration effect, which is exploited in the IV strategy. The output of all existing firms before the entry of a new firm in each region by sector and year is used as an instrument for the potentially endogenous variable, inland distance to port.

The detailed results of first and second stage regressions are reported in the appendix (Table A6). The first-stage regression has reasonable explanatory power and F statistics are much larger than the required threshold. Moreover, the correlation between endogenous regressor and IV is statistically significant at a 1% significance level. The negative coefficient on the instrumental variable (total_output) indicates that the increase in distance to port is associated with fall in total output per firm. The second-stage regression shows that the effect of inland distance is almost four times than that of external distance. The IV estimations corroborate the earlier results, although the actual effect of inland distance varies with the estimation approach.

5 Transmission Mechanisms of Inland and International Distances

The above estimates reveal the overall effect of domestic and international distances but for policy purposes the relative responses of trade margins are also likely to be informative. This section therefore deconstructs the overall effect of both distances into the responses of four constituent trade margins: the EM of firms and products, as well as price and quantity margins.

Following Bernard et al. (2007), Mayer and Ottaviano (2008) and Hillberry and Hummels (2008), the overall trade flow is decomposed to firm EM (number of exporting firms), product EM (number of products per firm) and quantity margins (quantity exported per product per firm, and price margins (price per product per firm) [19]. Trade flows and trade margins are constructed at the region-sector-market-year level, following the administrative structure of country and Comtrade's broader classification of products in 16 sectors[20]. The combined reactions of these four elementary margins adds to the total trade-impeding effect of distance on exports at the aggregate level.

Table 12: Decomposition of Distance Effect along Trade Margins

Dependent variables	X_{ijkt} (1)	Firm EM (2)	Prod. EM (3)	Qty. M (4)	Price. M (5)
Panel A:					
Domestic distance	-0.943***	**-0.607*****	-0.505***	**0.155*****	0.013
	(0.034)	(0.017)	(0.016)	(0.031)	(0.028)
Panel B:					
International distance	-0.476***	**-0.146*****	-0.120***	**-0.226*****	0.016
	(0.024)	(0.009)	(0.009)	(0.019)	(0.016)
R^2	0.343	0.393	0.401	0.362	0.314
Observations	34,117	34,117	34,117	34,105	34,105

Note: Robust standard errors are in parentheses, *p<0.10, **p<0.05, ***p<0.01. The coefficients on fixed effects and other gravity variables are not reported since they are not of direct interest. EM denotes extensive margins and IM indicates intensive margins. Column (1) contains the overall effect of distance and columns (2) through (5) decompose the coefficient in column (1) into various trade margins. All estimations are in logs.

Table 12 contains the estimation results of equation (3). Panel A contains the results for inland distance and panel B for international distance. Since we use a linear estimator (OLS), the coefficients in columns (2) and (5) add up to that in column (1). Figure 6 plots these coefficients for ease of interpretation. A comparison of the estimates for the extensive margins (EM) of firms and products shows that both margins drop in distances but the relative effect is much larger for internal distance. Moreover, both components of distance have heterogenous effects on trade margins: 64% of the effect of domestic distance is transmitted through EM of firms and 54% through EM of products, but the corresponding figures for international distance are 31% and 25%, respectively.

Columns (4) and (5) contain the responses of quantity and price margins. The results show that the response of quantities to domestic distance is positive (panel A) whereas the response to international distance is negative (panel B), indicating that quantity margins defy domestic remoteness but drop in

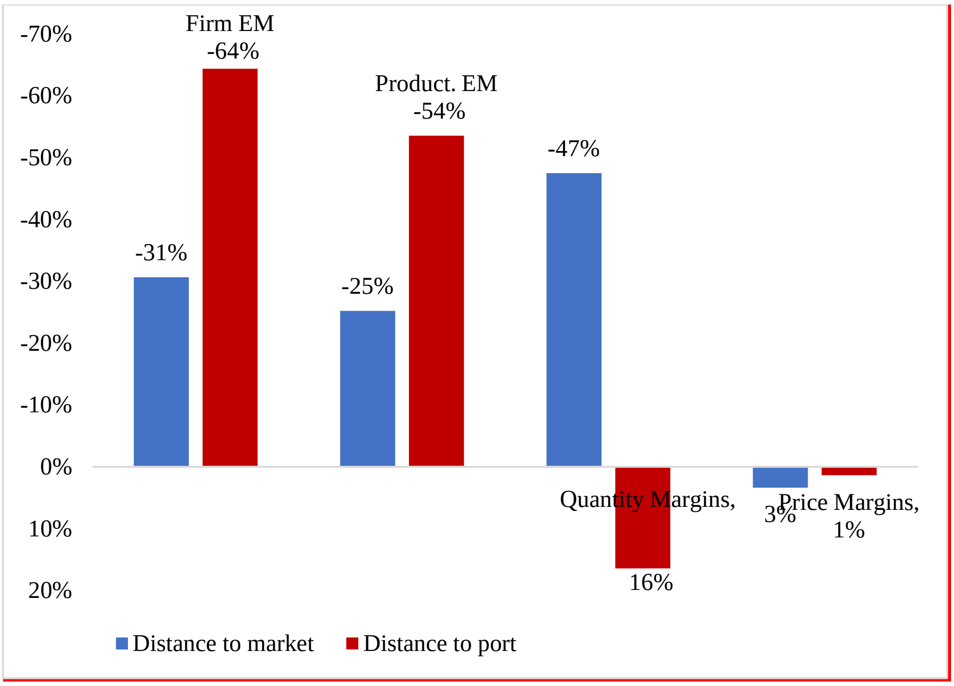
[19] $X_{ijkt} = N^{f}_{ijktt} \times N^{p}_{ijkt} \times p^{-fp}_{ijkt} \times q^{-fp}_{ijkt}$, where X_{ijkt} is value of exports from region i in sector k at time t. N^{f}_{ijkt} and N^{p}_{ijkt} are the number of firms and products per market by sector and p^{-fp}_{ijkt} and q^{-fp}_{ijkt} are average quantity and average price per product by firm. Quantity is measured in metric tons and price in PKR millions. The estimation method is Ordinary Least Squares (OLS). Since the OLS is a linear estimator, the coefficients have additive property, which allows estimation of relative responses of various trade margins.

20 The details of various sectors are contained in Table A 4 in the appendix.

its international element. The relative effects on quantity margins are -47% for international remoteness and +16% for internal remoteness.

Figure 6: Distance Effects on Trade Margins

(Values on y-axis are relative responses of trade margins plotted on reverse order)



Notes: The figure plots the relative contribution of each trade margin as estimated in in Table 12. EM denotes extensive margins. The deconstruction suggests that the trade-inhibiting effect of domestic distance operates mainly through the EM of firms and products, whereas international distance operates primarily through quantity margins besides restricting trade along EM.

These estimates suggest that the response of firms to internal remoteness is different from that to international remoteness. The former operates mainly through the EM of firms and products, whereas the latter operates primarily through quantity margins besides restricting trade along the EM. It seems that the extensive margin declines relatively more sharply with internal distance simply because firms have an extra margin of adjustment through their location choices. Among other factors, the variation in mode of shipment for inland and international transportation could explain the large marginal effect of domestic distance. Inland transportation occurs mainly through the land route which is particularly cost intensive given the poor infrastructure. By contrast, international transportation costs have fallen drastically with the improvement in the international shipping and communication technologies. This differential change in distance effect over time is further explored in section 6.

In the case of distance (a proxy for trade costs), the usual assumption in gravity modelling has been that it reflects transportation costs, which vary with the quantity exported. The positive response of quantities, however, suggests that there may be a fixed cost element associated with the domestic distance component. For instance, loading, unloading, handling and documentation charges do not vary with distance. These estimations suggest that the fixed cost component of domestic distance operates through average sales and the variable cost component through EM by restricting the entry of firms. It seems that domestic distance may be capturing the other elements; for example, information networks may decline with distance from port and absence of information may increase the cost of entry (Krautheim, 2009). This analysis also shows that internal distance to sea ports has some sort of selection effect on firms and products. It restricts the entry of firms into exporting but the entrants export a higher volume on average.

6 Heterogeneity Analysis and Further Robustness Checks

The inland distance effect is expected to be heterogeneous across ports (Karachi and Qasim) as they differ in terms connectivity with the hinterland. Karachi is the largest port of Pakistan and has relatively better connectivity, whereas the Qasim Port is relatively new and situated in a more remote part of the country with poorer access. Moreover, these ports handle export cargos for different destinations. Although cargo destined to the Western markets is processed at both ports, Karachi Port specialises in handling east-bound maritime traffic. The effect of inland distance for Qasim Port is expected to be larger because of poor connectivity as well as congestion caused by diversion of US-bound exports to this port following the implementation of IC3 programme in 2007 as discussed above.

Table 13 splits the inland distance effect of across ports (Karachi and Qasim). The estimated coefficient is negative and statistically significant for shipments through both ports. As expected the magnitude of inland distance coefficient is larger for shipments through Qasim Port than though Karachi (column 1). This decomposition informs the inland distance effect varies within the country across ports, depending upon their connectivity with the hinterland.

Within the exporting cohort, the trade-impeding effect of inland distance is expected to differ between exporting-only firms and exporters-cum-domestic sellers. The firms serving both domestic and international markets are relatively large; they constitute 35% of exporters but handle more than 85% of exports. The exporting-only cohort comprises relatively small firms accounting for 15% of total exports. The location choice of exporting-only firms might depend on their decision to export but for other firms, which engage in exports and domestic sales simultaneously, it might be influenced by other factors. As these exporting-only firms might choose optimal location, the effect of inland distance for this cohort could be biased.

Table 13: Distance Effect across Ports and along Trade Orientation

Dependent variable is log of exports at firm-product-market-year level

	Exports		Imports
	(1)	(2)	(3)
Domestic distance x			-0.125***
			(0.012)
Qasim Port	-0.321***		
	(0.025)		
Karachi Port	-0.221***		
	(0.025)		
# Firms that exports and sell domestically		-0.225***	
		(0.025)	
#Exporting-only firms		-0.349***	
		(0.025)	
International distance	-0.128***	-0.126***	-0.182***
	(0.004)	(0.004)	(0.009)
R2	0.224	0.214	0.224
N	809,271	809,271	363,300

Notes: Robust standard errors clustered at market level are in parentheses. * $p<0.10$, ** $p<0.05$, *** $p<0.01$. These estimations follow specification 5 of Table 7 above. The estimations contain product-year and region year fixed effects but the coefficients on fixed effects and other gravity variables are not reported since they are not of direct interest.

The decomposition of distance effect for exporting only and exporter-cum-domestic seller in column (2) of Table 13 shows that the effect is negative and statistically significant for both cohorts, but the magnitude is somewhat higher for exporting-only firms. For these exporting-only firms, the endogeneity of location choice could be more important and might explain whys the coefficient increases for these firms but for other cohort it is less likely to be the case as their manufacturing locations are determined by other factors.

Similarly, the inland distance effect is expected to be heterogenous along firms' trade orientation: exports or imports. Export shipments originate from various parts of the country but imports shipments are initially discharged at sea ports and then transported upcountry for further processing at the inland stations. Karachi is the largest importing station and hub of the transport sector. It is therefore much easier to arrange lorries for upcountry shipments than for transporting goods from hinterland to sea ports. Second, imports also occur under a multi-modal scheme, wherein foreign shippers take responsibility of international and domestic transportation. Third, a few large freight forwarders[21] handle the transhipment of import cargoes to dry ports in bulk. Therefore, the scale economies in transportation of imports upcountry is expected to reduce the effect of inland distance.

[21] Importing firms are not authorised to transport their cargo directly from sea ports to inland stations without payment of duty and taxes. However, they tranship it through bonded carriers (freight forwarding companies), which are licenced by Customs.

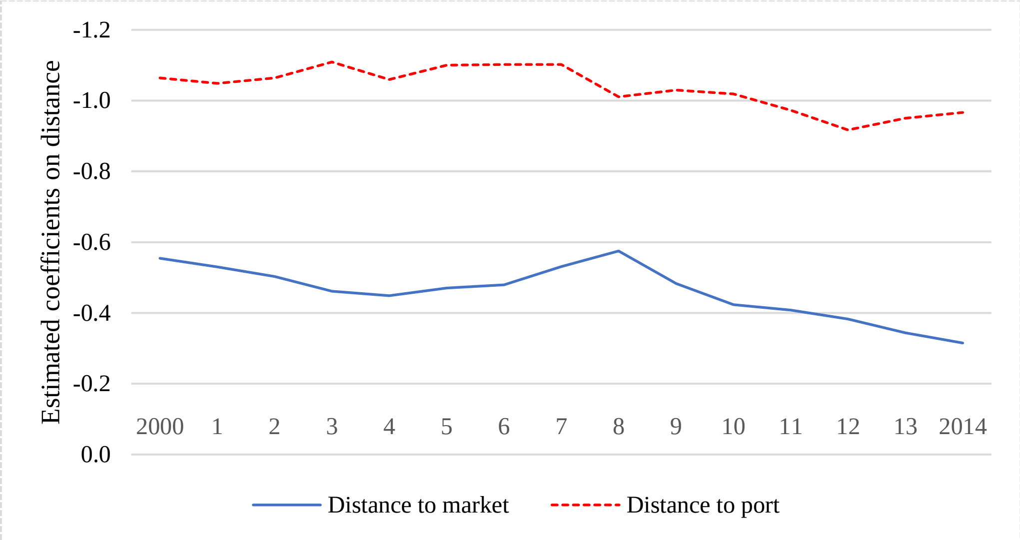
Column (3) examines inland distance effect on imports processed at dry ports. The estimated effect of domestic distance is negative and statistically significant but the magnitude of the effect is relatively smaller compared with that for exports, which could reflect the effect of competition in transport sector in Karachi and other factors discussed above.

6.1.1 Heterogeneity over Time and across Sectors

Figure 7 deconstructs the effects of internal and external remoteness on trade flows over time. The detailed estimates are available from authors upon request.

Figure 7: Distance Effects over Time

(Values on the y-axis are in reverse order)



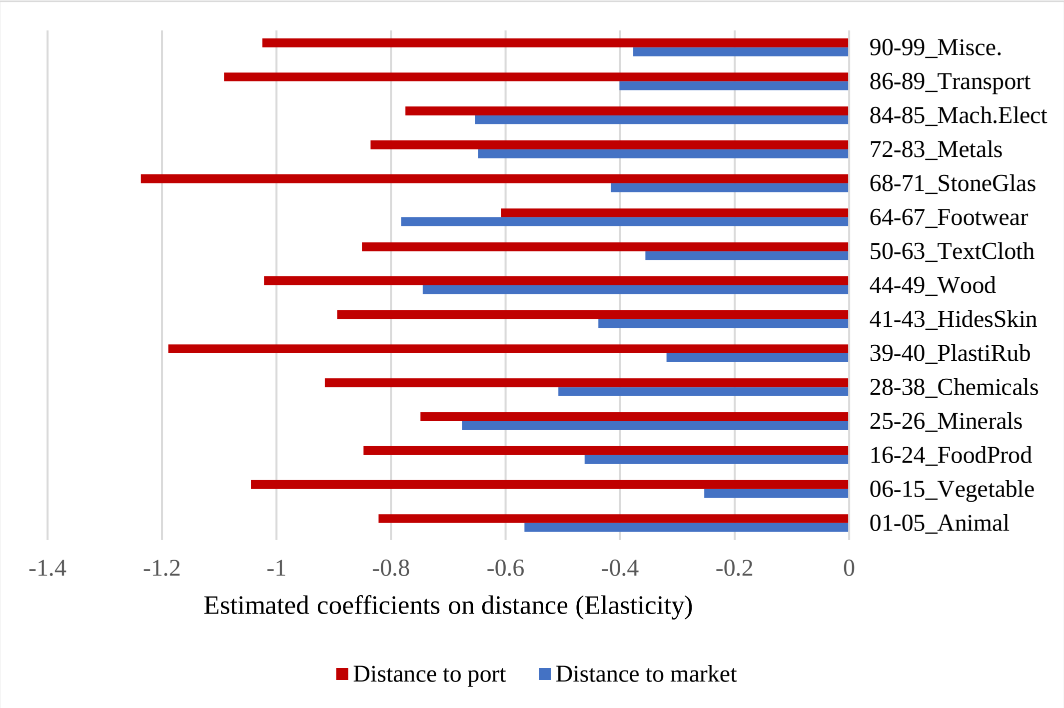
Notes: The figure plots the regression coefficients on internal and external distances estimated using equation (3). As the chart indicates, the effect of distance from port is larger than the effect of distance from export markets for all years in the study period.

As the chart shows, the magnitudes of the effect of international component of distance are smaller than those for domestic component for all years. Moreover, the trade-impeding effect of both components of distance tended to fall over time, and the drop being relatively higher for the international component. From 2000 to 2014, the trade-resisting effect of international distance dropped by 34%, whereas that for domestic distance dropped by 9% only, on average. The former may be a result of improvements in international shipping and communication technologies, leading to a reduction in international freight and other associated costs, and the latter may be a result of somewhat improvement in domestic infrastructure. Similarly, the heterogeneous reactions of quantity margins observed at aggregate level are not specific to any particular year; they respond positively to internal remoteness but negatively to external remoteness[22].

[22] The detailed estimates are available from the authors on request.

Since the estimations include the universe of exporting firms in both sectors, agriculture and manufacturing, it can be argued that a particular sector may be driving these results. By deconstructing the baseline results across sectors, Figure 8 shows that the trade-restricting effect of internal remoteness is larger in all sectors. Similarly, the heterogeneity of the effect along the EM of firms and products and quantity margins is observed across all sectors. This deconstruction confirms baseline estimates and also yields further information on the asymmetric nature of trade costs across sectors.

Figure 8: Heterogeneity of the Distance Effects across Sectors



Notes: The figure plots the regression coefficients on internal and external distances deconstructed at a sector level using equation (3). The detailed estimates are can be sought from the authors. It indicates that the effect of remoteness from ports is larger than the effect of remoteness from export markets for all sectors. The estimates vary widely, reflecting heterogeneity in the trade costs' sensitivity across sectors.

7 Conclusions

This paper examines the differential effects of domestic and international segments of distance by using novel datasets from a developing country. These datasets identify the locations of manufacturing firms, ports of entry and exit, and modes of shipment (air, land and sea) over time. It finds that, on average, the marginal export-restricting effect of internal distance (from manufacturing location to port of shipment) is almost three times than that of international distance (to the markets of trading partners). While the negative effects of domestic and international distances have been documented separately in some earlier studies, this paper examines the relative contribution of each segment. We further show that both segments of distance have heterogenous effects on different trade margins: the international distance negatively affects trade along all margins, with a relatively large effect through quantity margins, but the inland distance operates mainly through the extensive margins (EM) of firms and products, suggesting a larger role for domestic distance in restricting the entry of firms and constricting the diversification of products. Moreover, quantity margins defy domestic distance, although they drop with its international component.

The inland distance effect varies with the type of trade. It is relatively larger for export shipments than for imports and much larger for domestic trade. The measurement approach of inland distances also matter: the straight-line distance, rather than road distances, attenuate the effect of internal distance to the tune of 40%. The analysis further finds that the trade-impeding effects of distance, both international and domestic, have reduced over time but the drop is relatively higher for the international component. These results are robust to alternative specifications, data sources and the measurement approach of internal distances as well as to the decomposition of the distance effects across sectors and over time.

Since distance is commonly used proxy for trade costs, this paper shows that the relatively higher element of domestic transportation costs is a key impediment to accessing international markets. In the developing world, these costs – *inter alia* – are usually induced by the remoteness of trade-processing infrastructure from firms' production facilities and are further compounded by poor transport networks (ODI, 2015). Inland distance represents an implicit tax: it inhibits firms' participation in exporting and constricts their export product sets. This finding for Pakistan suggests that, from a trade facilitation perspective, a focus improving within-country transportation and connectivity matters more than improving the same at the international level for generating an appropriate trade response. Second, since the overall trade-restricting effect of domestic trade costs is much higher along the EM, this suggests that policies aimed at strengthening these margins assume more importance in promoting exports. Export promotion strategy and policy should focus on facilitating the market entry of firms and products, rather than on quantity subsidies. These findings imply that reducing inland transportation costs can boost exports though the channels of 1) entry of more firms into exporting and 2) widening of the export product set.

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9 Appendix

Table A 1**: Three Legs of Distance for Selected Economies**

	Elements of Distance (km)		
	Origin	International	Destination
Country	(1)	(2)	(3)
Pakistan	555	7,373	246
Malaysia	556	9,992	256
C. African Rep.	557	7,495	269
Vietnam	560	9,908	252
South Africa	585	8,392	285
Saudi Arabia	606	6,469	270
FM Sudan	620	11,942	266
Mozambique	696	7,879	261
Mexico	706	10,063	282
Indonesia	716	10,471	286
Congo, Rep.	803	6,995	267
Kenya	865	8,343	255
India	869	8,128	244
Kazakhstan	877	7,233	250
China	1,018	9,378	284
Australia	1,121	12,813	275
Brazil	1,157	9,232	265

Source: CEPII
Notes: This table presents domestic and international transportation distances for selected developing countries. Column (1) contains average inland transportation distance to port of exit, column (2) contains the distances between countries and column (3) contains the average transportation distance within the export market.

Table A 2**: Summary Statistics for Trade Margins**

Variable	Observations	Mean	Std. Dev.
Exports (X_{ijkt}) in PKR billions	34,117	0.335	2.67
Firm extensive margins	34,117	0.83	1.11
Product extensive margins	34,117	0.81	1.05
Quantity margins	34,105	2.59	2.10
Price margins	34,105	0.26	8.29

Notes: The table contains summary statistics of the data used for decomposing distance effect along trade margins. Following Bernard et al. (2007), Mayer and Ottaviano (2008) and Hillberry and Hummels (2008), the overall trade flow is decomposed to firm EM (number of exporting firms), product EM (number of products per firm) and quantity margins (quantity exported per product per firm, and price margins (price per product per firm).

Table A 3**: List of Trading Partners of Pakistan Included in the Analysis**

Afghanistan
Albania
Algeria
Angola
Argentina
Armenia
Australia
Austria
Azerbaijan
Bangladesh
Belarus
Belgium
Belize
Benin
Bolivia
Bosnia and Herzegovina
Brazil
Bulgaria
Burkina Faso
Burundi
Cabo Verde
Cambodia
Cameroon
Canada
Central African Republic
Chad
Chile
China
Colombia
Comoros
Congo, Republic of
Costa Rica
Croatia
Czech Republic
Cote d'Ivoire
Dem. Rep. Congo
Denmark
Djibouti
Dominica
Dominican Republic
Ecuador
Egypt
El Salvador
Equatorial Guinea
Estonia
Ethiopia
Fiji
Finland
France
Gabon
Georgia
Germany
Ghana
Greece
Grenada
Guatemala
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
Hong Kong
Hungary
Iceland
India
Indonesia
Iran
Ireland
Italy
Jamaica
Japan
Jordan
Kenya
Korea
Kyrgyz Republic
Lao PDR
Latvia
Lebanon
Liberia
Libya
Lithuania
Luxembourg
Macao
Madagascar
Malawi
Malaysia
Maldives
Mali
Mauritania
Mauritius
Mexico
Moldova
Mongolia
Morocco
Mozambique
Nepal
Netherlands
New Zealand
Nicaragua
Niger
Nigeria
Norway
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Portugal
Romania
Russia
Rwanda
Samoa
Senegal
Seychelles
Sierra Leone
Singapore
Slovak Republic
Slovenia
South Africa
Spain
Sri Lanka
St. Kitts and Nevis
St. Lucia
Sudan
Suriname
Sweden
Switzerland
Syrian Arab Republic
Sao Tome and Principe
Tajikistan
Tanzania
Thailand
The Gambia
Togo
Tonga
Trinidad and Tobago
Tunisia
Turkey
Turkmenistan
Uganda
Ukraine
United Kingdom
United States
Uruguay
Uzbekistan
Vanuatu
Venezuela
Vietnam
Yemen
Zambia
Zimbabwe

Table A 4**: Sector Definitions and Labels**

Abbreviation	Sector
01-05_Animal	Live animals; animal products
06-15_Vegetable	Vegetable products
16-24_FoodProd	Prepared foodstuffs; beverages, spirits and vinegar; tobacco and manufactured tobacco substitutes
25-26_Minerals	Mineral products
27-27_Fuels	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes.
28-38_Chemicals	Products of the chemical or allied industries
39-40_PlastiRub	Plastics and articles thereof; rubber and articles thereof
41-43_HidesSkin	Raw hides and skins, leather, fur, skins and articles thereof; saddlery and harness; travel goods, handbags and similar containers; articles of animal gut (other than silk-worm gut)
44-49_Wood	Wood and articles of wood; wood charcoal; cork and articles of cork; manufactures of straw, of esparto or of other plaiting materials; basket ware and wickerwork
50-63_TextCloth	Textiles and textile articles
64-67_Footwear	Footwear, headgear, umbrellas, sun umbrellas, walking-sticks, seat-sticks, whips, riding-crops and parts thereof; prepared feathers and articles made therewith; artificial flowers; articles of human hair
68-71_StoneGlas	Articles of stone, plaster, cement, asbestos, mica or similar materials; ceramic products; glass and glassware
72-83_Metals	Base metals and articles of base metal
84-85_MachElec	Machinery and mechanical appliances; electrical equipment; parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles
86-89_Transport	Vehicles, aircraft, vessels and associated transport equipment
90-99_Miscellan	Miscellaneous manufactured articles

Source: WTO, HS Nomenclature 2012 Edition

Table A 5**: Pattern of Domestic Trade**

A: Domestic Trade of Firms Located in Rahim Yar Khan
(A town in Punjab near the border of Sind province)

Locations of Trade Partners	Trade (PKR M)	Ethnic Region of Trade Partner	Intra-Town Distance (km)
Multan City	0.39	Same	227
Okara	1.06	Same	404
Karachi East	4.59	Different	490
Malir	252.92	Different	497
Karachi West	0.10	Different	513
Karachi South	247.15	Different	550
Lahore Cantt	17.93	Same	540
Lahore City	5.02	Same	510
Lahore	1,465.85	Same	523
Gujranwala	1.82	Same	558
Peshawar	340.69	Different	632
Islamabad	28.87	Same	646
Chota Lahore	49.99	Same	655
Haripur	454.03	Different	667

B: Domestic Trade of Firms located in Sukkur
(A town in Sindh near the border of Punjab province)

Locations of Trade Partners	Trade (PKR M)	Ethnic Region of Trade partner	Intra-Town Distance (km)
Malir	42.5	Same	352
Hub	20.6	Different	352
Karachi	4,934.7	Same	365
Karachi West	5.1	Same	365
Karachi Central	16.7	Same	365
Karachi South	1,314.4	Same	365
Karachi East	1.0	Same	365
Okara	0.6	Different	564
Sheikhupura	0.1	Different	667
Lahore Cantt.	0.2	Different	682
Ferozewala	25.0	Different	684
Peshawar	35.8	Different	747
Chota Lahore	5.0	Different	780
Islamabad	2.8	Different	782
Haripur	444.2	Different	799

Note: Sorted in the order of distance from town

Table A 6**: IV Estimates**

```
. //First-stage regression
. reg inland total_output , r

Linear regression                                    Number of obs =  484351
                                                     F(  1,484349) =50057.45
                                                     Prob > F      =  0.0000
                                                     R-squared     =  0.1677
                                                     Root MSE      =  1.0182

------------------------------------------------------------------------------
             |               Robust
      inland |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
total_output |  -.1644279   .0007349  -223.74   0.000    -.1658683   -.1629874
       _cons |   8.419361   .0066629  1263.62   0.000     8.406302     8.43242
------------------------------------------------------------------------------

.
end of do-file

. do "C:\Users\Salamat\AppData\Local\Temp\STD0j000000.tmp"

. predict inland_dist_hat
(option xb assumed; fitted values)

.
end of do-file

. do "C:\Users\Salamat\AppData\Local\Temp\STD0j000000.tmp"

.
. //Second Stage Regression
. reghdfe lexp external_dist inland_dist_hat $var4, abs(prod_year region_year)
>   //second stage
(converged in 10 iterations)

HDFE Linear regression                            Number of obs   =    484,351
Absorbing 2 HDFE groups                           F(   4, 483087) =    1806.57
                                                  Prob > F        =     0.0000
                                                  R-squared       =     0.2097
                                                  Adj R-squared   =     0.2077
                                                  Within R-sq.    =     0.0147
                                                  Root MSE        =     2.1829

------------------------------------------------------------------------------
        lexp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
external_d~t |  -.1259556   .0082544   -15.26   0.000    -.1421339   -.1097772
inland_dis~t |  -.5259005   .0099436   -52.89   0.000    -.5453896   -.5064114
    ln_gdp_d |   .0679829    .001898    35.82   0.000     .0642628     .071703
      contig |   .7695667   .0188611    40.80   0.000     .7325995    .8065339
-------------+----------------------------------------------------------------
    Absorbed |   F(1259, 483087) =     85.439   0.000           (Joint test)
------------------------------------------------------------------------------

Absorbed degrees of freedom:
---------------------------------------------------------------
 Absorbed FE |  Num. Coefs.  =   Categories  -   Redundant     
-------------+-------------------------------------------------
   prod_year |         1208           1208              0     
 region_year |           52             65             13     
---------------------------------------------------------------

.
end of do-file
```

Figure A 1: Spatial Distribution of Population in Pakistan

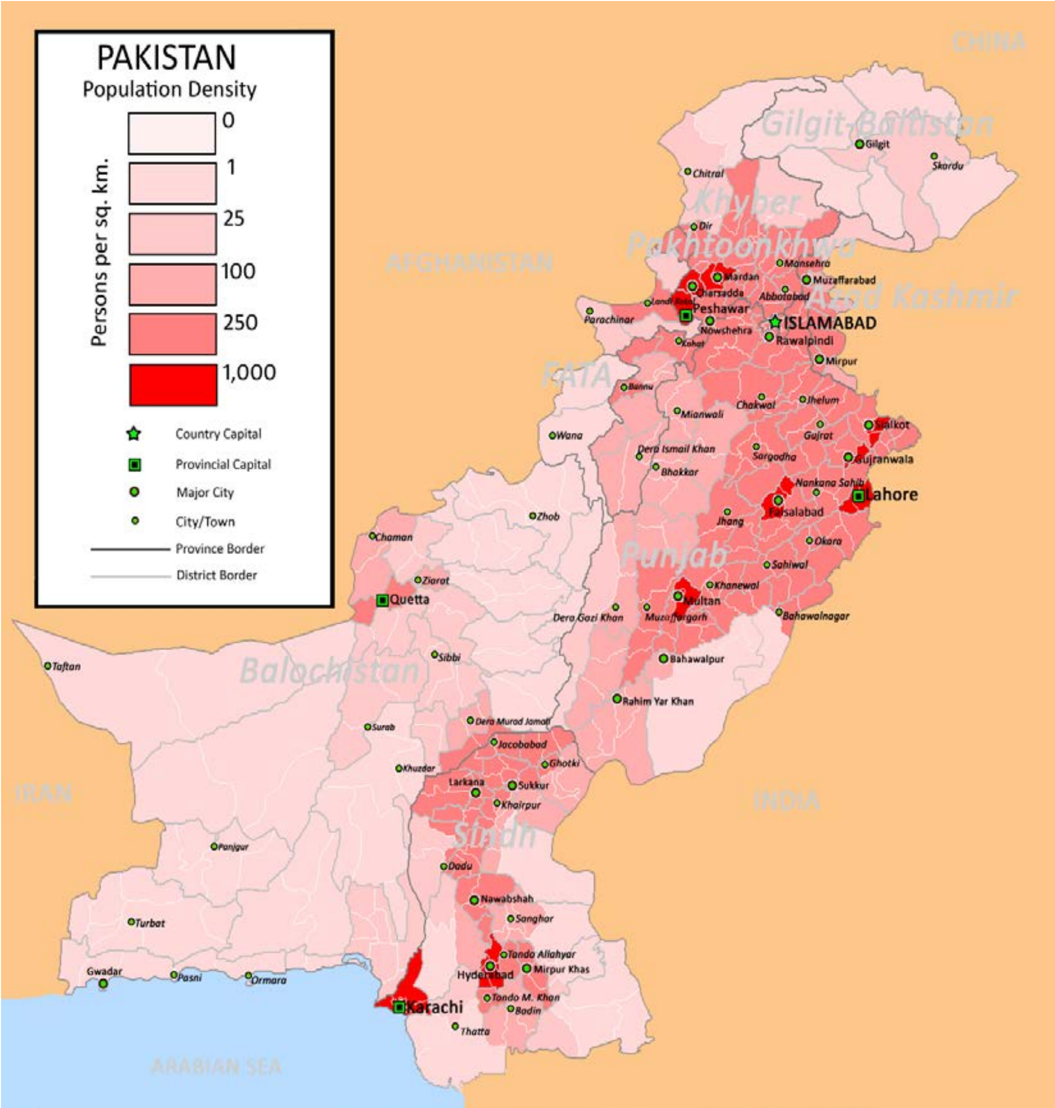
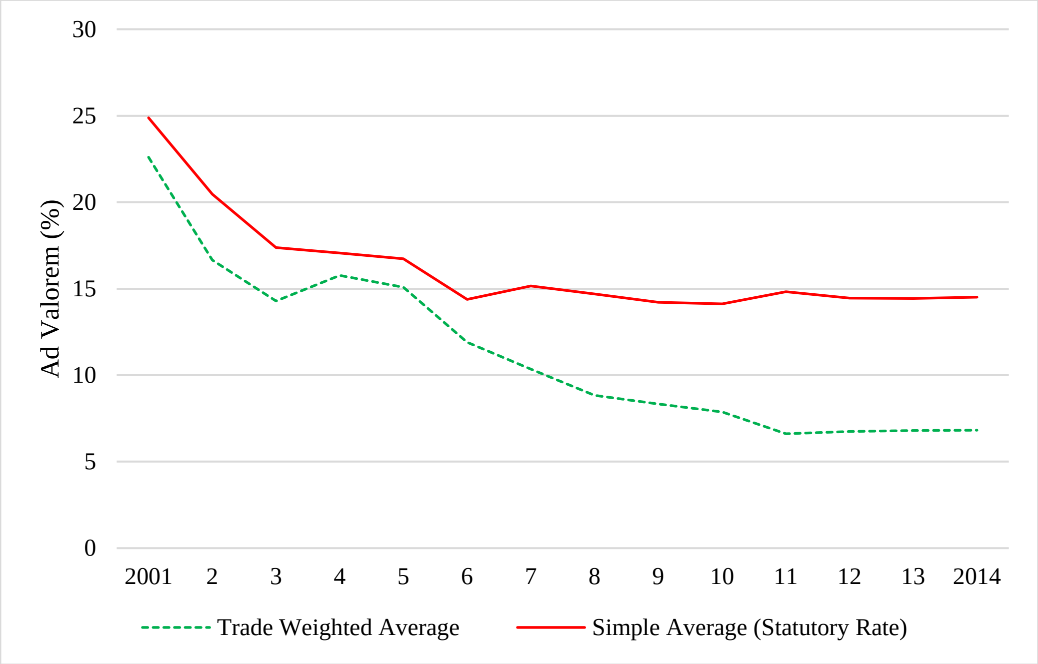


Figure A 2: Pakistan's Average Customs Duty on Imports



Notes: The chart presents the average rate of customs duty (CD) over time. Besides CD imports attract a range of para-tariffs, such as sales tax, income tax, provincial taxes and port development surcharge. Some of which were also rationalised under the policy reforms launched by the military government.