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Determinants of inter-State agricultural trade in India

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Abstract

Determinants of trade among various Indian states have been poorly studied in the literature. In this paper, we examine the nature of agricultural trade among Indian states and identify why certain states export more than others, and what governs trade among these Indian states. Using data provided by the Directorate General of Commercial Intelligence and Statistics (DGCIS) for years 2005, 2008, 2011 and 2014, we employ cross-section as well as panel gravity analysis to identify the impact of trade costs and other factors in determining intra-India trade. Contrary to traditional findings, we observe that exporter's size does not significantly affect exports to other Indian states. We also find that subsidies hurt trade and trade costs measured by deviations from the law of one price have a significant negative impact on the overall trade between Indian states.

Keywords: Inter-State trade, Agriculture trade, India, Gravity model, Trade costs.

JEL Classification: F14, H71, H77

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1. Introduction

Trade and its effects on the Indian economy have been a popular topic in the Indian economic literature (e.g. Chand and Sen, 2002; Krishna and Mitra, 1998; Topalova and Khandelwal, 2011; Topalova, 2007). After the liberalization of its economy in 1991, the country has undergone massive structural changes with increased focus on principles of privatization and liberalization. Consequently, at present, international trade accounts for almost 38 per cent of India's GDP (World Bank, 2014)[1] and the country ranks among the 12th largest traders in the world with total trade rising at more than 20 per cent per annum (World Bank, 2014). As a response to these changes, studies have focused on determinants of bilateral and multilateral trade (Srinivasan and Archana, 2009), trade's impact on growth (Modak and Mukherjee 2014), poverty and inequality (Topalova, 2007; Topalova, 2010) and mainly on productivity (Krishna and Mitra, 1998; Das, 2003; Mahadevan, 2003) among others.

While much has been said about the success or the lack thereof in India's international trade front, very little work has been done to study the internal trade in India. India is a conglomeration of States that exhibit a variety of climatic, socio-economic, and ethno-cultural diversity. Owing to the immense sizes and diversity of the local economies and considerable potential for trade, understanding the drivers of trade between the States in India therefore, constitutes an important exercise. However, attention in this regard (even by the State apparatus) has been sporadic and sparse highlighted by the fact that as of yet, Government of India does not even collect inter-state trade data on road transported goods.[2] What is known, however, is that internal trade in India is plagued by assortment of restrictions related to diversity in controls, and lack of uniformity in standards and taxing structures, and therefore, considerable room for improvement exists to improve facilitation of trade among various States in India itself (Behera, 2006).

The problems in inter-State trade, especially in the agricultural sector in India has been well documented (Behera, 2006; FAO, 2005). The Planning Commission estimated that in 2001-2002, share of internal trade in GDP was less than 13 per cent (Planning Commission, 2004).

[1] The corresponding figure for 1974 was 10.66 percent of GDP.

[2] As reported in the Economic Times of March 13 2013 where the Director General of Directorate General of Commercial Intelligence and Statistics quotes, "we presently compile data on interstate trade through railways, river, air and sea. Statistics of interstate movement of goods by road is not collected by any agency and has never been done before" (Dhoot 2013).

The Report of the Working Group on Agricultural Marketing Infrastructure, Secondary Agriculture and Policy required for Internal and External Trade highlighted that incidences of state and local taxes, collection of market fees by government agencies and existence of various laws have been prohibitive towards internal trade in India (Planning Commission, 2011). While these studies clearly highlight poor legal and marketing infrastructure of internal trade in India, they do not really help us understand factors that influence trade between various states.

It is now widely accepted that barriers to trade are just one component of the factors that determine trade. The traditional gravity model expects that "interaction between large economic clusters is stronger than between smaller ones, and nearby clusters attract each other more than far-off ones" (Van Bergeijk and Brakman, 2010). More recently, literature has moved away from traditional size and distance models to include other (non) economic factors such as socio-cultural and linguistic similarities (Campbell, 2010), institutional and political differences (Möhlmann et al., 2009), differences in productivity and technological development, among others. Therefore, while it is necessary to examine the nature of the trade barriers and their costs while trading between Indian states, it is also equally important to understand what factors drives trade between those states. Also it is important to identify the extent of difference these factors make in order to provide policy recommendations that can help in overcoming them.

This paper tries to address this gap in literature. The study is structured as follows. Section 2 describes the existing literature and elaborates on the primary research gap and the research question of the current study. Section 3 contains a discussion on the methodology applied in the study as well as a description of the data sources along with their potential limitations. Results and their interpretations are detailed in Section 4. Finally, conclusions are provided in Section 5.

2. Related literature

The idea of federalism and its economic importance are old. It is argued that federalism and ensuing decentralization means that local governments and consumers have better information and therefore, make better decisions (Hayek, 1945), and competition among States leads to more efficient resource allocation (Tiebout, 1956). Besides the gains from the efficiencies of resource allocation, however, is the additional prospect of creating a common

market enabling all constituencies to utilize their respective comparative advantages in a geographical area otherwise separated by jurisdictional boundaries (Bagchi, 2002). In that sense, trade among States remains a crucial element in utilizing the gains from decentralization and specialization. In India, in particular, gains from specialization especially in the field of agriculture are massive. There are 15 different agro-climatic zones in the country capable of producing vast array of crops and livestock.[3] In the presence of common markets, agricultural specialization can therefore, lead to significant gains from trade to farmers across the country.

The Constitution of India under Article 301 stipulates that "subject to the other provisions of this Part, trade, commerce and intercourse throughout the territory of India shall be free" (as cited in Bagchi, 2002). However, the role of trade in India's internal trade policy, especially in agriculture, has often intertwined – and at times contradicted – with its pursuit of food security. For a long period of time, and perhaps still today, India pursued a strategy of self-sufficiency in food production instead of following policies that enhanced productivity and efficiency in the sector. As it was so clearly elucidated by Dr. Manmohan Singh (as cited in FAO, 2005, p. 3):

"To a large extent our policy framework and investment priorities for agriculture were designed for addressing the issue of food security in the country and not really for a more balanced growth in agriculture. Since these policies have roots in the economy of shortages there is an excessive focus on controls on storing and trading agricultural products."

Consequently, the existing policies related to trade in agriculture, within and outside India, have been beset with various distortionary strategies where market signals do not necessarily incentivize farmers in production as well as trade of agriculture goods (FAO, 2005). This fact is further enforced by the intra-jurisdictional autonomy provided to States in India where financing of sub-national public services is to a certain extent of the prerogative of the States who subsequently have to raise their own public revenue to finance such services (Das-Gupta, 2006). The Constitution of India under Section 304(*b)* provides that the State legislature is permitted to "impose such reasonable restrictions on freedom of trade, commerce or intercourse with or within that State as may be required in the public interest"

[3] The Planning Commission has divided India into 15 agro-climatic zones namely, eastern and western Himalayan regions; lower-, middle-, upper- and trans ganga plains regions; eastern, central, western and southern plateaus; eastern and western coastal regions; Gujarat plains; dry western region and island region. Each of the regions are unique in terms of their climatic conditions, soil suitability and quality, and the agriculture/horticulture/or livestock potential.

(GoI, 1950). As a result, there has been a proliferation of distortionary policies that have been prohibitive towards internal trade in India. Incidences of duties like sales tax/VAT, State excise duties, motor vehicle taxes, checks and stops, taxes on forest based products and mines and minerals, as well as other procedural barriers including documentation are all discretionary and change as per States (Das-Gupta, 2006). Subsequently, trade barriers make up to 30 per cent of total trade costs within India with substantial variation across States (Leemput, 2014).

Despite its importance, not much attention has been paid in the area of internal trade in the literature. The most important studies in this regard have accounted for differences in inter- and intra-national trades and the reasons exploring the "border effect" (McCallum, 1995; Anderson and Wincoop, 2003) examining the determinants of trade among countries compared to trade within the countries themselves. Following the results of Anderson and Wincoop (2003), the studies have been applied most notably in the context of China (Poncet, 2005), Japan (Okubu, 2004), and European Union (Chen, 2004). However, most of these studies identify States and provinces within the country mostly as homogenous entities and have primarily focused on developed markets of the time to verify and demystify the border effect (Wei, 1996; Wolf, 1997). A notable exception was Poncet's study on China's provincial trade which focuses on what Poncet describes as "framework of endogenous protection" implemented by States in order to protect their own socio-political interests and maximize fiscal revenues (Poncet, 2005). This is especially true in countries like India where one expects significant heterogeneity in State-wise characteristics.[4]

Up till now, no such exercise has taken place in India. Most notable studies trying to identify determinants of trade in India have focused on the international market identifying costs and benefits of bilateral trade potential (Bhattacharya and Bhattacharyay, 2007), ascertaining India's trade potential (Batra, 2006), ascertaining determinants of India's international trade (Tripathi and Leitão, 2013) and have not considered internal trade in India. Publication from Directorate General of Commercial Intelligence and Statistics (DGCIS) aside very few quantitative analyses has been done on internal trade in India. One exception is Leemput (2014) who uses inter-State price dispersion to identify costs of trade across Indian states. She finds out that reducing trade costs across India increases welfare by 15% higher than

[4] In most of these studies, inter-state and international trade is distinguished only by dummy variables. Factors like language, cultural homogeneity, effects of migration, existence of similar political leadership, and other such factors are not taken into account.

welfare gains from reducing international trade barriers (where welfare gains come out to be 7 per cent).

This paper tries to build on the literature by exploring the determinants of intra-State trade in India. It especially focuses on the trade of agricultural and agro- goods between various Indian States and studies the impact of various factors (including subsidies) in determining trade of agricultural goods within India. Using the gravity model the study identifies the extent of trade between various Indian States across a period of time and factors that affect the trade between the States.

Gravity model

The gravity model has been one of the most successful empirical models in the international economics (Anderson, 2011). One of the earliest advocates of the model was Ravenstein (1885) who explained that migration between places is driven by sizes of the economies of centres of commerce and industry but "grows less with the distance proportionately" (as cited in Bergeijk and Brakman, 2010). It was Tinbergen (1962) and Pöyhönen (1963) who used the model empirically estimating trade to be a simple function of distance between the sizes of the countries' economies and inverse of the distance between them, and by today the use of the gravity modeling has grown beyond imagination. The model drew analogy from Newtonian Law of Gravitation to estimate trade (X_{ij}) between two regions *i* and *j*:

$$X_{ij} = \frac{GDP_i^{\alpha} GDP_j^{\beta}}{d_{ij}^{\theta}} \qquad (1.1)$$

where *GDPi* and *GDPj* are the respective sizes of the two economies, *d* is the distance between them and parameters *α, β,* and *θ* are the coefficients estimated during the log-linear reformulation of the model. In the latter applications, explanatory power of the model was further enhanced by considering other variables as proxies for trade friction.

Lack of sound economic theory behind the gravity model used for empirical work meant that despite the robustness of the findings of the model, the model remained an "intellectual orphan" disconnected from economic theory (Anderson, 2011). Particularly important was the lack of consideration the model provided to the significance of trade friction between *i* and

alternative markets relative to the bilateral trade resistance between *i* and *j* and the role of consequent relative resistance in determining trade between *i* and *j*. This absence of acceptable micro-economic foundation made the model a useful empirical tool but unappealing from a theoretical point of view (Bergeijk and Brakman 2010). The works of Anderson (1979) and Bergstrand (1985) were among the first to provide micro-economic theoretical foundation for the gravity model. Yet, it was the recent work of Anderson and Wincoop (2003) that has emerged as the standard of reference for subsequent work on gravity equations. In their structural gravity model, Anderson and Wincoop (2003) assume identical, homothetic preferences approximated by a CES function where c_{ij} is the consumption of goods from region *i* in region *j* and is subject to maximization of utility function (1.2) subject to budget constraint (1.3)

$$\left(\sum_i \beta_i^{(1-\sigma)/\sigma} c_{ij}^{(\sigma-1)/\sigma}\right)^{\sigma/(\sigma-1)} \tag{1.2}$$

$$\sum_i p_{ij} c_{ij} = y_j \tag{1.3}$$

where σ represents the elasticity of substitution between goods, β_i is the distribution parameter, y_j is the nominal income region *j* and p_{ij} is the price of region *i* good in region *j*. Assuming t_{ij} be the cost of trade between region *i* and *j*, and p_i be the f.o.b. price, we can say $p_{ij} = p_i t_{ij}$, the nominal value of export will be $X_{ij} = p_{ij} c_{ij}$ and *i*'s total income to be $\sum_j X_{ij} = y_i$. Then, the nominal demand for goods from region *i* in region *j* subject to (1.3) becomes,

$$X_{ij} = \left(\beta_i p_i t_{ij} \middle| P_j\right)^{(1-\sigma)} y_j \tag{1.4}$$

where P_j is the consumer price index in region *j* given by

$$P_j = \left[\sum_i \left(\beta_i p_i t_{ij}\right)^{1-\sigma}\right]^{1/(1-\sigma)} \tag{1.5}$$

then from (1.3), (1.4) and (1.5) we get,

$$y_i = \sum_j X_{ij} = \sum_j \left(\beta_i p_i t_{ij} \middle| P_j\right)^{(1-\sigma)} y_j = (\beta_i p_i)^{1-\sigma} \sum_j \left(t_{ij} \middle| P_j\right)^{(1-\sigma)} y_j \,, \forall i \quad (1.6)$$

We can say, world income is given by $\sum_i y_i = y_w$ and share of *j* in y_w as $\theta_j = y_j / y_w$. Then,

$$X_{ij} = y_j y_i / y_w \left(t_{ij} \middle| P_i P_j\right)^{(1-\sigma)} \quad (1.7)$$

where P_i is the multilateral resistance given by

$$P_i \equiv \left(\sum_i \left(\frac{t_{ij}}{P_j}\right)^{1-\sigma} \theta_j\right)^{\frac{1}{1-\sigma}} \quad (1.8)$$

and

$$P_j = \left(\sum_i \left(\frac{t_{ij}}{P_i}\right)^{1-\sigma} \theta_i\right)^{\frac{1}{1-\sigma}} \quad (1.9)$$

If trade barriers are assumed to be symmetric, i.e.$t_{ij} = t_{ji}$, then solving (1.8) and (1.9) gives $P_i = P_i$ and so substituting P_i in (1.7), the gravity equation becomes,

$$X_{ij} = y_j y_i / y_w \left(t_{ij} \middle| P_i P_j\right)^{(1-\sigma)} \quad (1.10)$$

3. Empirical method

The log linearization of (1.10) yields

$$\ln\left(X_{ij}\right) = \ln y_i + \ln y_j - \ln y_w + (1-\sigma) \ln t_{ij} - (1-\sigma) \ln P_i - (1-\sigma) \ln P_j + \varepsilon_{ij} \quad (1.11)$$

Since multilateral resistance terms P_j and P_i are not observable, three possible solutions have been forwarded in the literature to account for the unobservable variables. First, as was

used by Rose and Wincoop (2001), and Redding and Venables (2004), fixed effects can be used to account for the multilateral resistances between the trading regions. This method is popular and recommended owing to its simplicity, and consistency of estimates (Feenstra, 2004). The second involves application of first order Taylor-series expansion of the multilateral resistance terms and substituting these in equation (1.11) (Baier and Bergstrand, 2008). Third, linear approximation of the multilateral resistance terms is done and analysed via standard econometric methods to arrive at the results in Anderson and Wincoop (Van Bergeijk and Brakman, 2010). Here we use the fixed effects estimation of the multilateral resistance terms to arrive at the required gravity equation. We use exporter-time, importer-time and exporter-importer pair dummies to account for multilateral resistances.

In order to estimate the trade costs between the two regions, we use traditional indicators like existence of common borders, and common language between them. We also model for inclusion of dummy variable for existence of common ruling parties in the States in the assumption that trade between States sharing the same ruling parties might be easier. Similarly, the impact of production subsidy on trade is also examined by including data on total state subsidy on power/electricity for agricultural production. In addition, we also make use of the law of one price to evaluate the existence of sticky trade costs between the two regions.[5] High levels of integration would imply that across time, prices of commodities would equalize owing to possibility of arbitrage between them. Stickiness of prices, therefore, would be an indicator of high trade costs between two regions. We utilize methodology used by Crucini and Shintani (2008) to estimate deviations from the law of one price where difference of price of n between two markets i and j at time t is given by the difference between the log of prices between them:

$$d_{ijt}^{n} = lnp_{it}^{n} - lnp_{jt}^{n}$$

Here, we compute the difference between the prices of a brand of rice between various markets to compute the deviations from the law of one price in various Indian states.

One important issue that arises while dealing with bilateral trade data is the presence of zero trade between a pair of countries especially if the study focuses on product-specific disaggregated data. Significant presence of zero trade values can, in such circumstances,

[5] The law of one price states that in the absence of other trade costs, the cost of identical commodities must be the same across all markets (after accounting for transport and transaction costs).

lead to significantly biased results (Heckman, 1979; Martin, Pham, and Cong, 2015). Another important challenge associated with gravity models is the issue of heteroskedasticity. The presence of heteroskedasticity can lead to inconsistent estimated coefficients when variables are logarithmically transformed. Considering the two factors in mind, we use the Pseudo Maximum Likelihood Method (PPML) which provides consistent results in the presence of zero trade values as well as heteroskedasticity (Silva and Tenreyro, 2006).

Finally, in accordance with the recommendations provided by Trefler (2004), we consider panel data (taking the years 2005, 2008, 2011 and 2014) constructing a panel keeping a three year gap as proposed by Trefler (2004). As a consequence, our baseline regression is as follows:

$$\ln(trade)_{ij} = GDP_i + GDP_j + dist_{ij} + ComBor_{ij} + ComLan_{ij} + lnRoad_i + lnRail_i + diff_{ji} + lnsubs_i + lnsubs_j + PortDummy_i$$

Table 1: Definition of variables

Variable name	Definition
$\boldsymbol{Gov}$	Dummy variable where 1 implies common ruling parties between two states
$\boldsymbol{lnroad}$	Log of length of roads per 100 sq km. for exporting region
$\boldsymbol{lndist}$	Distance between the capitals of trading pairs
$\boldsymbol{diff}$	Difference between log of price of importing state and exporting state
$\boldsymbol{lnA}$	Log of agriculture GDP per capita of exporter
$\boldsymbol{lnAimp}$	Log of agriculture GDP of importer
$\boldsymbol{lnApc}$	Log of agriculture GDP per capita of exporter
$\boldsymbol{lnApcimp}$	Log of agriculture GDP per capita of importer
$\boldsymbol{lnsubs}$	Log of agriculture subsidy given in the exporting state
$\boldsymbol{lnsubsimp}$	Log of agriculture subsidy given in the importing state
$\boldsymbol{lnyield}$	Log of agricultural yield of rice in the exporting state
$\boldsymbol{ComBor}$	Incidence of common border between two regions
$\boldsymbol{ComLan}$	Incidence of common language between two regions
$\boldsymbol{lntrade_{ij}}$	Log of exports from i to j
$\boldsymbol{lntradenew_{ij}}$	Log of exports from i to j when 0 trade values are marginally increased

4. Description of data

We derive our dataset from the estimates provided by the Directorate General of Commercial Intelligence and Statistics (DGCIS) which is the only official source of internal trade data in India. The DGCIS maintains an annual record of movement of goods among States by rail, river and air of which only movement of goods by rail are disaggregated at the product level. Since trade via air and rivers amount to less than 1 per cent of total inter-state trade, we believe discounting these sectors does not lead to significant changes in the outcome of the study. There exists no official record on the movement of goods by roads in India. The internal trade data is disaggregated into agriculture, manufacturing inputs, and agricultural inputs with a total of 70 items recorded in any given year for 27 different states and their important ports. The items traded to and from ports can be classified as movements meant for international trade and therefore, have not been taken into consideration. The current study focuses on the movement of agricultural commodities across India. Taking availability of all necessary data, 21 states of India were taken into consideration.[6]

In order to identify prices of agriculture products across various markets, we use the excellent database maintained by Directorate of Marketing & Inspection (DM&I) under the Ministry of Agriculture and Farmers Welfare.[7] Since the trade data provided by the DGCIS is only in terms of quantity, prices of the commodities were derived from the monthly data from DM&I and averaged out across markets across various periods in order to arrive at the representative prices of the commodities for the three years. Similarly, data related to road infrastructure was taken from Basic Road Statistics of various years to be found under the website of Ministry of Statistics and Programme Implementation. State GDPs were taken from the data provided by the Ministry of Statistics and Programme Implementation. Data on subsidies provided and agriculture productivity was taken from Indiastat.com.[8] Distance between the two State capitals was taken using Google Maps.

[6] States including Arunachal Pradesh, Bihar, Goa, Himachal Pradesh, Jammu & Kashmir, Meghalaya, Mizoram, Nagaland, Sikkim and Telangana did not form part of the analysis. Similarly, only Pondicheri was included among the Union Territories.
[7] The prices of the commodities can be found under the webpage agmarknet.dac.gov.in.
[8] At this point, State government subsidy on the agricultural power usage (in production) has been taken as the proxy for total agricultural subsidies.

5. Results

Total trade of agriculture goods in India is extremely small.[9] Considering some estimates suggest that internal trade make up 13 per cent of GDP (Planning Commission, 2004), we argue that either this figure is highly exaggerated or the share of agriculture in total internal trade in India is extremely small. Since, India's total merchandize trade to GDP ratio was 37 per cent it further reinforces the fact that total internal trade in India provides considerable area of improvement vis-à-vis India's international trade.

Table 2: Internal trade indicators of India

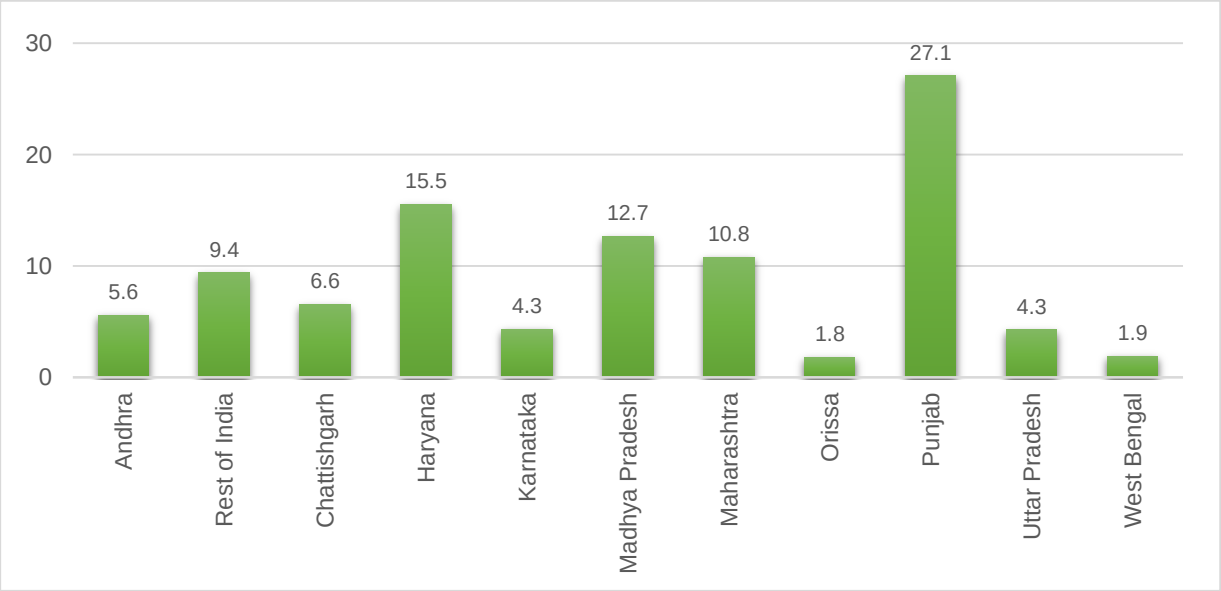
Indicators	2005	2008	2011	2014
Total internal trade (IRS in million)	555,422	570,108	774,083	1,016,095
Export/GDP (%)	1.86	1.24	1.07	0.42

Source: DGCIS 2005, 2008, 2011, 2014

Classification of the states on the basis of their exports and imports performance reveals that unsurprisingly, Punjab was the most important exporter of agricultural commodities followed by Madhya Pradesh. Andhra Pradesh, Haryana and Maharashtra were other important exporters of agricultural commodities. Similarly, Haryana, West Bengal, Gujarat and Uttar Pradesh were found to be the largest importers of agricultural products. Classification of export products show that rice followed by wheat, various oils and sugar were the most important traded items across India.

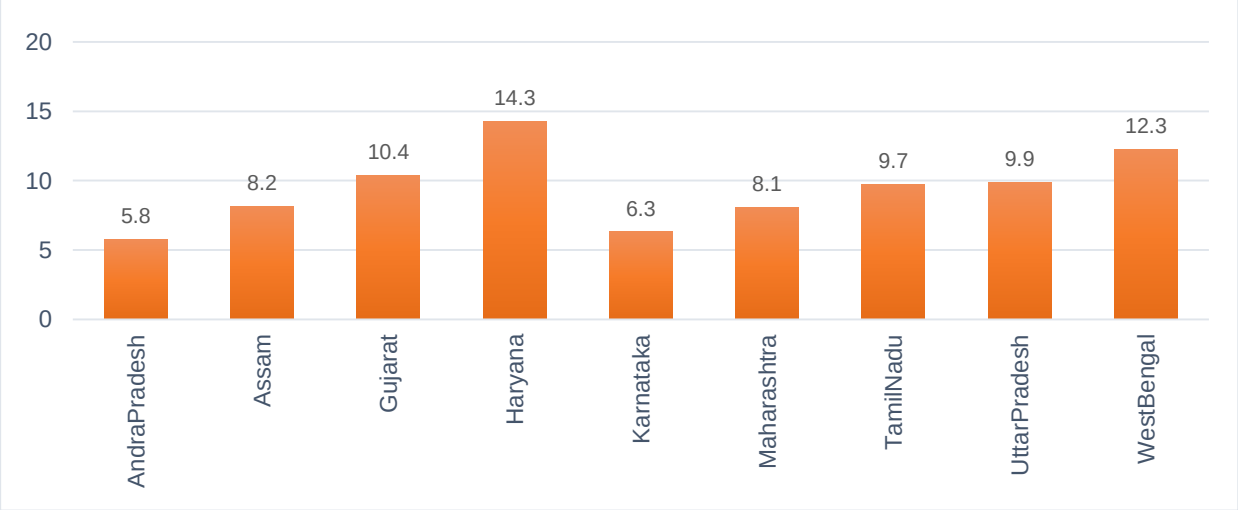
[9] It has to be kept in mind that trade here refers to movement of goods via railways only and does not include goods other than non-agricultural goods or goods traded via rivers, air or roads.

Figure 1: Share of major exporters in total internal trade in 2014 (per cent)



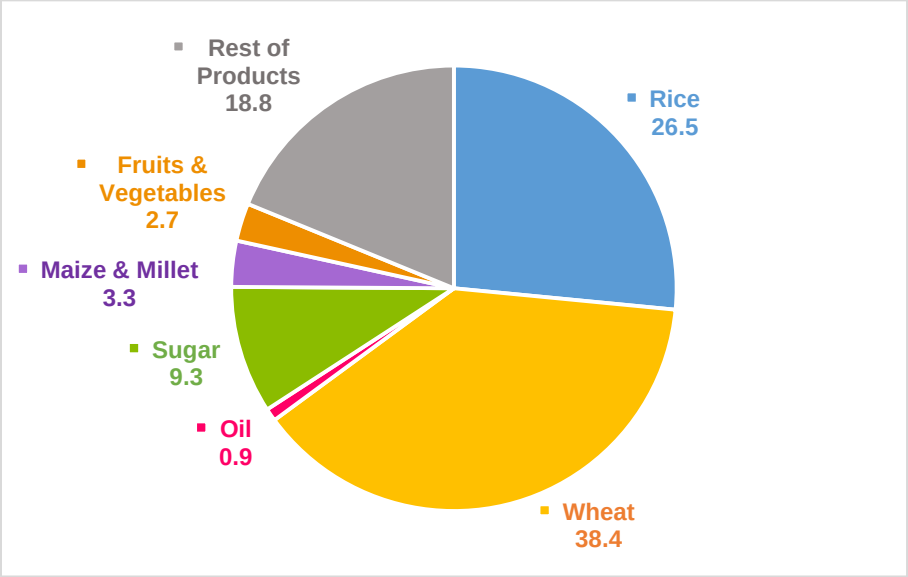
Source: DGCIS 2014

Figure 2: Share of major importers in total internal trade in 2014 (per cent)



Source: DGCIS 2014

Figure 3: Most important traded goods in 2014 (per cent)



Source: DGCIS 2014

Dominance of few states as well as products indicates high degree of export concentration among products and states. Dependence of trade with a single partner or lack of diversification of products is associated with various problems. Any supply side shock can drastically reduce the production and therefore, export potential hurting the farmers. Additionally, in the import side, impact of supply side shock in the importing market, in the short run, can translate to lower supply as well as higher prices for imported commodities. It is always economically advantageous to diversify one's product as well as market portfolio. Diversification reduces market risks, provides more stable source of income, and results in efficiency gains resulting out of use of unutilized production potential which in India's case is vast.

In terms of regression, we try to underestimate the impact of three main control variables in the estimations. First, we try to understand the role of political ruling parties in facilitating trade across border i.e. to examine whether states sharing same political ruling parties trade more than states that do not. Second, we try to understand the role of subsidies in exports among Indian states. Because data on export subsidies or marketing subsidies were unavailable, we take the subsidies provided by states to promote production as the variable of interest. Third, we try to understand the role of deviations from law of one price as the

extent of trade barriers between various states. Recognizing the potential of reverse causality where deviation from law of one price is a function of lack of trade rather than the other way around, prices of the previous years (one-year lag) were taken to arrive at *diff* values. We present the findings from the regressions involving the three control variables separately as well as together. In order to validate the findings, we take into consideration total agriculture GDP as well as agriculture GDP per capita separately.

Considering the existence of large number of zeros in the data, however, the estimates of the OLS are likely to be biased. Therefore, we try to go around this issue by adding 1 to the existing zero trade values and call the model A.OLS. However, since we expect high levels of heteroskedasticity in the data, the results of OLS estimators are bound to be inconsistent. In this light, we also run separate PPML regressions with importer fixed effects, exporter fixed effects and importer fixed effects.[10] Findings are clustered around pair ids of the exporters and importers to make the results more robust. As we shall see, the indicators from PPML can vary significantly compared to the OLS results.

In the first set of regressions, we find that among the traditional indicators, only importer's GDP and length of roads seem to have an impact on trade between two states. The income elasticity of imports seems to vary between 0.77 and 0.39 depending on the method of estimation. Assuming PPML to be the more robust methodology, the income elasticity of import was found to be around 0.67 in case of AGDP, and 1.09 in case of per capita AGDP. Length of road was found to be negatively related to total exports with rise in roadways by 10 per cent leading to fall in exports by around the same margin in case of AGDP and 1.21 in case of per capita AGDP. The finding, though unusual, is not surprising considering the data primarily consists of trade via railways. Since roadways and railways are substitute modes of transportation, it is not surprising to find a negative elasticity between the two modes of transport.

However, our primary variable of interest, the effect of same political ruling parties in the two trading states does not seem to have any effect on total trade between the two states. The finding is important. Between 2005 and 2014, India went through two general elections and except for 2-3 states, the entire federal entities were governed by the coalition of two major

[10] Due to limitations on the number of observations, we could not implement further robust fixed effect models including taking pair fixed effects or exporter-time, importer-time and pair fixed effects. This is largely due to incomparable dataset provided by the DGCIS where the data from 2005 onwards do not match with those from earlier years.

political parties and bitter rivals namely Bharatiya Janata Party (BJP) and Indian National Congress. Absence of a positive relationship between the ruling parties and exports, therefore implies that trade between states is independent of the discretions of the elected representatives.

The second set of results echo the findings of the first in terms of the traditional proxies of trade costs. We find that besides the strong positive income elasticity of imports, common borders and common language do not seem to have much impact on trade. Surprisingly, it was found that subsidies on production inputs have negative effect on trade, at least on the exporters' side. Meanwhile, importers with higher subsidies tend to importer more. This acts counter to the intuition that production subsidies tend to promote exports (WTO 2006). One possible explanation behind this phenomenon could be the case where high levels of subsidies are provided by the states with lower levels of production and therefore, rise in subsidies equates with necessity to fulfill domestic demand instead of exporting abroad. One method to examine this case was to use AGDP per capita to proxy for levels of agriculture production. Agricultural yield was also included as a variable to control for efficiency of production among States (Appendix, Table 4). So, even after controlling for the productivity of the states, negative relationship between subsidies by exporters and their exports was encountered. Another possible reason could be the fact that states with higher subsidies with competitive prices choose to export abroad rather than trading it with other Indian states. Since we do not have export related trade data, the validity of this reason cannot be explored at the moment.

The third set of regressions examined the role of trade costs proxied by deviations from the law of one price. We assume that the higher the deviations from one price, the higher will be the trade costs and examine the role of trade costs in determining trade between Indian states. As with the earlier two sets of regressions, there was a negative and equivalent elasticity of road infrastructure with trade although, the role of importers' GDP is a little less pronounced with income elasticity to import falling to 0.6. The regressions showed a strong effect of the trade costs (measured in terms of deviations from one price) in determining trade with rise in one percent deviations in prices between two states leading to fall in trade by 2 per cent between them implying that trade costs pose a considerable barrier between Indian states.

The fourth set of regressions where all variables of interests are combined do not change the results too much. However, the elasticity of importer's GDP and the road infrastructure rise marginally to 1.75 and -1.4 respectively. The importance of ruling political parties is insignificant. The signs as well as the magnitude of subsidies though remain fairly comparable. While exporter subsidies hurt exports, importer subsidies promote exports but the combined effect of subsidies comes out to be negative with an elasticity of around 0.21. Similarly, trade costs measured by deviations from one price in the earlier year were also found to be major deterrent to overall trade with an elasticity of over -2 implying high degree of trade costs between the Indian states.

6. Conclusions

Against the backdrop of rising importance of international trade in the Indian economy, the potential offered by internal trade in India remains untapped. Beset with incidences of highly distortionary subsidies and protectionist measures, traders within India find commerce within India expensive and prohibitive. In this light, it becomes an important exercise to identify the determinants of internal trade in India and to identify factors that are prohibitive to internal trade.

Our study attempted to fill this gap by conducting a gravity analysis of the determinants of internal trade in India. The study made use of the data provided by DGCIS which documents internal movement of goods within India by rail. Considering the existence of multiple zero values between the trading regions, we made use of the PPML method which produces consistent and unbiased results in the presence of zero values as well as heteroskedasticity. We found that traditional factors like physical or cultural proximities like sharing borders or common languages do not seem to significantly affect trade between two Indian states. Similarly, size of the exporter's market is less of a determinant in exports compared to the size of the importer States' GDP so in a sense, trade within India are demand driven rather than supply driven.

However, considering the surprising negative relationship between subsidies and exporters, we hypothesize that supply driven exports happen outside India from the Indian states. More studies are needed, however, to examine the role of subsidies in determining India's trade taking into account the exhaustive set of production as well as trade related subsidies provided by the various States. Finally, we also found that rise in differences in prices of

commodities between the two States is a strong indicator of high trade costs between Indian states and that past differences in prices are indicative of current costs of trade and higher price differences indicate poor exportability between various states.

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Appendix

Table 1: Estimates from regressions with GOV as the primary variable of interest

GOV						
VARIABLES	**OLS**	**OLS(pc)**	**A.OLS**	**A.OLS(pc)**	**PPML**	**PPML (pc)**
lnA	-0.640*		-0.297*		0.121	
	[0.350]		[0.167]		[0.271]	
lnAimp	0.830***		0.389*		0.671***	
	[0.227]		[0.233]		[0.219]	
lnApc		-0.726		0.780		0.093
		[1.181]		[0.898]		[0.403]
lnApcimp		1.532***		0.773**		1.178***
		[0.370]		[0.375]		[0.317]
lnroad	-1.267*	-0.998	-0.313	0.169	-1.014*	-1.136**
	[0.731]	[0.758]	[0.670]	[0.626]	[0.563]	[0.447]
ComBor	0.343	0.313	0.654	0.654	0.256	0.258
	[0.583]	[0.580]	[0.728]	[0.728]	[0.227]	[0.225]
ComLan	0.389	0.515	-0.134	-0.135	0.111	0.108
	[1.471]	[1.396]	[0.998]	[0.998]	[0.293]	[0.291]
Gov	0.134	0.090	-0.225	-0.254	-0.061	-0.048
	[0.243]	[0.242]	[0.175]	[0.172]	[0.179]	[0.172]
Observations	850	850	1,520	1,520	1,440	1,440
R-squared	0.241	0.236	0.163	0.164	0.288	0.291
exp FE	Yes	Yes	Yes	Yes	Yes	Yes
imp FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	yes	yes	yes	yes	yes	yes
s.e.	cl. pair_id	cl. pair_id	cl. pair_id	cl. pair_id	cl. pair_id	cl. pair_id
***** p<0.01, ** p<0.05, * p<0.1**						

Table 2: Estimates from regressions with *Subsidy* as the primary variable of interest

Subsidy						
VARIABLES	**OLS**	**OLS(pc)**	**A.OLS**	**A.OLS(pc)**	**PPML**	**PPML(pc)**
lnA	-0.590		-0.388**		-0.015	
	[0.400]		[0.192]		[0.299]	
lnAimp	1.935***		0.906**		1.398***	
	[0.388]		[0.370]		[0.269]	
lnApc		0.445		0.211		-0.803
		[1.661]		[1.208]		[0.773]
lnApcimp		3.307***		1.571***		2.507***
		[0.564]		[0.558]		[0.474]
lnroad	-1.487**	-0.844***	-0.757	-0.237	-1.536**	-1.788***
	[0.736]	[0.836]	[0.723]	[0.703]	[0.659]	[0.346]
ComBor	0.353	0.308	0.227	0.227	0.261	0.416
	[0.575]	[0.560]	[0.331]	[0.331]	[0.246]	[0.310]
ComLan	0.485	0.667	0.492	0.487	0.137	0.129
	[1.355]	[1.260]	[0.946]	[0.947]	[0.318]	[0.310]
lnsubs1	-0.692*	-0.583	-0.297	-0.239	-0.734***	-0.739***
	[0.397]	[0.397]	[0.301]	[0.301]	[0.250]	[0.244]
lnsubs1imp	1.056***	1.09***	0.431*	0.434*	0.608***	0.705***
	[0.290]	[0.269]	[0.247]	[0.228]	[0.208]	[0.242]
lnyield					-0.278	-0.198
					[0.661]	[0.620]
Observations	665	665	1,220	1,220	1,152	1,203
R-squared	0.310	0.309	0.190	0.184	0.368	0.382
exp FE	Yes	Yes	Yes	Yes	Yes	Yes
imp FE	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	No	No	No	No	No	No
Year FE	yes	yes	yes	yes	yes	yes
s.e.	cl. pair_id	cl. pair_id	cl. pair_id	cl. pair_id	cl. pair_id	cl. pair_id
***** p<0.01, ** p<0.05, * p<0.1**						

Table 3: Estimates from regressions with *Diff* as the primary variable of interest

Diff						
VARIABLES	**OLS**	**OLS(pc)**	**A.OLS**	**A.OLS(pc)**	**PPML**	**PPML(pc)**
lnA	-0.447		-0.201		0.289	
	[0.346]		[0.149]		[0.204]	
lnAimp	0.742***		0.360		0.592***	
	[0.215]		[0.222]		[0.194]	
lnApc		0.370		0.966		0.660
		[1.139]		[0.812]		[0.996]
lnApcimp		1.297***		0.682*		0.938***
		[0.347]		[0.354]		[0.307]
lnroad	-1.327*	-0.980	-0.311	0.089	-1.104**	-1.068**
	[0.691]	[0.712]	[0.587]	[0.548]	[0.469]	[0.475]
ComBor	0.320	0.306	0.773	0.772	0.289	0.354
	[0.616]	[0.616]	[0.590]	[0.590]	[0.221]	[0.291]
ComLan	0.422	0.549	-0.092	-0.093	0.092	0.078
	[1.384]	[1.304]	[1.008]	[1.008]	[0.296]	[0.290]
diff	-1.846***	-1.870***	-1.296***	-1.316***	-2.017***	-2.012***
	[0.418]	[0.424]	[0.311]	[0.304]	[0.542]	
Observations	847	847	1,636	1,636	1,557	1,557
R-squared	0.283	0.281	0.202	0.203	0.364	0.363
exp FE	Yes	Yes	Yes	Yes	Yes	Yes
imp FE	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	No	No	No	No	No	No
Year FE	yes	yes	yes	yes	yes	yes
s.e.	cl. pair_id	cl. pair_id	cl. pair_id	cl. pair_id	cl. pair_id	cl. pair_id
***** p<0.01, ** p<0.05, * p<0.1**						

Table 4: Estimates from regressions with all the primary variables of interest

VARIABLES	OLS	OLS(pc)	A.OLS	A.OLS(pc)	PPML	PPML(pc)
lnA	-0.376		-0.429**		0.194	
	[0.404]		[0.191]		[0.226]	
lnAimp	1.643***		0.787**		1.109***	
	[0.388]		[0.362]		[0.277]	
lnApc		2.147		0.594		0.195
		[1.628]		[1.168]		[1.183]
lnApcimp		2.689***		1.263**		1.751***
		[0.602]		[0.545]		[0.401]
lnroad	-1.655**	-0.774	-1.773**	-1.039	-1.385***	-1.418***
	[0.743]	[0.822]	[0.728]	[0.710]	[0.483]	[0.496]
ComBor	0.349	0.291	-0.283	-0.290	0.300	0.300
	[0.643]	[0.635]	[0.266]	[0.267]	[0.237]	[0.237]
ComLan	0.590	0.770	0.675	0.664	0.105	0.109
	[1.330]	[1.203]	[0.994]	[0.998]	[0.325]	[0.324]
Gov	0.471**	0.402*	-0.099	-0.125	0.131	0.132
	[0.220]	[0.213]	[0.212]	[0.211]	[0.174]	[0.173]
lnsubs1	-0.759**	-0.646*	-0.572*	-0.493*	-0.609***	-0.629***
	[0.381]	[0.375]	[0.298]	[0.296]	[0.235]	[0.225]
lnsubs1imp	0.862***	0.862***	0.460*	0.427*	0.422**	0.415**
	[0.278]	[0.259]	[0.247]	[0.228]	[0.199]	[0.186]
diff	-2.508***	-2.684***	-3.244***	-3.251***	-2.477***	-2.367***
	[0.621]	[0.651]	[0.578]	[0.560]	[0.560]	[0.550]
Observations	638	638	1,053	1,053	1,036	1,036
R-squared	0.359	0.362	0.302	0.300	0.409	0.411
exp FE	Yes	Yes	Yes	Yes	Yes	Yes
imp FE	Yes	Yes	Yes	Yes	Yes	Yes
Pair FE	No	No	No	No	No	No
Year FE	yes	yes	yes	yes	yes	yes
s.e.	cl. pair_id	cl. pair_id	cl. pair_id	cl. pair_id	cl. pair_id	cl. pair_id
***** p<0.01, ** p<0.05, * p<0.1**						

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