Examining the Relationship between Regulatory Quality and Forest Product Exports to India: A Gravity Model Approach

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Abstract

The value of aggregate forest product exports to India has increased from about \$1.5 billion in 2003 to about \$5.4 billion in 2013. Although many of the forest product resources can be sourced from within India, the subcontinent must also source forest products from trading partners, in the form of wood product exports. This presents many economic challenges and opportunities for wood product markets and trade, as India is the second-largest importer of wood products in the world. In this study, we focus on the effect of regulatory quality on forest products exports by partner countries to India. Using a panel of trade flows during 2009 through 2013 of 143 partner countries exporting forest products to India, we estimate an augmented gravity trade model to capture the effect of relevant variables on the outflow of aggregate forest products and disaggregate paper and paperboard, wood pulp, fiberboard, veneers, sawn wood, industrial roundwood, and plywood products from partner countries to India. Results from the analysis are mixed; regulatory quality is found to have positive correlation with exports to India in some cases (paper and paperboard products and wood pulps) and no correlation in a few instances (fiberboard, veneer sheets, sawn wood, industrial roundwood, and plywood). Other explanatory variables such as the distance between the partner country and India, forest area of partner country relative to forest area of India, gross domestic product, population, and trade agreements are mostly found to have positive or negative significant effects on trade, varying across different sectors.

Forests in India supply a wide array of goods and services such as timber, fuelwood, fodder, wood products, pulpwood, sawn wood, veneer wood, paper, and other wood-based materials. India ranks 10th among the most forested nations of the world, with a total forest cover of 78.92 million ha. The forest area covers nearly 24.01 percent of the total geographic area of the country (Food and Agriculture Organization Corporate Statistical Database [FAOSTAT] 2013). Dense forests once covered almost all states of India, but forest cover has been significantly reduced over the last several decades. At a population of just above 1.2 billion, and with two-thirds of the population of the country depending on agricultural activities for their livelihood, the demand for forest products[1] in India is very high, and there are increasing pressures on domestic sources of forest products (Forest Survey of India 2013).[2] Given the population pressures and subsequent stress placed on domestic forests, India must also rely on a robust import market to augment the domestic demand for forest products

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[1] By stating forest product, we mean aggregate forest products that include roundwood, fuelwood, sawlogs, veneer logs, pulpwood, wood charcoal, wood chips, wood residues, wood pellets, sawn wood, veneer sheets, wood-base panels, plywood, particleboard, strand board, fireboard, hardboard, wood pulp, carton board, and paperboards, etc.

[2] During the period 2009 through 2011, the forest cover in India decreased by about 34,700 ha.

(http://www.fao.org/faostat/en/#data/FO). In the last decade, the value of forest product imports by India has increased from about $1.5 billion in 2003 to about $5.4 billion in 2013 (FAOSTAT 2015). Second only to China, India is the largest timber-importing country in the world (Flynn 2013). Relatedly, log imports in India have doubled since 2006 to meet the country's growing appetite for wood products (https://timberupdate.com/blog/timber-exports-to-india-expected-to-triple-by-2021). This number is expected to triple by 2021. Given the recent large increase in timber product imports and robust forecasts in the coming years, it is important to understand which factors affect the success of firm or country efforts to sell their domestically produced goods in other nations, a concept referred to as export performance.

In our specific case, a partner country's export performance may be a key indicator determining the dollar amount of forest products exported to other nations (i.e., India). Generally, and regardless of product or service, export performance is a country's conduct in leveraging its capabilities and resources at a global level at a given point of time (Beleska-Spasova 2014). Foreign market access, domestic infrastructure, and macroeconomic aspects such as exchange rates and tariffs are a few of the factors that determine export performance (United National Conference on Trade and Development [UNCTAD] 2005). The regulatory environment of the exporting countries has been shown to have an effect on export performance in other industries (Iwanow and Kirkpatrick 2007). Yet, to our knowledge, any possible effects of regulatory quality on exports in the forest products sector have not been examined before this study. Does regulatory quality matter in terms of forest products trade? If it does, there should be evidence for a country that relies heavily on forest product exports. If it does matter, then there are policy implications, given the forecasted growth in demand for forest products in India over the next decade and beyond.

Figure 1 shows the total value of forest product exports into India from major partner countries during 2009 through 2013. The United States, Malaysia, Myanmar, New Zealand, China, Indonesia, Canada, and Germany are the top eight exporting countries from which India imports the majority of the forest products.[3] The total value of these forest product imports accounted for about 0.29 percent of India's gross domestic product (GDP) in 2013 (Central Intelligence Agency 2015).[4] A rapid increase of wood products into the continent during the last decade is because of the increase in demand of raw materials used for rapid economic growth, industrialization, and growth of population in the country (Malik and Dhanda 2003). Figure 2 shows the forest product exports into India categorized by disaggregated sectors and by countries in 2013. Although the import of industrial roundwood has remained high (about 75% of the total imports of forest products in 2013), India has been slowly moving toward importing higher value-added products over the last couple of years.

Industrial roundwood (mostly nonconiferous) is imported from Malaysia, Myanmar, and New Zealand.[5] Paper and paperboard, wood pulp, fiberboard, sawn wood, veneer, and plywood are other major forest products imported by India (US Department of Agriculture 2014). We have used the FAOSTAT classification of aggregate forest products and the above-mentioned disaggregated sectors for our study, which is discussed later (see the Appendix for detailed descriptions).

Given that a third of the forest and wood product economy of India is brought in from other countries, which is complemented by a robust export of higher value-added products, understanding certain trade characteristics or qualities that influence the level of exports from the partner countries is vital to understanding characteristics that promote cost-efficient access to Indian wood product markets or, in other words, to facilitate export performance.

One such characteristic may be regulatory quality. Regulatory quality helps simplify trade across countries as it enhances the functioning of the government, policy implementation, and integration (Iwanow and Kirkpatrick 2007). Regulatory quality directly reflects the transaction costs associated with trade because it focuses on the policies implemented, investments in bureaucratic procedures, and is an important determinant of export performance (Iwanow and Kirkpatrick 2007). Regulatory quality enhances the value of trade between countries and can improve economic growth. It identifies flexibility in the labor market, along with smooth functioning of the banking and the business sector. As mentioned in Breen and Gillanders (2012), several researchers such as Banerjee (1997), Guriev (2004), and Freund and Bolaky (2008) find that factors such as poor institutions and associated corruption decrease the functioning of the government in the trading countries.

Iwanow and Kirkpatrick (2007) found that regulatory quality is reported to have a robust impact on the exports in several manufacturing sectors. Their study results indicated that a 10 percent increase in the value of regulatory quality among all exporting countries increases exports of the manufacturing sector all over the world by nearly 10 percent, ceteris paribus. Although studies have not focused on the effect of institutions and regulatory environment on forest products trade in particular as we have mentioned earlier, Bartley (2003) studied the institutional factors and regulations concerning certification issues in the forest products industry. He reported that the institutional factors help in ensuring free trade by mitigating private certification of forest products with the help of government and other parties. This further helps in export performance. However, the existing literature does not suggest anything about the institutional factors affecting the value of forest products traded and the share of exports of forest products by the partner countries to the importing countries.[6]

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[3] Percentage of India's forest product exports to India in 2013 from the United States is 12.92 percent, New Zealand is 8.58 percent, Canada is 8.19 percent, Indonesia is 7.89 percent, Myanmar is 7.41 percent, China is 7.41 percent, Malaysia is 6.94 percent, and Germany is 3/01 percent.

[4] The forestry industry contributes approximately 1 percent of the GDP of India (2011).

[5] Of the exports in this category 43 percent of the value comes from nonconiferous (tropical) and 45 percent from nonconiferous (nontropical). The remaining 12 percent is from coniferous sources.

[6] By partner countries, we mean all the countries that are exporting forest products into India. So we use the terms ''partner country'' or ''exporting country'' interchangeably throughout this article. Our importing country in the study is only India.
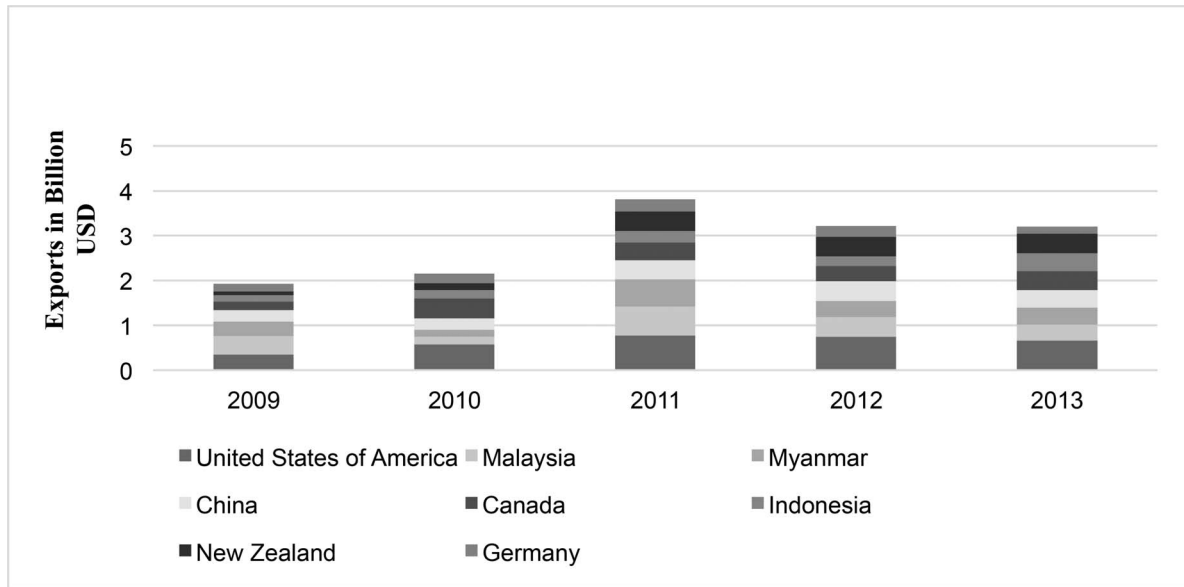
Figure 1.—Total forest products exports into India by major partner countries: 2009 through 2013.

The study explores the effect of regulatory quality on the value of forest products exported to India by partner countries. By applying an augmented gravity model, we attempt to estimate, empirically, if any relationship exists between the dollar amount of forest products exported to India and regulatory quality of that exporting country.

The World Bank defines regulatory quality as the index that captures ''perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.'' It has an index ranging from -2.5 (weak) to $+2.5$ (strong) (World Bank Group 2014). Regulatory quality directly reflects the transaction costs associated with trade because it focuses on the policies implemented, investments in bureaucratic procedures, and is an important determinant of export performance (Iwanow and Kirkpatrick 2007).

In the next section, we perform a literature review of related trade research in aggregate forest products, disaggregate wood pulp, paper and paperboard, sawn wood, veneers, industrial roundwood, and fiberboard, with an emphasis on research that utilizes the gravity model. After that, we detail relevant model specifications and cover the data used in the analysis, followed by the results of the empirical analysis and discussion of how those findings contribute and fit with the existing literature and a priori theoretical expectations. Finally, we conclude with a discussion of the implications and relevance of this study to global forest and wood products trade.

Literature Review

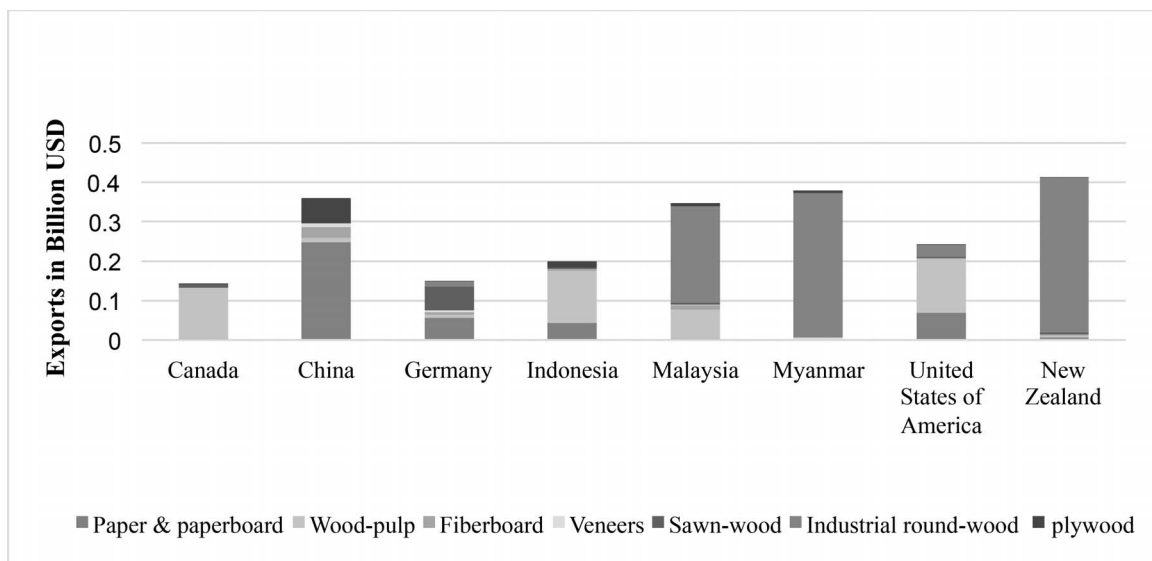A standard gravity model states that the volume of trade between two countries is directly proportional to the size of

Figure 2.—Forest products exports into India by disaggregated sectors and countries—2013.

the economy and inversely proportional to the trade costs (Tinbergen 1962). A country's GDP and population typically represent the size of the economy, whereas distance is taken as a proxy for trade costs, as these are reported to affect export performance by UNCTAD (2005). Li and Zhang (2008) have argued that distance has an important effect on the volume of trade as it determines the trade transaction cost and hence export performance. Relatedly, macroeconomic and policy-related factors such as exchange rate, tariffs, and other trade agreements (TAs) that affect export performance as mentioned above are also included in most gravity-model research in the forest products sector (Kangas 2001, Kang 2003, Kangas and Niskanen 2003, Zhang and Li 2009). Finally, we include a proxy of a country's forest resource endowment and production capacity (FAOSTAT 2006), for which we have taken the total area covered by forests in the partner countries as well as in India, which acts as a comparative advantage of the partner country relative to India in regard to the opportunity cost of wood production. There are several other variables that can alter trade costs such as existing TAs between two countries and regulatory quality, which are examined in this study. Besides GDP, the relative forest area is used as a proxy for the size of economy in context to the forest products industry. Anderson (1979), Bergstrand (1985), and Helpman and Krugman (1985) have provided the theoretical basis for the gravity equation. The gravity trade model is one of the most commonly used trade theories to examine bilateral trade (Haveman and Hummels 2004), and there is a rich and diverse literature that applies the economic gravity equation to relevant agricultural trade inquiry (Zahniser et al. 2002, Yang and Woo 2006, Disdier and Marette 2010, Peterson et al. 2013).

The applications of gravity models to test relevant questions in the trade of aggregate forest products and disaggregated wood products and paper and paperboard research are fewer in number in comparison with agricultural trade but robust nonetheless. Buongiorno (2016) makes a quick synopsis of the use of gravity models in forest and wood products research with respect to trade policy. Buongiorno et al. (1980) have investigated the multilateral flow of logs from the tropical regions and represented the influences of economic, and to a certain extent, political systems on multilateral trade with the use of a gravity model. Similarly, Akyuz et al. (2010) showed a high degree of integration between the European Union and Turkey with the use of gravity model. Relatedly, Buongiorno (2015) argued that the European trade of wood and derivatives was positively affected by the introduction of the euro, with the help of the gravity model, and in a subsequent paper, Buongiorno (2016) uses the model to estimate the value of trade of various wood commodities between countries. Kangas and Niskanen (2003) studied trade patterns between the European Union and Eastern European access candidates. Moreover, empirical gravity equations were built by Dai and Shen (2010) on the trade of forest products between China and other Asia-Pacific countries. An analysis of the gravity model on pulp and paper industries in China found that the imports of pulp and paper in China depend on the size of countries and the distance between them (Li and Zhang 2008). Zhang and Li (2009) explored determinants of China's wood products trade from 1995 to 2004. Hujala et al. (2013) estimated augmented gravity models of trade flows for chemical pulp and recovered paper exports.

Data and Methods

The study hypothesizes that better regulatory quality of partner countries leads to larger values of forest products exported by them to India. In this study, we examine a 5-year panel from 2009 to 2013 for India and 143 partner countries that export forest products to India. This study applies the gravity equation (Tinbergen 1962, Pöyhönen 1963), where exports from country of origin i to destination j is explained with a log-log equation using, as predictors, economic forces in both the origin and destination of the traded goods, and forces either aiding or impeding the movement of traded products (Bergstrand 1985). The effect of regulatory quality on export performance, in terms of the total value of forest products exported to India, is examined by using an augmented gravity trade model. By augmented model we refer to the inclusion of regulatory quality and TAs as proxies of trade costs, along with distance between markets. We also consider relative forest area of trading countries as a proxy for commodity prices, along with traditional use of GDP and population variables as a proxy for size of economies. Regulatory quality directly reflects the transaction costs associated with trade because it focuses on the policies implemented and investments in bureaucratic procedures and is an important determinant of export performance. Regulatory quality has comparatively larger effects on trade relative to the other five institutional indices mentioned earlier in the study. An improvement in regulatory quality helps simplify trade across countries as it enhances the functioning of the government, policy implementation, and integration (Iwanow and Kirkpatrick 2007).[7]

We have also included a proxy for TAs to capture the effect of unobserved factors that may have been affecting forest product exports to India.[8] The relative forest area of partner countries as a percentage of India's forest area is taken as a control variable to proxy the relative size of the partner countries' forest products resource relative to India's.

The data that are usually observed at regular time intervals are called panel data (Cameroon and Trivedi, 2010). In our study, the panel is longitudinal in nature where the partner country's regulatory quality index and other variables are observed across time, i.e., during 2009 through 2013. As there are 143 partner countries that export forest products to India, the sequence is repeated 143 times, turning it to 715 data points. It is assumed that the regressors are exogenous in a pooled model. Considering the structure of the data and the variables involved in the model, we utilize several panel specifications, including a pooled

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[7] Given the nature of the regulatory quality statistic, where some countries have negative and some positive values, these measures were scaled up to result in positive indicators for ease in interpreting and comparing the respective country's regulatory quality index values.

[8] TA with India means that the partner countries and India have trade agreements (includes free trade agreements, regional trade agreements, and preferential trade agreements) signed and in effect during 2009 to 2013 in our study. It denotes a binary dummy variable, which is one if country j and India have TAs and zero otherwise.

ordinary least squares (POLS) regression, random-effects generalized least-squares (GLS) regression, and a population average feasible generalized least-squares (FGLS) regression model to find the effect, if any, of regulatory quality on forest product imports by India.[9] A fixed-effects model could be run using the data, but we chose not to report them for two reasons. First, there is presence of time-invariant variable in the model, such as distance, and second, the main variable in the model, regulatory quality, has a very subtle change over time. Hujala et al. (2013) also hold this view for their analysis. Although the data are only for 5 years, the Breusch-Pagan Lagrange multiplier (LM) and the Hausmann test ratio recommend the use of random-effects model; we have also run a random-effects GLS regression and a population average FGLS regression. Unlike the random-effects GLS regression, the error terms in the population-averaged FGLS regression method control for the correlation over time for a given individual (within correlation) and possible correlation over individuals (between correlations; Cameron and Trivedi 2010). Last, we examine a population average Poisson panel model. The rationale here is that many of the partner countries in the model have multiple years where no trade (exports) occurs. Using the prior panel models mentioned merely drops these observations from the regression analysis, potentially biasing the results. A Poisson panel model or pseudo-Poisson maximum likelihood model (PPML) provides the same results if you are clustering variables (in our case partner country) to condition the model for unobserved characteristics within that variable that, in this case, affects the exports of forest products to India (Santos Silva and Tenreyro 2006).

All of the above-mentioned statistical methods were then performed using the following gravity equation. The standard gravity equation takes the following form:

$$Y_{ij}^t = \beta_0 + \sum \beta_k Z_{k,ij}^t + \epsilon_{ij}^t \qquad (1)$$

where Y_{ij}^t is the amount of exports from country i to country j or the value of trade flows at time t. $Z_{k,ij}^t$ ($k = 1, 2, \ldots, k$) denote gravity variables such as GDP, distance, population, etc. In our study, the augmented gravity equation takes the following empirical specification:

$$\begin{aligned} \ln Y_{ij}^t = \beta_0 &+ \beta_1 \ln \text{REGPI}_j^t + \beta_2 \ln \text{DIST}_{ij} + \beta_3 \ln \text{GDPP}_j^t \\ &+ \beta_4 \ln \text{POPP}_j^t + \beta_5 \ln \text{FORPI}_j^t + \beta_6 \text{TA}_{ij} + \epsilon_{ij}^t \end{aligned} \qquad (2)$$

where i and j are trading partners and India, respectively; j is fixed, and i considers each of the 143 partner countries that exports forest products to India. t denotes time. In this model, the period under observation is 2009 to 2013. The variables of Equation 2 are explained in Table 1.

The value of forest product exports is taken from the FAOSTAT (2015) data set. The data for the main variable of

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Table 1.—Definitions of the variables with respective hypothesized directions.

Variable	Description	Hypothesized direction
Y_{ij}^t	Value of total forest product exports to India (j) from country i at time t	
REGP^t	Regulatory quality of partner country at time t	Positive
GDPP_j^t	Real gross domestic products of country i at time t	Positive
POPP_j^t	Population of country i at time t	Positive
DIST_{ij}	Distance between the capital city of India (j, New Delhi) and the capital city of country i	Negative
FORPI_j^t	Ratio of total forest area of country i to total forest area of India	Positive
TA	Denotes a binary dummy variable that is 1 if country i and India have trade agreements and 0 otherwise	Positive

the study regulatory quality partner country and India are taken from the World Bank 2014 database, and the variable is taken from the data set of Kaufmann et al. (2013). Likewise, the data for the traditional gravity equation variables in the model, such as GDP, population, and distance are taken from World Bank database (2014). Also from the same database, we have obtained data for forest cover of partner countries and India. We have calculated the percent share of India's forest area to exporting countries' forest area from those data. The TA data were obtained from Asian Development Bank database (Asia Regional Integration Center 2014). Summary statistics of the data used in the study are shown in Tables 2 and 3. There are a few missing values in the data set as apparent from the total number of observations reported in Tables 2 and 3. This was because of data limitations for several of the explanatory variables. All of the models, POLS, random-effects GLS, population average FGLS, and the population average Poisson (generalized estimating equation [GEE][10]) model, indicate that regulatory quality and size of economies of partner countries mostly have a significant positive effect on imports by India. While determining which model was most robust, we examined the Breusch-Pagan LM test that recommended the use of the random-effects model. Moreover, the FGLS model is the one that accounts for within and between correlations. However, these models do not allow us to include zero level of exports from exporting countries; to alleviate this, we use the population average Poisson model (GEE), clustered on the partner country to achieve the same results as the PPML recommended by Santos Silva and Tenreyro (2011a, 2011b). Although this model does not perform as well in the aggregate as the population average random-effects model (Wald chi-square), it does include the "missing" values for the years where a trading partner exported no value of wood products; therefore it is considered more appropriate, as it is less likely to have missing observation bias (all of these results are available upon request from the authors). Therefore all

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Table 2.—Summary statistics of data used in empirical estimation, India.

Variable	No. observed	Mean	SD	Min.	Max.
Export of aggregated forest products to India (million)	715	32.85	93.42	0.00	775
Export of disaggregate paper and paperboard products by India (million)	530	7.16	24.30	0.00	247.31
Export of wood pulp by India (million)	335	9.98	28.38	0.00	159.69
Export of disaggregate fiberboard products by India (million)	365	1.33	4.04	0.00	31.77
Export of veneer sheets by India (million)	345	0.69	2.75	0.00	33.49
Export of sawn-wood products by India (million)	500	14.11	4.89	0.00	59.09
Export of industrial roundwood products by India (million)	575	10.98	55.24	0.00	589.47
Export of plywood products by India (million)	335	1.53	9.04	0.00	112.45
Regulatory quality of India	715	−0.39	0.07	−0.47	−0.30
Gross domestic product of India (billion)	715	1,730	189	1,370	1,880
Population of India (million)	715	1,220	219	1,190	1,250
Distance (km)	680	7,510.14	4,186.01	800	16,909

Table 3.—Summary statistics of data used in empirical estimation of partner countries.

Variable	No. observed	Mean	SD	Min.	Max.
Regulatory quality of partner country	710	0.005	1.02	−2.52	1.96
Gross domestic product of partner country (billion)	692	478	1,590	0.19	16,800
Population of partner country (million)	715	38.6	119	0.17	1,360
Distance (km)	680	7,510.14	4,186.01	800	16,909
Total forest area of partner country as a percentage of India's forest area	572	37.23	130.08	0	1,184.71

results are reported using this model selection and the analysis is done using the statistical software STATA, version 2011 (Stata 2011).

Results

Table 4 shows the effect of the explanatory variables on aggregate forest product exports.[11] Table 5 shows the effect of the explanatory variables on paper and paperboard, wood pulp, and fiberboard products. Table 6 shows the effect of the explanatory variables on veneer sheets, sawn-wood products, and industrial roundwood and plywood exports to India.

Table 4 reports the results for aggregate forest products. The population average Poisson (GEE) model reports that the regulatory quality of partner countries does not show a significant impact on the value of aggregate forest products exported to India by partner countries. However, for the disaggregate paper and paperboard products the population average Poisson (GEE) model (results reported in Table 5) shows that with a 1 percent improvement in regulatory quality of partner countries, the value of paper and paperboard products exported to India by partner countries significantly increases by about 2.87 percent. In the wood pulp sector (results reported in Table 5), with a 1 percent improvement in the regulatory quality of partner countries, the total value of wood pulp products exported to India by partner countries significantly increases by about 4.74 percent. However, fiberboard, veneer sheets, sawn wood,

industrial roundwood, and plywood products do not show a significant impact on exports to India.

Further, results reported in Table 4 show that the distance between the exporting country and India does not have any significant effect on the total value of aggregate forest product exports from partner countries to India. For the disaggregate paper and paperboard products (results report-

Table 4.—Regression results of augmented gravity model for dollar value of forest product exports to India.[a]

Variable	Pooled ordinary least squares	Random effect	Population average	Poisson
Regulatory quality of partner country	6.02***	2.96	3.95	0.44
	(2.09)	(2.95)	(3.24)	(0.55)
Distance	−0.54**	−0.51	−0.52	−0.10
	(0.22)	(0.37)	(0.38)	(0.07)
Relative forest area of partner country to forest area of India	0.32***	0.30*	0.31***	0.04***
	(0.05)	(0.10)	(0.09)	(0.02)
Gross domestic product of partner country	0.49***	0.82***	0.73***	0.14***
	(0.12)	(0.17)	(0.18)	(0.03)
Population of partner country	−0.13	−0.39*	−0.32	−0.08*
	(0.14)	(0.23)	(0.23)	(0.04)
Trade agreement	0.42	0.48	0.52	0.12
	(0.33)	(0.54)	(0.37)	(0.08)
Constant	−10.75	−8.16	−9.32	−0.45
n	457	457	457	510
R^2	0.38			
Root mean square error	2.16			
F statistic (6, 450)	62.95***			
Wald χ^2 (6)		107.65***	186.34***	117.81***

[a] Dependent variable = aggregate forest products. * $P < 0.1$, ** $P < 0.05$, and *** $P < 0.01$ (corresponding error statistics are reported in parentheses).

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[11] As regulatory quality improves the expectation that exports will increase, it is to be noted that the range of regulatory quality index has a very narrow scale. A minor change in the value of regulatory quality can indicate a substantial change in the infrastructure, bureaucratic formalities, governance, transparency of financial institutions, a business-friendly environment in the country, and hence, a decrease in the trade transaction cost. This may account for the large coefficient relative to the other variables.

Table 5.—*Regression results of augmented gravity model for dollar value of forest product exports to India.*[a]

Variable	Paper and paperboard products	Wood pulp	Fiberboard
Regulatory quality of partner country	2.87***	4.74***	1.52
	(0.78)	(1.56)	(1.24)
Distance	−0.36***	−0.11	−0.16
	(0.07)	(0.16)	(0.15)
Relative forest area of partner country to forest area of India	0.06***	0.13**	0.12***
	(0.02)	(0.06)	(0.04)
Gross domestic product of partner country	0.19***	0.00	0.12
	(0.05)	(0.10)	(0.08)
Population of partner country	0.02	0.11	0.00
	(0.06)	(0.12)	(0.10)
Trade agreement	0.35***	0.38**	0.57***
	(0.11)	(0.17)	(0.22)
Constant	−7.36	−10.64	−4.13
n	387	242	276
Wald χ^2 (6)	260.41***	83.61***	76.88***

[a] Table shows population average Poisson panel results only. Dependent variables = paper and paperboard products, wood pulp, and fiberboard. * $P < 0.1$, ** $P < 0.05$, and *** $P < 0.01$ (corresponding error statistics are reported in parentheses).

Table 6.—*Regression results of augmented gravity model for dollar value of forest product exports to India.*[a]

Variable	Veneer sheets	Sawn wood	Industrial roundwood	Plywood
Regulatory quality of partner country	−2.37	1.47	−1.14	−0.82
	(1.98)	(0.10)	(1.27)	(1.46)
Distance	0.11	−0.02	0.16	−0.56***
	(0.21)	(0.12)	(0.13)	(0.13)
Relative forest area of partner country to forest area of India	0.04	0.10***	0.04	0.16***
	(0.06)	(0.03)	(0.04)	(0.06)
Gross domestic product of partner country	0.19	0.07	0.15**	0.25***
	(0.12)	(0.07)	(0.07)	(0.08)
Population of partner country	0.05	−0.04	−0.05	−0.14
	(0.14)	(0.08)	(0.08)	(0.10)
Trade agreement	0.30	−0.07	−0.24	0.68***
	(0.21)	(0.15)	(0.17)	(0.21)
Constant	−0.24	−2.74	0.08	3.41
n	257	367	419	252
R^2				
Root mean square error				
F statistic (6, 159)				
Wald χ^2 (6)	54.79***	49.87***	33.03***	61.08***

[a] Table shows population average Poisson panel results only. Dependent variables = veneer sheets, sawn wood, industrial roundwood, and plywood. * $P < 0.1$, ** $P < 0.05$, and *** $P < 0.01$ (corresponding error statistics are reported in parentheses).

ed in Table 5) a 1 percent increase in the distance between the exporting country and India decreases the total value of exports from partner countries to India by about 0.36 percent. Wood pulp, fiberboard, veneer sheets, sawn wood, and industrial roundwood do not show a significant effect of distance on exports of the respective products to India. However, for plywood (results reported in Table 6) a 1 percent increase in the distance between the exporting country and India decreases the total value of exports from partner countries to India by about 0.56 percent.

For aggregate forest products, with a 1 percent increase in the relative forest area of partner countries to India, the total value of forest product exports from partner countries to India increases by about 0.04 percent. For the disaggregate paper and paperboard products (results reported in Table 5), with a 1 percent increase in the relative forest area of partner countries to India, the total value of paper and paperboard product exports from partner countries to India increases by about 0.06 percent. For wood pulp, with a 1 percent increase in the relative forest area of partner countries to India, the total value of plywood exports from partner countries to India increases by about 0.13 percent. For fiberboard (results reported in Table 5), with a 1 percent increase in the relative forest area of partner countries to India, the total value of fiberboard product exports from partner countries to India increases by about 0.12 percent. Veneer sheets and industrial roundwood do not show a significant result, whereas in the sawn wood sector (results reported in Table 6), with a 1 percent increase in the relative forest area of partner countries to India, the total value of sawn wood exports from partner countries to India increases by about 0.10 percent. For plywood, with a 1 percent increase in the relative forest area of partner countries to India, the total value of plywood exports from partner countries to India increases by about 0.16 percent.

Also, with a 1 percent increase in the GDP of a partner country, the total value of forest product exports from partner countries to India increases by about 0.14 percent. For the disaggregate paper and paperboard products (results reported in Table 5), with a 1 percent increase in GDP, the total value of paper and paperboard product exports from partner countries to India increases by about 0.19 percent. Wood pulp, fiberboard, veneer sheets, and sawn wood do not show a significant result. For industrial roundwood (results reported in Table 5), with a 1 percent increase in GDP of partner country, the total value of wood pulp exports from partner countries to India increases by about 0.15 percent. For plywood (results reported in Table 5), with a 1 percent increase in GDP of partner countries, the total value of plywood exports from partner countries to India increases by about 0.25 percent.

The population of partner countries shows a significant effect on the exports of aggregate forest products. With a 1 percent increase in the population of partner countries, the total value of forest product exports from partner countries to India decreases by about 0.08 percent. However, the population of partner countries does not show any significant effect on paper and paperboard, wood pulp, fiberboard, veneer sheets, sawn wood, industrial roundwood products, and plywood exports from partner countries to India.

TAs neither significantly affect aggregate forest product exports nor does it affect the veneer sheet, sawn wood, and industrial roundwood exports from partner countries to India. For paper and paperboard products, with a TA, the total value of exports of the respective product by partner countries to India increases by about 0.35 percent compared with no TA. Similarly, with a TA, the total value of exports of wood pulp products by partner countries to India increases by about 1.38 percent compared with no TA.

Also, with a TA, the total value of exports of fiberboard products by partner countries to India increases by about 0.57 percent compared with no TA. Finally, for plywood, the total value of imports by India increases by about 0.68 percent with TA compared with no TA.

Discussion

Our results indicate mixed results as to the effect of regulatory quality on the value of exports to India. Although the regulatory environment does appear to have an effect on forest products trade, it is dependent on the disaggregated product being examined. It appears that the products that are the lightest to ship and perhaps cheapest per unit total value, are positively affected by regulatory quality, with quite dramatic effects, whereas the typically more expensive (and heavier per unit) products show no relationship. Why? India imports higher-valued products (not necessarily per unit costs but in overall total values) from far fewer countries than paperboard and wood pulp. That is to say the value of those products exported is spread among many countries, unlike sawn wood and the other disaggregated products that do not come from a large variety of countries; these also do not appear to be statistically influenced by regulatory quality. It has been observed that most of the disaggregated wood products that are imported by India come from only a limited number of partners such as industrial roundwood, which is exported to India mostly by Myanmar, Malaysia, and New Zealand. Likewise for veneers, the top 10 trading values come from three countries (Vietnam, China, and Italy); only Italy has a regulatory quality value of greater than zero. Thus, for these products (industrial roundwood—mostly hardwoods and veneers) the importance of stream-lined rules vis-à-vis a stronger regulatory environment is not valued, but steady trade with a small set of partners is. It appears that where more competition exists for access to the Indian market, the more likely regulatory quality is to matter.

Distance is another key factor in trade, as the transaction cost (transportation cost in this case) goes up as the distance between the trading countries increases. However, in most cases distance does not matter. Distance adversely affects the total value of exports of only two forest products, plywood and paper and paperboard products.

The GDP of a country usually increases as its ability to export increases (Mofrad 2012, Olson et al. 2014). The positive coefficient of GDP of a partner country supports this proposition. Our results are in accordance with the standard gravity model, which states that the size of the economy (here GDP) has a positive effect on total value of trade between countries. However, several of the categories were not affected by the partners' GDP: wood pulp, fiberboard, veneers, and sawn wood.

Also, as production costs of forest products is highly dependent on the presence of forested lands, the area covered by forests in both exporting partner and India have significant effect on total value of forest product exports into India. As the relative forest area of a partner country increases relative to India, India imports more forest products from that country because of the comparative advantage of growing timber in the exporting country relative to India. The only categories where relative forest cover did not matter was veneer sheets and industrial roundwood. Interestingly, these categories are dominated by hardwood species. It appears then that relative forest area

plays a significant role typically in the import of softwood products because these products are mostly imported from forested countries such as the United States and Canada that have abundant forest cover. Relative forest area does not matter for products dominated by hardwood imports, i.e., veneers and roundwoods. Hardwoods are mostly imported from a very few countries such as New Zealand, Malaysia, and Myanmar; labor costs are low for the latter two and these countries are closely located to India. One explanation may be that although other large forested countries grow hardwoods (United States and Canada, for example), in many cases, they are cost prohibitive for India to utilize as finished solid wood products that they then export.

TAs increase bilateral trade (Baier and Bergstrand 2007). In line with our expectations, in our study, TAs do show a significant result for many of the disaggregated forest products (but not the aggregate category or the sawn wood, veneers, or industrial roundwood). Again, these are dominated by hardwood species (sawn wood exports to India are approximately 2:1 nonconiferous). As mentioned earlier, these products come from few countries (the majority of value); therefore it appears that being one of these partners matters, regardless of a trade deal.

TAs do not necessarily mean free trade; the data might be biased because of the presence of a few dominant trade partners for sawn wood, for which India does not have TAs. However, for roundwood they do have TAs with their dominant trade (export) partners. For roundwood only GDP of the partner is statistically significant in determining the value of exports to India.

Conclusions

The purpose of the study was to test empirically the effect, if any, of the regulatory quality of partner countries as being advantageous to exporting forest products to India. In some cases, the regulatory quality of exporting countries plays a positive significant role in forest product exports to India. Over and above distance, GDP and areas covered under forest are influential factors in forest product exports to India. Relative size of forests of the trading countries give a comparative advantage in deciding the price of forest products traded. As India continues to develop economically, paper and paperboard products and wood pulps would flow more easily if partner countries improved the regulatory quality. As for the other forest products, given their results, and the reasons for those results, it is difficult to make those same claims. However, if India has to depend on more and more trade partners for those products as population growth and the need for forest products increases, we may see a similar finding to that of wood pulp and paper products, which come from a larger variety of partners than the other products examined.

A puzzling finding of the study is that TAs, seemingly, do not always induce larger exports of forest products, in terms of aggregate value. For disaggregate sectors the effect of TAs is clearer and in most cases in line with expectations. The positive significant impact of TAs on exports for paper and paperboard, fiberboard, and plywood to India clearly implies more sensitivity of TAs on softwood-sourced forest products and not necessarily more highly value-added products.

As mentioned in the ''Discussion,'' the TAs do not necessarily imply free trade. It is also possible that using a simple dummy variable for the existence of a trade deal

between two countries is too simplistic to notice the effects on exports of products from each sector and the effects that removing or reducing trade barriers (i.e., tariffs on imported products) may have on exports.

Last, more analysis needs to be done on other factors of institutional quality as it affects export performance. Institutional quality is the status of institutional reforms of the country in question and its trading partners (Iwanow and Kirkpatrick 2007). It has six aspects, i.e., the rule of law, voice and accountability, government effectiveness, control of corruption, political stability, and regulatory quality (Kaufmann et al. 2013). We only tested regulatory quality for this study given the disaggregation of the different forest products, but it is possible that some of these other institutional factors could play an important role in forest product exports. Further, exports to all countries from all other countries may provide a clearer picture of the role of regulatory quality in the forest products trade literature.

Acknowledgments

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Appendix

Forest products include the following: roundwood, fuelwood, sawlogs, veneer logs, pulpwood, wood charcoal, wood chips, wood residues, wood pellets, sawn wood, veneer sheets, wood-based panels, plywood, particleboard, strand board, fiberboard, hardboard, wood pulp, papers, carton board, and paperboards (Source: Food and Agriculture Organization of the United Nations 2016).

Sawn wood

Wood that has been produced from both domestic and imported roundwood, either by sawing lengthwise or by a profile-chipping process and that exceeds 6 mm in thickness. It includes planks, beams, joists, boards, rafters, scantlings, laths, boxboards, and ''lumber,'' etc., in the following forms: unplaned, planed, end-jointed (e.g., finger-jointed), etc. It excludes sleepers, wooden flooring, mouldings (sawn wood continuously shaped along any of its edges or faces, like tongued, grooved, rebated, V-jointed, beaded, moulded, rounded, or the like), and sawn wood produced by resawing previously sawn pieces. It is reported in cubic meters solid volume.

Coniferous.—All woods derived from trees classified botanically as Gymnospermae, e.g., *Abies* spp., *Araucaria* spp., *Cedrus* spp., *Chamaecyparis* spp., *Cupressus* spp., *Larix* spp., *Picea* spp., *Pinus* spp., *Thuja* spp., *Tsuga* spp., etc. These are generally referred to as softwoods.

Nonconiferous.—All woods derived from trees classified botanically as Angiospermae, e.g., *Acer* spp., *Dipterocarpus* spp*., Entandrophragma* spp*., Eucalyptus* spp*., Fagus* spp., *Populus* spp., *Quercus* spp., *Shorea* spp., *Swietonia* spp*., Tectona* spp., etc. These are generally referred to as broadleaves or hardwoods.

Veneer sheets

Thin sheets of wood of uniform thickness, not exceeding 6 mm, rotary cut (i.e., peeled), sliced, or sawn. It includes wood used for the manufacture of laminated construction material, furniture, veneer containers, etc. Production statistics should exclude veneer sheets used for plywood production within the same country. It is reported in cubic meters solid volume.

Fiberboard

A panel manufactured from fibers of wood or other lignocellulosic materials with the primary bond deriving from the felting of the fibers and their inherent adhesive properties (although bonding materials or additives may be added in the manufacturing process). It includes fiberboard panels that are flat-pressed and moulded fiberboard products. It is an aggregate comprising hardboard, medium-/high-density fiberboard, and other fiberboard. It is reported in cubic meters solid volume.

Wood pulp

Fibrous material prepared from pulpwood, wood chips, particles, or residues by mechanical or chemical process for further manufacture into paper, paperboard, fiberboard, or other cellulose products. It is an aggregate comprising mechanical wood pulp, semichemical wood pulp, chemical wood pulp, and dissolving wood pulp. It is reported in metric tons air-dry weight (i.e., with 10% moisture content).

Paper and paperboard

The paper and paperboard category is an aggregate category. In the production and trade statistics, it represents the sum of graphic papers; sanitary and household papers; packaging materials, and other paper and paperboard. It excludes manufactured paper products such as boxes, cartons, books, and magazines, etc. It is reported in metric tons.