Bridging India and Bangladesh: Cross-border Trade and the BBIN Motor Vehicle Agreement*

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Abstract

This paper studies the effects of changing current trade barriers between Bangladesh and India on national welfare, and on the distribution of people and Real GDP in regions within these countries. We use a spatial general equilibrium model calibrated to these two economies, along with road network travel-time calculated using GPS data, to measure changes in economic outcomes given changes in trade costs across regions. In particular, we focus on three scenarios: (i) allowing traffic of vehicles transporting goods along the routes specified in the BBIN motor vehicle agreement (MVA); (ii) changes in traffic and trade of vehicles transporting goods along the routes specified in the MVA; and (iii) complete integration allowing traffic and trade of vehicles transporting goods across any route. Our counterfactual exercises show that decreasing trade barriers between these two countries can lead to up to a 3.2 and 4.54 percent increase in real income for India and Bangladesh, respectively.

*The findings, interpretations, and conclusions expressed in this paper do not necessarily reflect the views of the World Bank, the Executive Directors of the World Bank or the governments they represent. The World Bank does not guarantee the accuracy of the data included in this work.

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1 Introduction

Economies of South-East Asian are characterized by sharp concentration of population and income in few other regions. In this paper we explore the aggregate and regional effects of of changing current trade barriers between Bangladesh and India on national welfare, and on the distribution of people and Real GDP in regions within these countries. We use a spatial general equilibrium model calibrated to these two economies, along with road network travel-time calculated using GPS data, to measure changes in economic outcomes given changes in trade costs across regions.

In particular, we focus on three scenarios related to the Bangladesh-Bhutan-India-Nepal Motor Vehicles Agreement (BBIN MVA). The BBIN MVA allows vehicles to enter any of the four nations without requiring the trans-shipment of goods from one country's truck to another's at the border. Under this agreement, cargo vehicles are tracked electronically, and are assigned electronic seal that alerts regulators every time the container door is opened. The counterfactuals we explored are (i) allowing traffic of vehicles transporting goods along the routes specified in the BBIN motor vehicle agreement (MVA); (ii) changes in traffic and trade of vehicles transporting goods along the routes specified in the MVA; and (iii) complete integration allowing traffic and trade of vehicles transporting goods across any route.

Our counterfactuals explore the policy question of what are the potential benefits for two neighboring economies of relaxing trade barriers; and we do so considering potential policies being currently considered. We focus on the aggregate impact of increasing market access, and on examining the extent to which it affects, not only neighboring regions, but locations far away from the countries' boundaries.

The model presented in this paper uses tools displayed in the recent literature on quantitative spatial economics, summarized in (Redding and Rossi-Hansberg, 2017) and (Eaton and Kortum, 2002; Anderson and van Wincoop, 2003). The setting allows for multiple regions (which in our case will correspond with districts and divisions) that trade differentiated products while facing bilateral trade costs.

We follow Allen and Arkolakis (2014), in having these trade costs proportional to the least-cost-route connecting any pair of locations, given the road network of the country. Workers who consume traded and non-traded goods are imperfectly mobile across regions, as we include idiosyncratic shocks. Further, along the lines of Krugman (1991), each region features free entry of firms, each with increasing returns, and thus, positive agglomeration externalities.

For our quantitative exercises, we use data on the economic activity of Bangladesh and India (employment, wages and number of firms) across districts and divisions in Bangladesh

and India, along with GIS data on the specific road network of each country. The latter allows us to estimate changes in trade costs more precisely than using standard distance-based measures, given the heterogeneous conditions of roads in these developing countries. Using these data, we recover trade flows across locations, and calibrate the rest of parameters to different moments. Also, we use standard values in the literature for the elasticities in the model.

Our results suggest that regions that gain market access tend to gain employment and increase their real GDP. These changes consistently decrease on distance to the countries' boundaries, but affect even locations far away from the shock. Another common pattern is that the expansion in the transport network tends to decrease spatial inequality. Quantitatively, we find that allowing for a decrease in trade barriers between these two countries generates economically significant changes, for instance, it can lead to up to a 1.3 and 1.5 percent increase in national welfare for India and Bangladesh, respectively.

2 Regional Integration and the Motor Vehicle Agreement

In order to push for more regional integration, four countries (Bhutan, Bangladesh, India and Nepal) signed an agreement on 15 June 2015 titled "Motor Vehicle Agreement for the Regulation of Passenger, Personal and Cargo Vehicular Traffic Between Bangladesh, Bhutan, India and Nepal" (MVA). The agreement is to facilitate seamless movement of passenger, personal and cargo vehicles within the territories of partner countries. Since 2015, Bangladesh, India and Nepal have ratified the agreement while Bhutan has halted.

The opening of new routes as well as the push for more regional trade integration is expected to bring economic gains for both India and Bangladesh. Reducing the transport times for Indian trucks to travel to and from the Indian Northeast will better integrate the region with the rest of the country. Both countries will benefit from larger market access by respectively opening their borders. Compared to India, Bangladesh will benefit from a larger increase in market access. This chapter aims at understanding the economic benefits and how the MVA would affect the economic geography of each country.

The MVA will open road corridors between Bangladesh and India to regional traffic. Currently, most flows of goods between Northeast India and the rest of India go around Bangladesh through the Siliguri corridor, as do exports from Northeast India to the rest of the world. Transit flows through Bangladesh are expected to increase due to reductions in

trade and transit costs triggered by the integration agreements. The agreements are also expected to trigger increases in trade and transport flows between Bangladesh and India. The new regional corridors will become a reality and potentially deliver economic benefits, if the expected increases in traffic flows materialize. The potential increase in trade between Bangladesh and India due to a reduction in transport cost has already being studied.

Under the MVA, Indian trucks would be allowed to cross Bangladesh along five cargo routes that are defined below:

1. Teknaf - Cox Bazaar - Chittagong - Dhaka - Hatikamrul - Rangpur - Burimari / Chengrabandha - Jaigaon / Phuentsholing - Thimphu;

2. Mongla - Khulna - Jessore - Kushthia - Hatikamrul - Rangpur - Burimari / Chengrabandha - Jaigaon / Phuentsholing - Thimphu;

3. Teknaf - Cox Bazaar - Chittagong - Dhaka - Hatikamrul - Rangpur - Banglabandha / Phulbari - Panitanki / Kakarvita - Kathmandu;

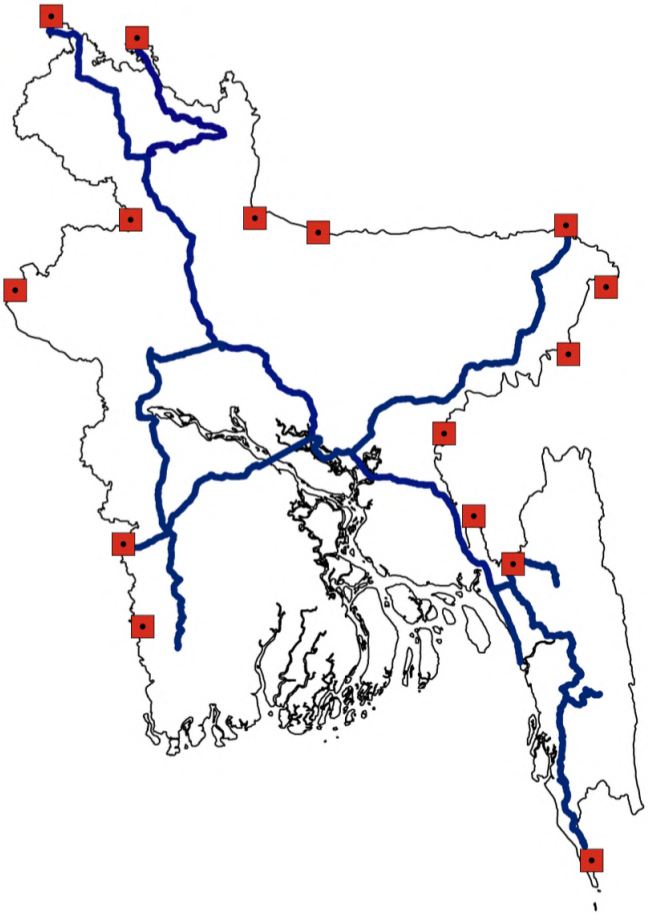
4. Mongla - Khulna - Jessore - Kushthia - Hatikamrul - Rangpur - Banglabandha / Phulbari - Panitanki / Kakarvita - Kathmandu;

5. AH1: Guwahati (India) - Dawki (India)/Tamabil - Sylhet - Shaistaganj - Narshingdi - Katchpur - Dhaka - Mawa - Charjanajat - Bhanga - Bhatiapara - Kalna Ferry Ghat (Padma bridge) - Narail - Jessore-Benapole/Petrapole (India).

These cargo routes are shown in Figure 1. This paper looks at different counterfactual scenarios included or not in the MVA and their trade and welfare impacts of the agreement for two countries, India and Bangladesh. In our counterfactuals, we will decrease transport costs between regions whose least-cost route changes as a result of allowing for transit on these cargo routes.

The paper develops a spatial general equilibrium model that was developed and calibrated for Bangladesh and India. It examines how districts in Bangladesh and states in India are likely to adjust to trade and transport shocks from new transit routes and improved regional integration.

Figure 1: MVA Agreement: Cargo Routes



Notes: The figure shows the main cargo routes outlined in the MVA agreement, along with all the existing points of entry in Bangladesh (in red).

3 Framework

3.1 Environment

This paper uses a standard spatial equilibrium model applied to the economies of Bangladesh and India. The model is an economy where there are $n = 1, .., N$ locations inside a country. In our application each n corresponds to a district, for the case of Bangladesh; and a division, for the case of India. Locations trade with each other and are generally indexed by i as exporter and n as importer. Whenever there are two subscripts, the importer comes first, therefore X_{ni} will denote the exports from i to n. Table 5 in Appendix A summarizes the notation for all the variables used throughout the paper.

Each location features a particular supply of effective land H_n, which is used by households in consumption and for housing. The quantity of land in each location is taken as given. Each location also has amenities U_n that represent natural characteristics that are valued by individuals, for instance, good weather. Productivity of the traded sector A_n and entry cost F_n also vary across locations.

Finally, there is a bilateral cost τ_{ni} of exporting from i to n. This cost depends on distance and on the quality of infrastructure linking the two locations. In particular, we assume that τ_{ni} is a function of distance d:

$$\tau_{ni} = \phi_{ni} d^{\omega},$$

and calibrate ϕ_{ni} using data on speed times per location.

There are two types of agents in the economy, mobile workers and immobile capital owners. Workers earn a wage w_n in state n, while landowners from n own the total returns to land in the region where they live, $R_n H_n$. The model is static, and therefore all income is spent by workers and capital owners in the region where they live.

3.2 Production

Final Good Each location produces a final good used for either consumption or as an intermediate input in production. The quantity produced of the final good in n is

$$Q_n = \left(\sum_i M_i q_{ni}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \tag{1}$$

where M_i is the number of firms located in i and q_{ni} is the quantity that each firm located in i sells to n. The good Q_n is priced competitively, hence its price is

$$P_n = \left(\sum_i M_i p_{ni}^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \tag{2}$$

where p_{ni} is the price set by each firm from i in n.

As mentioned, the final good is used either for consumption, C_n, or as an intermediate input in production of traded goods, I_n. In addition, we allow part of Q_n to be transferred to owners of private capital used in production of traded goods K_n living in other countries, in the form of net exports to the rest of the world, NX_n

$$Q_n = C_n + I_n + NX_n. \tag{3}$$

Tradeable Goods Firms in each location i produce differentiated tradeable goods. In particular, to be set up each firm in i needs F_i units of a bundle X_i that includes various factors of production (defined below), and then produces output one-to-one from the bundle of factors X_i. The output q_i of each firm in i is sold in other locations subject to transport costs, hence:

$$q_i = \sum_n \tau_{ni} q_{ni} \tag{4}$$

where q_{ni} is the quantity exported by each firm from i to n. Assuming that firms are monopolistically competitive, they set prices equal to

$$p_{ni} = \tau_{ni} p_{ii} \tag{5}$$

where p_{ii} is the domestic price

$$p_{ii} = \frac{\sigma}{\sigma - 1} p_i^X \tag{6}$$

where p_i^X will be the cost of a bundle of factors and intermediates used in production, X_i. Constant markups and zero profits imply that all firms in i have the same size ensuring zero profits,

$$q_i = (\sigma - 1) F_i. \tag{7}$$

As a result, given a total production X_i of the bundle of intermediate inputs used by firms, the number of firms consistent with free entry is pinned down. In particular, using the share of wages in local production from the relation (20) in the appendix, the number of firms in i is:

$$M_i = \frac{1}{\beta_L \sigma F_i} \frac{w_i L_i}{p_i^X}. \tag{8}$$

Intermediate Bundle All the primary productive resources in state n are employed in a non-traded bundle X_n is produced using perfectly mobile private capital K_n, labor L_n, and a bundle of tradeable intermediate products I_n, using a Cobb-Douglas production function:

$$X_n = A_n\left(L_n\right) L_n^{\beta_L} K_n^{\beta_K} I_n^{1-\beta_L-\beta_K} \tag{9}$$

The TFP shifter of each location A_n may be endogenous through an agglomeration externality,

$$A_n\left(L_n\right) = A_n^0 L_n^{\gamma} \tag{10}$$

where γ is the aggregate TFP elasticity of the economy. X_n is supplied under perfect competition, implying that the price of the bundle of intermediates in i equals the marginal cost:

$$p_i^X = \frac{w_i^{\beta_L} P_i^{1-\beta_L-\beta_K}}{Z_i\left(L_i\right)} \tag{11}$$

where, $Z_i\left(L_i\right)$ takes the form

$$Z_i \equiv Z_i^0 L_i^{\gamma}, \tag{12}$$

where $Z_i^0 \equiv \frac{A_i^0 G_i^X}{(r^X)^{\beta_K}}$ captures fundamental component of productivity A_i^0, public capital and the cost of private capital r^X.

3.3 Workers

The utility of each individual worker i in region n is $v_n = v_n^W e_n^i$. The common component of utility depends on amenities U_n, as well as consumption of traded goods (c_n^W) and housing (h_n^W):

$$v_n^W = U_n\left(c_n^W\right)^{\alpha_C^W}\left(h_n^W\right)^{1-\alpha_C^W}, \tag{13}$$

subject to the budget constraint, $P_n c_n^W + R_n h_n^W = w_n$.

After consumer optimization over $\left(c_n^W, h_n^W\right)$ we get

$$v_n^W = U_n \frac{w_n}{\left(P_n/\alpha_C^W\right)^{\alpha_C^W}\left(R_n/1-\alpha_C^W\right)^{1-\alpha_C^W}}$$

And using equilibrium prices in housing market derived in (24), we obtain:

$$v_n^W = V_n\left(\frac{w_n}{P_n}\right)^{\alpha_C^W} L_n^{-\left(1-\alpha_C^W\right)} \tag{14}$$

where $V_n = U_n\left(\alpha_C^W\right)^{\alpha_C^W}\left(\alpha_C^K H_n\right)^{1-\alpha_C^W}$ combines fundamental amenities and government sup-

plied services.

The random component is assumed to be i.i.d Frechet, $\Pr\left(e_n^i < x\right) = e^{-x^{-\varepsilon}}$. As a result, the fraction of workers that choose to live in n is:

$$\frac{L_n}{L} = \left(\frac{v_n^W}{v^W}\right)^{\varepsilon_W} \tag{15}$$

where v^W is worker welfare in the country, set such that the national labor-market clears

3.4 Landowners

Landowners have similar preferences to workers, although the may spend a different fraction of income on housing:

$$v_n^K = U_n \left(c_n^K\right)^{\alpha_C^K} \left(h_n^K\right)^{1-\alpha_C^K} \tag{16}$$

with budget constraint of $P_n c_n^K + R_n h_n^K = R_n$. Because we assume homothetic preferences, when we aggregate the model it does not matter how many capital owners there are, hence we assume that all capital owners own one unit of land. Therefore after optimization, the aggregate utility of all capital owners is

$$v_n^K = U_n \frac{R_n}{P_n^{\alpha_C^K} R_n^{1-\alpha_C^K}}. \tag{17}$$

3.5 Equilibrium in Relative Changes

In the counterfactuals, we will consider shocks to trade costs $\hat{\tau}_{ni}$, where $\hat{x}$ denotes the value of variable x in the counterfactual equilibrium relative to the initial equilibrium.[1] As shown in Appendix B.2, following standard steps (Redding and Rossi-Hansberg, 2007) we can define an equilibrium in changes for employment, price indexes and wages $\left\{\hat{L}_n, \hat{P}_n, \hat{w}_n\right\}$ and the welfare of workers $\hat{v^W}$ as function of parameters and data. In particular, to solve the system we need to information on the parameters $\left\{\sigma, \gamma, \beta_L, \beta_K, \varepsilon_W, \alpha_C^W\right\}$ and on data on import shares λ_{ni}, export shares s_{ni}, and employment L_i. Having computed $\left\{\hat{L}_n, \hat{P}_n, \hat{w}_n\right\}$, in the counterfactuals we can then compute all the outcomes in each city.

[1] I.e., $\hat{x} = \frac{x'}{x}$, where x' is the counterfactual value and x is the initial value of variable x.

4 Data and main counterfactual scenarios

4.1 Data

In this section, we summarize the geo-referenced data used in our analysis. In particular, we use data on Bangladesh's and India's road network, labor force and wages. Figure 2 shows the spatial distribution of wages and labor force for the countries in our study. Labor force includes the working-age population (15+ years). All wages are monthly and expressed in dollars. Our data comes from the Ministry of Statistics and Programme Implementation (Government of India, 2011), for the case of India; and the 2010 Labor Force Survey for the case of Bangladesh. Figure 9 in Appendix C shows the road networks used in our experiments. For both Bangladesh and India, we consider only roads that are part of the primary and secondary road network of each country, excluding tertiary roads.

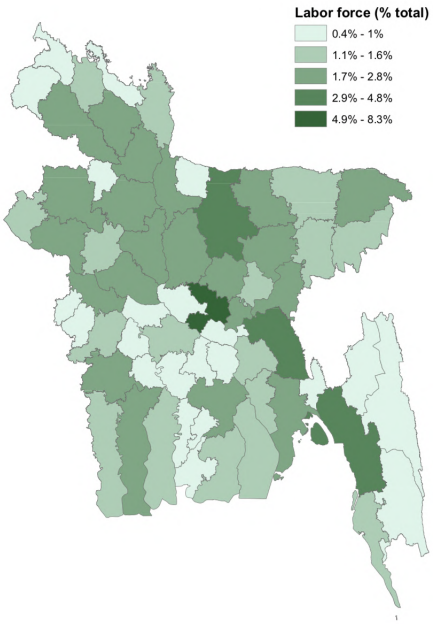
4.2 Calibration

We assume an elasticity of substitution between traded varieties of $\sigma = 5$, as in Head and Mayer (2014). For robustness, also consider 4 and 6 as alternative values of this elasticity. The aggregate TFP elasticity, γ, is calibrated to 0.05 following Ciccone and Hall (1996). We set the Cobb-Douglas share of labor, β_L , to 0.39; and the share of private capital, β_K to 0.49 using data from KLEMS for India, and to .46 and 0.26, respectively, for Bangladesh, according to data from the WITS. We set $1 - \alpha_C^W$ to 0.35 for Bangladesh and to .44 for India using the share of household consumption expenditures in total expenditures from UN data. Following Fajgelbaum et al. (2015), the calibrated shape parameter of the random component of utility, ε_W, is chosen to be 1.5.

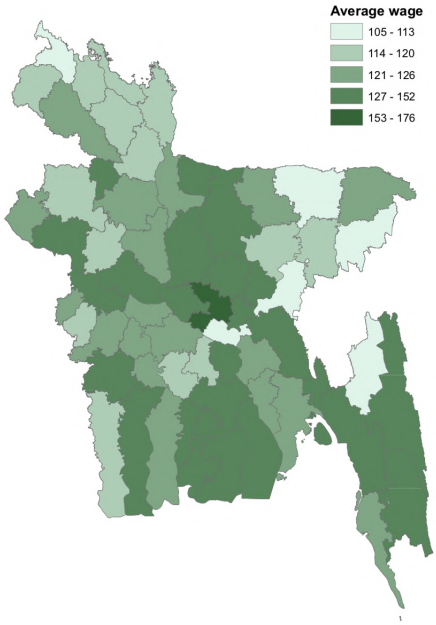
Table 1: List of calibrated parameters

Parameter	Value	Source
σ	5	Head and Mayer (2014)
γ	0.05	Ciccone and Hall (1996)
β_L	0.39 (India)	KLEMS
	0.46 (Bangladesh)	WITS
β_K	0.49 (India)	KLEMS
	0.26 (Bangladesh)	WITS
1-α_C^W	0.44 (India)	UN data
	0.35 (Bangladesh)	UN data
ε_W	1.5	Fajgelbaum et al. (2015)

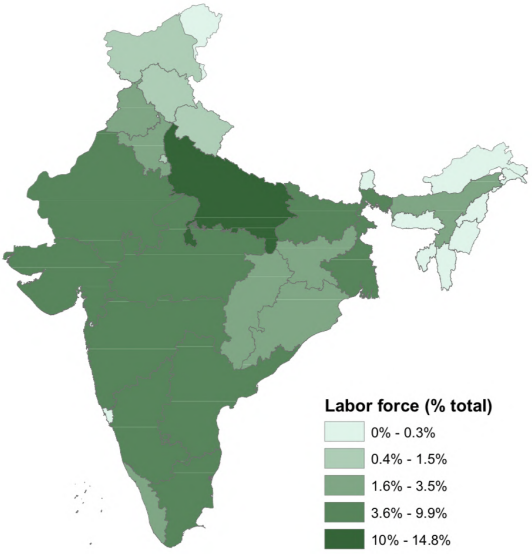
Figure 2: Variables of Interest



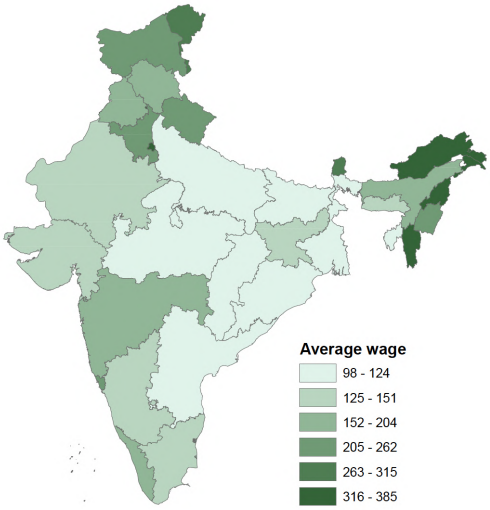
Labor Force



Wages



Labor Force



Wages

Notes: Labor force includes the working-age population (15+ years). All wages are monthly and expressed in dollars. Sources: Ministry of Statistics and Programme Implementation, Government of India(2011); and Labor Force Survey (2010), Bangladesh.

4.3 Three counterfactual scenarios

To understand the implications of the MVA and the economic gains from deeper integration between India and Bangladesh, we perform three counterfactual exercises that gradually implement and eventually overpass aspects of the agreement. Each of the counterfactual makes assumptions on future changes in transport and trade costs between states in India and districts in Bangladesh. Changes in trade costs will affect the movement of goods and indirectly the movement of workers within countries. For each counterfactual exercise, we assume that goods travel through the less costly routes of the road network between any two regions. We assume labor is mobile within countries, and immobile across countries. In our baseline scenario, Indian trucks are not allowed to drive through Bangladesh, forcing trucks that connect Northeast Indian regions with the rest of the country to bypass Bangladesh. The first scenario considers the opening of new transit routes through Bangladesh for Indian trucks that go to and from Northeast India. In the baseline, Indian trucks are not allowed to use Bangladeshi routes and must bypass Bangladesh through the Siliguri corridor to reach the Northeast states.

The first scenario considers the opening of new transit routes through Bangladesh for Indian trucks that go to and from Northeast India. In the baseline, Indian trucks are not allowed to use Bangladeshi routes and must bypass Bangladesh through the Siliguri corridor to reach the Northeast states. In this first scenario, part of the agreement is implemented and Indian trucks are allowed to pass through Bangladesh along the routes specified in the BBIN motor vehicle agreement (Section 2). Trucks crossing Bangladesh are not allowed to trade goods on the way while in Bangladesh. This scenario benefits Indian states but does not directly benefit Bangladeshi districts. We do not consider the possible gains for Bangladesh from increased traffic on Bangladeshi routes (services along the routes for trucks, fees, etc) nor do we include the negative externalities such as increased pollution, noise or congestion along these routes. In this counterfactual, transit through Bangladesh is allowed, but trade by Indian trucks along the route is not.

The second scenario adds the possibility for Indian trucks to enter Bangladesh, through the land ports along on Figure 1, to deliver Indian exports but not to take goods back to India. This scenario also allows Bangladeshi trucks to enter India, through the same land ports, to deliver Bangladeshi exports but not to take goods back to Bangladesh. This scenario is the closest to the MVA. Crossing the border between Bangladesh and India at Benapole-Petrapole takes on average 138 hours, including 28 hours spent in transloading cargo between Bangladeshi and Indian trucks. This scenario assumes the transloading is not required anymore, but it is an option for shippers. Some shippers might still prefer to

transload cargo between trucks as the restriction that foreign trucks should return empty to their country means shippers must pay for a roundtrip. Removing the frictions at the border, including the need to transload cargo, reduces the transport costs for bilateral trade between some locations , but the reduction is less than if trucks could return loaded.

To model this scenario, we make a series of additional assumptions. First transit between countries occurs only through the entry ports outlined in the MVA agreements, which are located at the end points of the corridors. Second, only one-way trade is allowed, however, once trucks unload products from one country to another one, they cannot reload a new shipment. This implies they must return to their country of origin empty, and we model it as a "double" transport cost whenever a shipment from country i travels through country j for $i \neq j$. Third, given the double cost of a foreign truck to travel, we allow producers to choose between using a foreign truck shipping, or transloading the shipment at the border[2]. The process of transloading is costly. Namely, it increases the time at the border by 20%[3]

The third scenario goes beyond the MVA and assumes complete regional integration with no restrictions on foreign truck movements. Indian trucks can both deliver Indian exports and bring Bangladeshi goods to India. The same applies for Bangladeshi trucks. This scenario also assumes trucks do not need to stop at the border between India and Bangladesh. As a result, transport costs in this scenario are the lowest of all three scenarios. This counterfactual exercise analyzes the effects on Real GDP and movement of labor when trade can happen through any route, not necessarily the five cargo routes described in the previous section, between Bangladesh and India. Gains in transport time are limited as alternative routes are on average slower than the ones included in the MVA. However, total transport costs are much lower as it is not required any more to pay double while shipping to foreign land.

[2]Assuming, for instance, that an Indian truck would unload at the border, and reload the shipment on a Bangladeshi truck that is not required to return empty after delivering the shipment.

[3]According to a time release study at Benapole border, the entire clearance process for imports to Bangladesh takes on average 5 days, 18 hours and 24 minutes (weighted by volumes of the different commodities across different clearance procedures). Out of this time, 28 hours are involved in the transloading of goods. Eliminating the transloading amounts to a decrease of approximately 20% in border time. Other border posts in Bangladesh that are less congested the border time might be lower, but given the lack of data we use this value as an upper bound.

5 Which gains from the MVA and regional integration?

This section presents the results for each of the three scenarios in terms of population, real wage and welfare changes first at the aggregate level for each country and then at the sub-national level to explore the determinants of spatial effects within countries.

5.1 Aggregate gains

The opening of new transit routes for Indian trucks travelling to and from Northeast India through Bangladesh would bring large economic benefits to India because of the reduction in travel time and transport costs for freight. Allowing Indian trucks to transit through Bangladesh is estimated to increase Indiaâs real income by 2.5 percent (Table 2). The reduction in transport costs reduces the prices of intermediate and final goods in all states, with some states experiencing higher reductions than others. Lower prices of final goods increase the purchasing power of consumers, and cheaper input prices make producers more competitive. The states experiencing the largest decreases in prices become more competitive attracting more workers and increasing their economic activity. The reductions in prices, relocation of economic activity and potential increases in wages lead to the increase in real aggregate income in India.

Allowing foreign trucks to bring goods is a step towards deeper regional integration and bring large economic benefits to both India and Bangladesh. Scenario 2 (that is transit and one-way trade) looks at the benefits from both opening new transit routes for Indian trucks and allowing foreign trucks to export goods. Transport costs are reduced for traders that come from or go to the Northeast, and firms and consumers have access to foreign goods. While consumers have access to more goods, firms benefit from access to more types of intermediate goods for production. Overall, real income in India increases by 2.6 percent when transit and delivery of imports by foreign trucks is allowed. This is just a 0.1 percentage point above the gains when only transit is allowed, which shows that the main gains for India come from lower transport costs between the Northeast and the rest of India.

While real income in Bangladesh does not change because of transit of Indian trucks, its aggregate real income increases by 4.1 percent when allowing foreign trucks to deliver imports. The gains in Bangladesh are not due to reduction in domestic transport costs, but reductions in transport costs to access Indian markets. The gains from regional integration are much larger for Bangladesh than for India because while the Bangladeshi markets are

relatively small for India, Bangladesh gains access to much larger markets in India. Small countries tend to gain more from regional integration if they remain competitive enough to export to foreign markets.

Regional integration with the MVA restricts Indian trucks from importing goods from Bangladesh. Trading with Bangladesh therefore remains expensive as trucks are not allowed to bring back goods. Deeper regional integration with foreign trucks allowed to both export and import goods and no need to stop at the border would increase the economic gains for both India and Bangladesh. Indiaâs national real income will increase by 3.20 percent compared to the actual baseline case (Table 2), which is more than 20 percent higher than under the MVA. The additional gains in India are largely driven by the removal of the need to stop at the border, which saves significant time to trucks transiting through Bangladesh. In Bangladesh, national real income would increase by 4.54 percent (Table 2), which is more than 10 percent higher than under the MVA. In Bangladesh, the additional gains are largely driven by the reduction in transport costs as shippers do not need to pay for empty return trips.

Table 2: Changes in Standards of Living from the Counterfactuals

Counterfactual	Δ Traffic Only	Δ Traffic & One-Way Trade		Δ Traffic & Trade	
	India	India	Bangladesh	India	Bangladesh
Δ Welfare	0.95%	1.04%	1.49%	1.29%	1.86%
Δ Real Income	2.51%	2.62%	4.08 %	3.20%	4.54%

Notes: The table shows the percentage change in worker's welfare at the country-level. We consider transit from India-Bangladesh only trough the entry points outlined in the MVA.

Table 3 presents the results in terms of spatial inequality at the national level[4]. Both new transit routes and deeper integration will reduce spatial inequality across regions in each country. While trade integration benefits more certain regions at the expense of others, there is no trade-off between efficiency and equity when the countries become more integrated (Table 3). When comparing the impacts with and without trade integration, the opening of new transit routes appears as the main driver of the reduction in spatial inequality across India. The reduction in spatial inequality is also larger for Bangladesh than for India.

[4]Spatial inequality is measured as the Gini coefficient between regions whose income refers to the total labor income.

Table 3: Changes in Spatial Inequality from the Counterfactuals

Counterfactual	Δ Traffic Only	Δ Traffic & One-Way Trade		Δ Traffic & Trade	
	India	India	Bangladesh	India	Bangladesh
Δ Spatial Inequality	-1.27%	-1.29%	-1.73%	-1.61%	-5.36%

Notes: The table shows the percentage change in the Gini coefficient measuring income inequality across locations affected by the counterfactuals. In all cases, income refers to total labor income.

5.2 Spatial effects

While India and Bangladesh gain from the MVA, the gains will not be evenly shared across regions, with some regions gaining more than others, and some regions potentially losing because of the integration. Theses spatial effects will also be different in both countries. The reason is the nature of the economic shock differs across countries. Indian states experience both a decrease in trade costs to reach other Indian markets and an improvement in the access to Bangladeshi markets, while Bangladeshi districts only benefit from improved access to Indian marketsâdomestic transport costs do not change in Bangladesh. This section focuses on the regional effects and discusses the role that initial characteristics such as initial population and geography and the importance of transport cost reduction versus market access improvements to explain that some regions will gain while others will not.

Description of the resulting spatial effects

Scenario 1: New transit routes

By lowering transport costs and therefore prices, the opening of new transit routes increases the competitivity of some regions relatively to others followed by workers and economic activities moving towards regions that overall gain from better integration. Prices fall the most in the Northeast, as most goods are imported from the rest of the country and benefit from large reduction in transport times (Figure 13 in Annex). Provinces in the South of India also benefit from relatively larger reduction in prices as trucks to and from the Northeast will use the newly-open routes through Bangladesh. Reduction in prices benefit both consumers and companies because of cheaper consumption foods and production inputs.

Better integration will reduce economic distances between Indian provinces, create more trade opportunities, make companies more profitable and increase wages. Overall, nominal wages will increase the most in the Assam province, in West Bengal, in Tamil Nadu, and in Maharashtra (Figure 13 in Annex). Wages will increase by less than 1% in the Northern

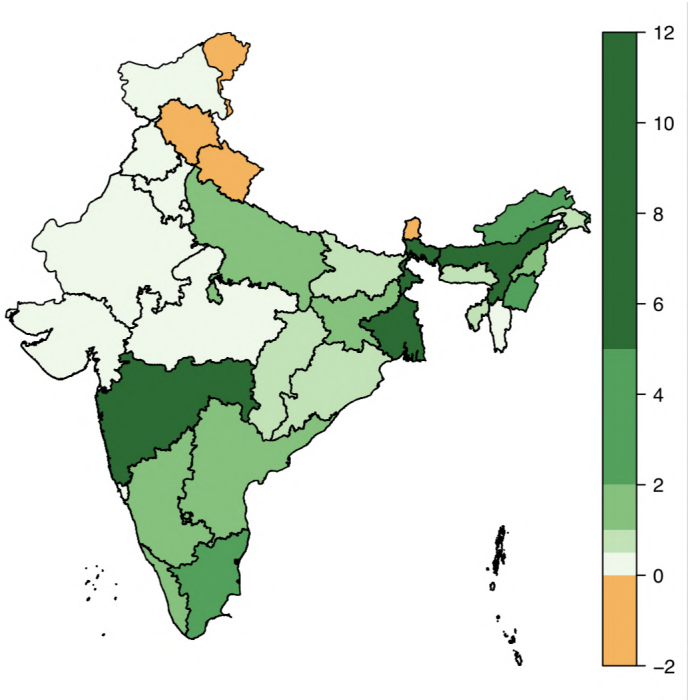
provinces except Uttar Pradesh. However real wages might be a better proxy for quality of life improvement. Real wages are growing the most in the Assam province, in West Bengal, in Tamil Nadu, and in Maharashtra.

Workers go to provinces with better trade opportunities where more workers are needed and where real wages are attractive. Workers move where economic opportunities are growing, from the provinces that make the least of the new routes towards the provinces that benefit the most. Overall the number of workers is growing the most in West Bengal and to a lesser extent in the South and East of the country at the expense of the Northern provinces (Figure 12 in Annex). The ability of workers matters for an efficient relocation of economic activities across regions.

The opening of new transit routes for Indian trucks increases the integration of the Northeast with the rest of the country and benefit the Northeast, especially the Assam province. Overall the gains from the new routes in terms of local GDP depends on the relocation of both people and economic activities across provinces. The Northeast will directly benefit from the opening of these new transport routes through reduced driving time and therefore lower transport costs. Instead of bypassing Bangladesh by the North, truckers that go from or to the Northeast can drive through Bangladesh and reduce their travel times. Transport costs for the Northeast to import and export from other Indian regions will be reduced and benefit these regions through cheaper goods, and more profitable sales due to more competitive products to other locations. Local real GDP will increase in all regions of the Northeast with Assam experiencing the largest income gains (Figure 3).

Other Indian regions will also benefit from larger trading opportunities and from cheaper intermediary goods and final products being imported from the Northeast regions. Among these states, the gains vary depending whether truckers will keep using the Indian routes through the Siliguri corridor or will drive through Bangladesh. As a result, Northern states, whose truckers keep bypassing Bangladesh, do not benefit from gains in transport time and therefore gain much less than the Southern states (Figure 3). Among the states that gain the most, West Bengal which is located next to Bangladesh will benefit from large economic gains. Maharashtra will also largely benefit from better trade opportunities. Provinces in the North will either benefit very little or lose from the new routes. Cheaper goods from other regions and more trade opportunities do not compensate for the loss of workers. Finally, Bangladeshi regions do not directly benefit from the increase in transit through the new domestic corridors .

Figure 3: Percentage changes in real GDP from the new transit routes



Scenario 2 and 3: Deeper regional integration

India In addition of the opening of the new transit routes, partly removing the trading restrictions on foreign trucks increases trade opportunities to new foreign markets for Indian states. Following changes in transport costs and regional trade opportunities, some states become more competitive and attract relatively more workers. The regions that attract more workers are regions that gain in connectivity to large markets and whose trade costs to reach regional markets decrease. Better connectivity boosts economic activities and increases profit margins for producers who can then offer higher wages to attract workers. Lower prices from cheaper transport costs to regional goods also makes these regions more appealing for workers.

When deeply integrating Indian and Bangladeshi regions, the patterns of resulting spatial effects differ in the two countries. While Indian regions gain a better access only to their domestic markets when allowing Indian trucks to transit through Bangladesh, both countries gain access to new markets when allowing for trade through land entry points. In India, the resulting effects across regions will depend whether traders will use the new routes and benefit from cheaper transport costs and whether access to new but relatively small Bangladeshi markets will be beneficial.

The gains for Indian divisions from accessing Bangladeshi markets are small compared to the gains from new transit routes. Accessing new markets affects prices, wages and the movement of economic activities and workers across provinces in India. While all regions benefit from cheaper goods overall, the Southern provinces in India benefit the most from access to cheaper goods in Bangladesh. The fall in prices is larger in the Southern provinces, including West Bengal (Figure 16). The spatial gains in wages vary little compared to the gains due to the new transit routes, meaning that trade opportunities increase first and foremost because of the reduction in transport times to the Eastern provinces. Similarly, workers are moving away from the Northern provinces to the Southern and Eastern provinces, benefiting mostly West Bengal (Figure 15). Overall the gains for Indian provinces from accessing markets in Bangladesh are relatively small compared to the gains from using the new transit routes. Given that the transport costs remain high from trading with Bangladesh, the gains remain limited for most Indian provinces. Compared to the effects from the new transit routes only, the Northern provinces which gained little from these new routes gain relatively more from accessing new markets (Figure 4). When combining both the new transit routes and access to Bangladeshi markets, Assam, West Bengal and Maharashtra remain the provinces that gain the most in terms of real GDP, while Northern distant provinces gain little or lose from more integration with Bangladesh through the MVA (Figure 4).

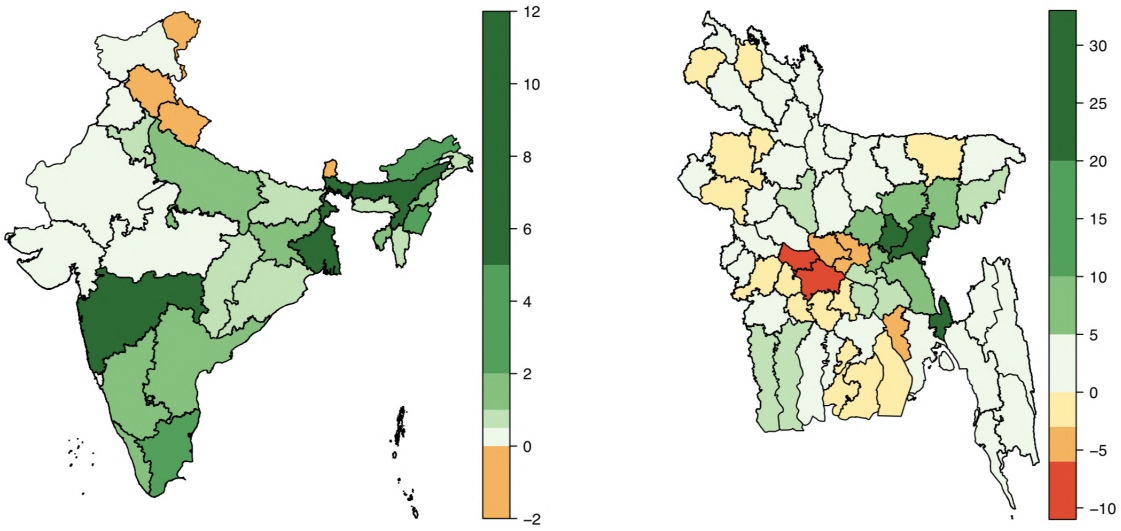
Bangladesh Partial trade integration will give Bangladeshi districts access to cheaper goods and to larger markets to export to. Access to cheaper intermediate inputs and consumption goods will lower prices, especially for land-border districts (Figure 18). Increased trade opportunities will lead to higher wages in some provinces while others that become less competitive will experience decreasing nominal wages (Figure 18). Change in wages explain part of the domestic movement of workers across districts. Periphery districts benefit from the largest gains in connectivity and attract workers away from the most populated areas in the center of the country, around Dhaka.

Despise lower prices in the whole country, trade integration with India affects negatively some districts that are not competitive enough. Real wages decrease in some of the central districts and in the peripheric districts that do not have a direct access to India and remain isolated despise their proximity to the border (Figure 18). Compared to India, distance is less a main determinant of spatial gains and losses in the country.

Regions that gain in terms of additional workers and real GDP are the ones that gain relatively more in market access to Indian markets, the regions that are very close to a port of entry or are well connected through the domestic transport network to one. The rest of this section provides a deeper analysis of our results and the potential mechanisms behind them.

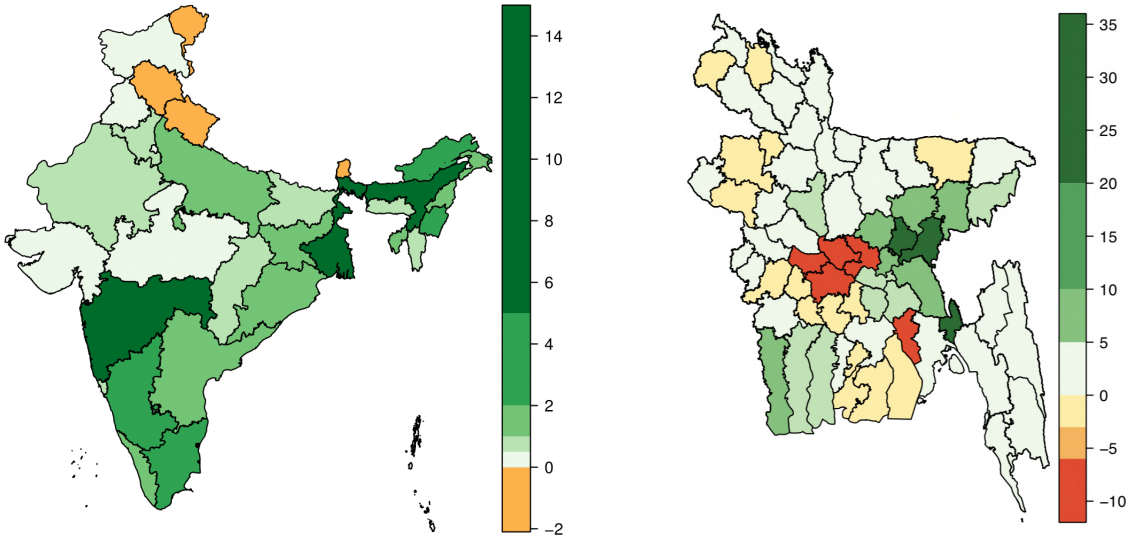
From limited to deeper integration The third scenario removes the remaining trade restrictions for truckers going back and forth across countries. Transport costs are much lower as foreign trucks can bring goods back, which avoids exporters to pay twice for transport. Overall, deeper integration amplifies the spatial effects, with winning regions that gain even more and losing regions that lose more. Figure 6 shows the increase in gains when comparing the gains from deeper integration with the gains from limited integration. In India, the gains from complete integration are 25% higher in the Southern states than the gains from limited integration. The gains for the Northern states increase by 11%, but a few states that lose from regional integration will lose even more from deeper integration.

Figure 4: Changes in real GDP for limited integration



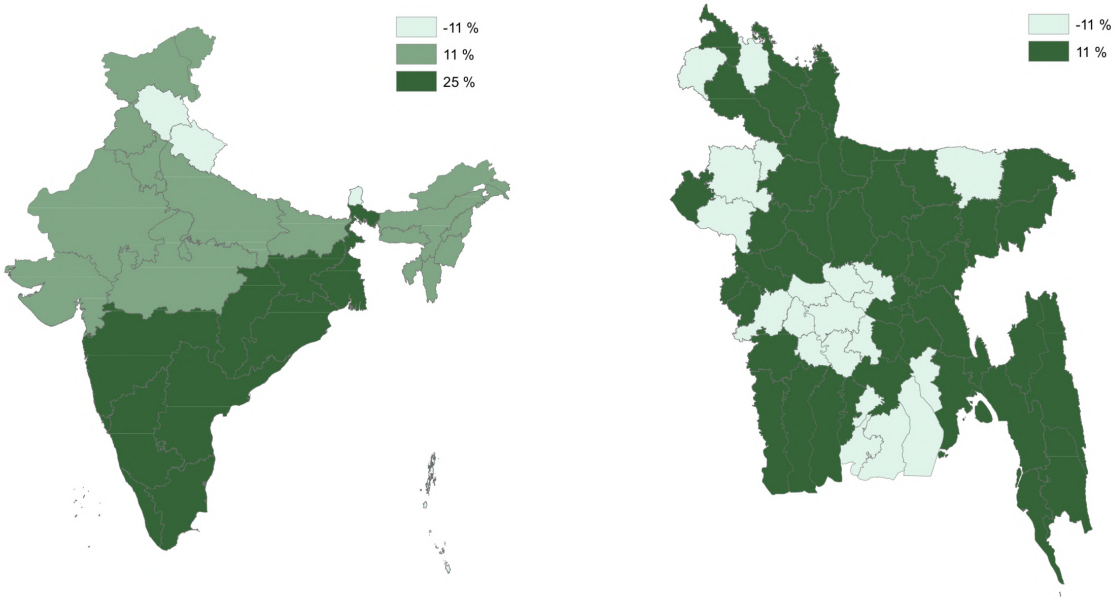
Notes: The figure shows the percentage change in real GDP (defined as wage bill over price) in each region as a result of our counterfactual, as compared with their baseline levels.

Figure 5: Changes in real GDP for complete integration



Notes: The figure shows the percentage change in real GDP (defined as wage bill over price) in each region as a result of our counterfactual, as compared with their baseline levels.

Figure 6: Which gains from complete integration versus limited integration?



Notes: The figure shows the percentage change between the gains from counterfactual 3 compared to the baseline with the gains from counterfactual 2 compared to the baseline. In India, the gains from complete integration are 25% higher in the Southern states than the gains from limited integration.

Explaining the spatial changes across regions

In this section, we discuss the main factors behind the spatial effects, here the relocation of workers across states in India and Bangladesh, and limit our analysis to the counterfactual of complete integration (counterfactual 3). We first describe the drivers of internal migration for both countries and then focus on the role of geography versus market access to explain the spatial effects. In addition of the initial differences in population, economic size and geography, the nature of the economic shock when allowing for complete integration differs across countries. Indian regions are experiencing both a decrease in trade costs to reach other Indian markets and an increase in market-size, while for Bangladeshi regions domestic traveling times are not changing.

Determinants of internal migration Following changes in transport costs and regional trade opportunities, some regions become more competitive and attract additional workers while others lose some, keeping country population constant. The drivers of population change are the initial characteristics of the location, the nature of the economic shock, and the counterfactual change in real wages. A simple regression can help us understand the relative contribution of the forces outlined above in the overall population changes [5] The results in the case of complete integration - counterfactual 3 - are shown in Table 6. They show a significant and inverse relationship between a region's initial size (labor share), and the overall final effect on its population. As previously stated in section 5.1, this suggests that our counterfactual scenario tend to reduce spatial concentration with workers moving away from the most populated locations. Further, the change in trade costs for the overall effect suggests that in our setting this direct effect is a determinant of internal migration, even when controlling for changes in real wages. Finally, population growth and real wages are significantly and positively correlated. Regions that benefit from lower consumer prices or/and experience higher wages attract more workers. Figures 7 show the relationship between the change in wages and the population change for each region. As it is graphically verified, changes in wages and changes in population are strongly associated as a result of the equilibrium forces in the model.

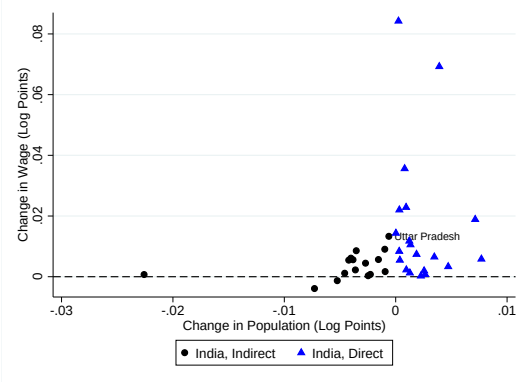
[5] We consider the following regression:

$$\log(\hat{L}_i) = \beta_1 \log\left(\frac{\hat{w}_i}{\hat{P}_i}\right) + \beta_2 \log\left(\sum_n \hat{\tau}_{ni}\right) + \beta_3 \log\left(\frac{L_i}{L}\right) + \varepsilon_i. \tag{18}$$

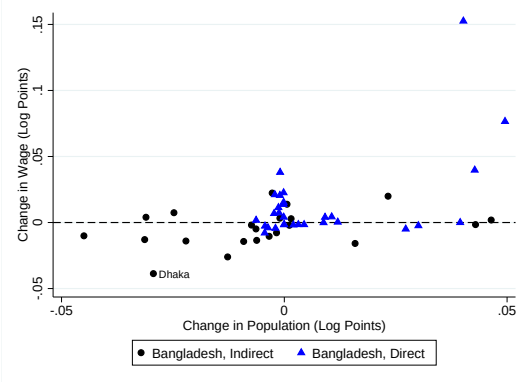
That is, we regress the changes in populations in each region[6] with the changes in real wages, the change in total transport costs and the initial labor shares of that location.

Figure 7: Wage and labor changes for complete integration

India



Bangladesh



Notes: The figure shows the change in wages (in log points) plotted against the change in labor force (in log points) in each region, resulting from the most general counterfactual (with free transit and trade). The color and shape of the markers in each graph allow us to distinguish between regions that were directly shocked and those that were not. For India, a region is directly shocked if its traveling time to other parts of India changed when we modified the network (that is, most of India except for the its northwest). For Bangladesh a region is directly shocked if it has a port of entry, or if it is directly adjacent to a region with one.

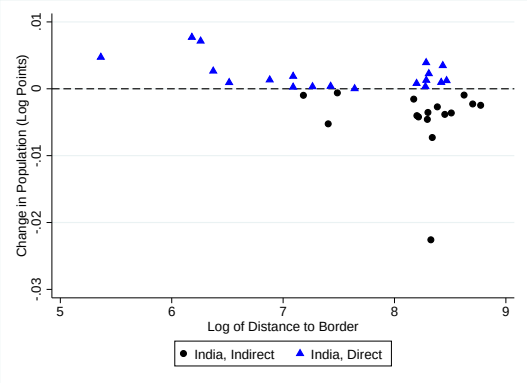
While there is a clear divide between directly and indirectly impacted regions in India, the results are more mixed in Bangladesh (Figure 7). While regions directly shocked that benefit from the new routes tend to gain population in India, there is a more varied range of outcomes for regions in Bangladesh. In particular, gains from accessing Indian markets are strong enough for some regions that are not directly shocked to become more attractive for workers. In addition, the impact of market access is stronger for Bangladesh given the differential in wages and prices in both countries.

The role of geography and market access If regional integration was to be fully implemented, the spatial effects would depend on geography and connectivity along the domestic transport network. Distance to the border is a main determinant of gains from integration in both countries as shown in Figures 8. In India, the economic gains are strongly positively correlated with the distance to the Bangladeshi border (Figure 8). Indian regions in the East and West-Bengal that were previously at the periphery of the country with a more limited access to regional markets and few opportunities to access foreign markets through the maritime routes directly benefit from accessing Bangladeshi markets. In Bangladesh, the regions that are currently trading the most are located along the Dhaka-Chittagong corridor with Chittagong being the largest entry port for foreign goods. By allowing for complete integration between India and Bangladesh, several regions will become new entry ports

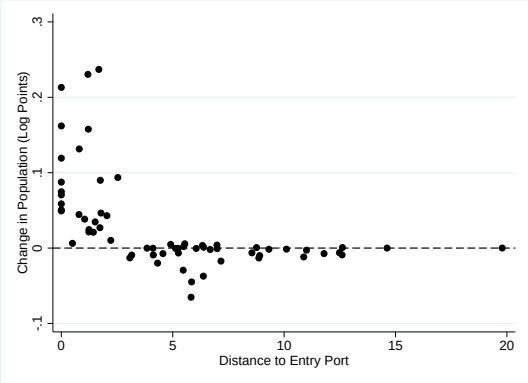
for Indian goods and benefit from a very large increase in access to new markets (figure 1). Similar to India, the economic gains for Bangladeshi regions are strongly positively correlated with the distance to an entry port along the Indian border (Figure 8).

Figure 8: Geographical location versus population growth per region for complete integration

Distance to the Bangladeshi border



Distance to an entry port



Notes: The figure shows the change in population (in log points) in each region against the distance from the population center of each location and the border with Bangladesh for Indian regions and the distance to an entry port for Bangladeshi regions, resulting from the most general counterfactual allowing for free transit and trade. Indian regions shocked directly are those for which the transport cost to other parts of India changed. Bangladeshi shocked directly are those that are have or are adjacent to an entry port.

The model provides the explanatory channel to explain how being close to a border point is translated into lower prices and higher economic gains. To the extent that reductions in transport costs are passed through prices, consumer prices decrease in the regions that benefit the most from this connectivity shock, in the Northeast especially and more broadly the Eastern part of India. Wages tend to increase in these regions, attracting workers from the regions that are the furthest away from Bangladesh and do not benefit from these new routes, especially in the North. Overall, the locations that experience the largest increase in real GDP are regions close to Bangladesh, especially in the Northeast and in West-Bengal, and Southern regions that benefit from the new routes to reach the Northeastern regions. These gains are decreasing in the distance to the shock, as it was to be expected given that the proportional change in trade costs is larger for these locations.

While change in transport costs is key, the change in market access might be a better index to understand the spatial effects of regional integration. In Bangladesh, the effects of being close to an entry point on population growth are heterogeneous, and for a same distance to the border, some regions will disproportionately gain while others will not (Figure

8). Economic gains will be much larger for the regions in the Center East of Bangladesh, whose index of market access is increasing a lot in the scenario of regional integration (Figure **??**). In order to better understand the relative role of increased market access, we also run the following regression:

$$\hat{L}_i = \beta_1 \hat{MA}_i + \varepsilon_i, \tag{19}$$

where is a measure of change in market access constructed as $\hat{MA}_i = \sum_n \frac{\hat{L_n}\hat{w_n}}{\hat{\tau}_{ni}}$. To better understand if the underlying mechanism behind the Bangladeshi changes is the change in market access given the initial levels of market access of each region, we run regression 19 separately for each country. The results of this regression are shown in Table 4.

Table 4: Labor Changes and Market Access

Dependent Variable: Labor Changes in each Location ($\hat{L}_i$).

Variable	Coefficient Bangladesh	Coefficient India
Δ Market Access	0.104^{**}	0.011
	(0.032)	(0.297)
Robust SE	✓	✓
Adj R^2	0.14	0.08

Notes: Table 4 reports the regression results when the dependent variable is the change in population of each region. Independent variable is in levels. The table shows the results for the counterfactual where both transit and trade are allowed. Robust SE are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

As Table 4 shows, the change in market access is an important determinant of the realized changes in Bangladesh. The same is not true for India, where as previously discussed changes are mainly driven by changes in trade costs for domestic markets.

Additional Robustness In Appendix **??**, we explore how the different size of locations in both countries can bias our results. The potential source of bias in the estimations given by region-size is the agglomeration externality captured by γ. Therefore, in the Appendix we set $\gamma = 0$ and redo our calculations, and find little difference in our results. Further, we argue this effect is not coming from the different in sizes between Indian states and Bangladeshi ones, but from the decrease in productivity resulting from a lower γ. The reason is that in our model in changes, outlined in Section B.2, the only variable in levels coming from the data is the population share L_i/L in Equation (40) to ensure the total population does

not change. As these shares are consistent within country, and as the population changes *in each country* must add up to 1 independently from each other, results in this section are very close to those in the main paper.

6 Conclusion

This project has simulated the impact of counterfactual changes in trade barriers between two neighboring countries using a standard model of trade and economic geography. We explored the extent to which different degrees of reduction to trade barriers – transit only, transit and one-way trade, transit and unrestricted trade – would affect the productivity and quality of life across regions. In particular, we explored the case of India and Bangladesh: two countries in South Asia that are considering a reduction in trade barriers through the BBIN Motor Vehicle Agreement.

Among the counterfactuals, we consider alternative scenarios that involve current proposed plans being considered by India and Bangladesh. Our exercises focused on the question of whether the agreement would be significantly beneficial for both countries, and which regions would benefit within each nation. We have also focused on the question of how the gains from integration vary depending on the degree to which trade barriers are reduced, and on how these changes would impact spatial inequalities.

Our results suggest that regions that gain market access tend to gain employment and increase their real GDP. These changes consistently decrease on distance to the countries' boundaries, but affect even locations far away from the shock. Another common pattern is that the expansion in the transport network tends to decrease spatial inequality. Quantitatively, we find that allowing for a decrease in trade barriers between these two countries generates economically significant changes, for instance, it can lead to up to a 1.3 and 1.5 percent increase in national welfare for India and Bangladesh, respectively.

While interpreting these results, it is important limitation is that we have inherited the value of model elasticities (like the elasticity of labor mobility with respect to real wages and trade with respect to trade costs) from standard values in the empirical literature that estimates these coefficients for other countries. In addition, we have not used any measure of relative costs across the different types of reductions in trade barriers (for instance, the cost of monitoring trucks in case of allowing only for transit).

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Appendix

A Additional Tables and Figures

Table 5: Notation

Notation	Variable
A_n	Productivity of the traded sector in location n
F_n	Entry cost in location n
U_n	Fundamental amenities in location n
H_n	Housing in location n
X_n	Non-traded bundle in location n
L_n	Labor in location n
K_n	Private capital in location n
Q_n	Final good in location n
q_{ni}	Quantity exported by each firm from i to n
q_n	Quantity produced by each firm in n
α_C^K	Consumption share in capital owner's utility
α_C^W	Consumption share in workers's utility
β_K	Share of private capital
β_L	Share of labor
C_n	Consumption in location n
I_n	Intermediate input in location n
λ_{ni}	Share of imports from i to n
s_{ni}	Share of exports from i to n
τ_{ni}	Trade cost from $i$to n
R_n	Price of housing in location n
p_n^X	Price of non-traded bundle in n
w_n	Wage in location n
r^X	Cost of private capital
P_n	Price of final good in location n
p_{ni}	Price of exports from i to n
M_n	Number of firms in location n
ε_W	Shape parameter of utility's random component
γ	Aggregate TFP elasticity
σ	Elasticity of substitution
v^W	Utility of workers
v_n^K	Utility of capital owners in n

B System of Equilibrium in Relative Changes

B.1 Additional Derivations

Factor Demands From the optimization of producers of X_n, aggregate demand for each factor in n is

$$w_n L_n = \beta_L p_n^X X_n \tag{20}$$

$$r^X K_n = \beta_K p_n^X X_n \tag{21}$$

$$P_n I_n = (1 - \beta_L - \beta_K)\, p_n^X X_n \tag{22}$$

For future use, it is convenient to express intermediate expenditures as function of the wage,

$$P_n I_n = \left(\frac{1 - \beta_L - \beta_K}{\beta_L} \right) w_n L_n \tag{23}$$

Housing Market Clearing From the aggregation of workers and landowners, the condition that supply equal demand of housing is:

$$R_n H_n = \left(1 - \alpha_C^W\right)(w_n L_n) + \left(1 - \alpha_C^K\right)(R_n H_n),$$

implying rents to wage ratio of.

$$\frac{R_n}{w_n} = \left(\frac{1 - \alpha_C^W}{\alpha_C^K} \right) \left(\frac{L_n}{H_n} \right) \tag{24}$$

Aggregate Goods Demand From the aggregation of workers and landowners, the total demand for traded commodities is $P_n C_n = \alpha_C^W (w_n L_n) + \alpha_C^K (R_n H_n)$. Using (24), we obtain that that aggregate expenditures in final consumer goods equals wages:

$$P_n C_n = w_n L_n \tag{25}$$

As a result, combining (3), (23) and (25), aggregate expenditures in tradeable goods is:

$$P_n Q_n = \frac{1 - \beta_K}{\beta_L} w_n L_n + P_n N X_n \tag{26}$$

We assume that $r^X K_n$, the income of owners of capital used in n, is spent entirely in goods produced in n. Then, using (20) and (21), we have $P_n N X_n = \frac{\beta_K}{\beta_L} w_n L_n$. Combining with

(26) get:

$$P_n Q_n = \frac{1}{\beta_L} w_n L_n. \tag{27}$$

Import Shares The total exports from i to n are

$$M_i p_{ni} q_{ni} = (P_n Q_n) \lambda_{ni} \tag{28}$$

where λ_{ni} is defined as the share of n's expenditures going to i:

$$\begin{aligned} \lambda_{ni} &= M_i \left(\frac{p_{ni}}{P_n} \right)^{1-\sigma} \\ &= Z_{ni} w_i^{1-\sigma\beta_L} L_i^{1+\gamma\sigma} \frac{P_n^{\sigma-1}}{P_i^{\sigma(1-\beta_L-\beta_K)}}, \end{aligned} \tag{29}$$

where

$$Z_{ni} \equiv \frac{(Z_i^0)^\sigma}{\beta_L \sigma F_i} \left(\frac{\sigma}{\sigma - 1} \tau_{ni} \right)^{1-\sigma} \tag{30}$$

where the first condition follows from optimization of producers of Q_n and the second follows from using the expression determining the number of firms (8) for M_i, the pricing equations (5) and (6), and the cost of the intermediate bundle (11).

Export Shares Using goods market clearing and bilateral pricing decisions, total sales of tradeable products are $M_i p_i q_i$.

$$M_i p_i q_i = \sum_n M_i p_{ni} q_{ni}$$

In turn, using (28),

$$M_i p_i q_i = \sum_n \lambda_{ni} (P_n Q_n).$$

Using the pricing equation 6, and free entry conditions (8) and (7), we obtain that the value of total sales is

$$M_i p_i q_i = \frac{w_i L_i}{\beta_L} \tag{31}$$

Therefore, using (26), the share of exports from i that go to n is

$$s_{ni} = \frac{w_n L_n}{w_i L_i} \lambda_{ni}. \tag{32}$$

B.2 System in Relative Changes

Main System Suppose we have shocks $\left\{\hat{Z_{ni}}, \hat{V}_n, \hat{L}\right\}$ to the system of equilibrium equations in levels. Note that these shocks capture shocks to all the fundamentals and government spending. In particular:

$$\hat{Z_{ni}} = \left(\hat{A}_i^0 \left(\hat{r^X}\right)^{-\beta_K}\right)^{\sigma} \frac{\hat{\tau_{ni}}^{1-\sigma}}{\hat{F}_i}, \tag{33}$$

$$\hat{V}_n = \hat{U}_n \hat{H}_n^{1-\alpha_C^W}. \tag{34}$$

Then, in changes, the system of equilibrium conditions is given by:

$$1 = \sum_i \lambda_{ni} \hat{\lambda_{ni}} \text{ for all } n, \tag{35}$$

$$1 = \sum_n s_{ni} \hat{s_{ni}} \text{ for all } i, \tag{36}$$

where using (29) and (32), the changes in import and export shares are

$$\hat{\lambda_{ni}} = \hat{Z_{ni}} \hat{w}_i^{1-\sigma\beta_L} \hat{L}_i^{1+\gamma\sigma} \frac{\hat{P}_n^{\sigma-1}}{\hat{P}_i^{\sigma(1-\beta_L-\beta_K)}} \tag{37}$$

$$\hat{s_{ni}} = \frac{\hat{w}_n \hat{L_n}}{\hat{w}_i \hat{L}_i} \hat{\lambda_{ni}}. \tag{38}$$

Using (15), the change in the employment share is:

$$\hat{L_n} = \left(\frac{\hat{V}_n}{\hat{v^W}} \left(\frac{\hat{w}_n}{\hat{P}_n}\right)^{\alpha_C^W}\right)^{\frac{\varepsilon_W}{1+\varepsilon_W\left(1-\alpha_C^W\right)}} \hat{L}^{\frac{1}{1+\varepsilon_W\left(1-\alpha_C^W\right)}} \tag{39}$$

where $\hat{v^W}$ is pinned down by labor market clearing, which must clear independently for each country given we assume no international migration. Thus, slightly modifying notation to be more clear

$$\hat{L}_{Ban} = \sum_{i \in Ban} \frac{L_i}{L} \hat{L}_i \qquad \hat{L}_{Ind} = \sum_{i \in Ind} \frac{L_i}{L} \hat{L}_i \tag{40}$$

Replacing the import and export shares in the market clearing condition, we end up with a system in 3N+1 equations ((35), (36), (39) and (40)) in equal number of unknowns, $\left\{\hat{L_n}, \hat{P}_n, \hat{w}_n, \hat{v^W}\right\}$.

More Compact System To simplify the system note that from (39) we have

$$\hat{P}_n = \hat{w}_n \left(\frac{\hat{L_n}^{\frac{1}{\varepsilon_W}+\left(1-\alpha_C^W\right)}}{\hat{L}^{\frac{1}{\varepsilon_W}}} \frac{\hat{v^W}}{\hat{V}_n} \right)^{-\frac{1}{\alpha_C^W}} \tag{41}$$

Replacing into (37) we have:

$$\hat{\lambda_{ni}} = \hat{A_{ni}} \hat{w}_i^{1-\kappa_1} \hat{L}_i^{1-\kappa_2} \hat{w_n}^{\sigma-1} \hat{L_n}^{-\kappa_3} \left(\frac{\hat{v^W}}{\hat{L}^{\frac{1}{\varepsilon_W}}} \right)^{\frac{1-\sigma\left(\beta_L+\beta_K\right)}{\alpha_C^W}} \tag{42}$$

where

$$\kappa_1 = \sigma\left(1-\beta_K\right) \tag{43}$$

$$\kappa_2 = -\sigma\left[\gamma + \frac{1-\beta_L-\beta_K}{\alpha_C}\left(\frac{1}{\varepsilon_W}+1-\alpha_C^W\right)\right] \tag{44}$$

$$\kappa_3 = \frac{\sigma-1}{\alpha_C}\left(\frac{1}{\varepsilon_W}+1-\alpha_C^W\right) \tag{45}$$

and where the shock is summarized by

$$\hat{A_{ni}} \equiv \hat{Z_{ni}} \frac{\hat{V_n}^{\frac{\sigma-1}{\alpha_C^W}}}{\hat{V_i}^{\frac{\sigma\left(1-\beta_L-\beta_K\right)}{\alpha_C^W}}}. \tag{46}$$

In sum, combining (38) and (42) with (35) and (36), and letting

$$\hat{V^W} \equiv \left(\frac{\hat{v^W}}{\hat{L}^{\frac{1}{\varepsilon_W}}} \right)^{\frac{1-\sigma\left(\beta_L+\beta_K\right)}{\alpha_C^W}}, \tag{47}$$

we can write the equilibrium in changes as a system for $\left\{\hat{L}_i, \hat{w}_i, \hat{V^W}\right\}$ such that:

$$\hat{w_n}^{1-\sigma} \hat{L_n}^{\kappa_3} = \hat{V^W} \sum_i \lambda_{ni} \hat{A_{ni}} \hat{w}_i^{1-\kappa_1} \hat{L}_i^{1-\kappa_2} \text{ for all } n, \tag{48}$$

$$\hat{w_i}^{\kappa_1} \hat{L}_i^{\kappa_2} = \hat{V^W} \sum_n s_{ni} \hat{A_{ni}} \hat{w_n}^{\sigma} \hat{L_n}^{1-\kappa_3} \text{ for all } i, \tag{49}$$

and (40) hold. Note that we care about welfare $\hat{v^W}$, but we solve for the transformed variable $\hat{V^W}$ defined in (47).

B.3 Equilibrium Uniqueness

We map the conditions of the model to Allen et al. (2014). In our case,

$$X_{ni} = \left(\frac{1}{\beta_L} w_n L_n\right) Z_{ni} w_i^{1-\sigma\beta_L} L_i^{1+\gamma\sigma} \frac{P_n^{\sigma-1}}{P_i^{\sigma(1-\beta_L-\beta_K)}} \tag{50}$$

Using (14) and (15), bilateral trade flows can be written as

$$X_{ni} = K_{ni}\gamma_i\delta_n \tag{51}$$

where

$$K_{ni} = \frac{L^{\frac{\sigma(\beta_L+\beta_K)-1}{\varepsilon_W \alpha_C}}}{\beta_L} Z_{ni} V_n^{\frac{\sigma-1}{\alpha_C}} V_i^{-\frac{\sigma(1-\beta_L-\beta_K)}{\alpha_C}} \tag{52}$$

$$\gamma_i = w_i^{1-\kappa_1} L_i^{1-\kappa_2} \tag{53}$$

$$\delta_n = \left(v^W\right)^{-\frac{\sigma(\beta_L+\beta_K)-1}{\alpha_C}} w_n^{\sigma} L_n^{1-\kappa_3} \tag{54}$$

Conditions 1 to 3 from Allen et al. (2014) are therefore satisfied. In addition, using (31), total sales are:

$$\sum_n X_{ni} = \frac{w_i L_i}{\beta_L}.$$

Combining (53) and (54) we have

$$\sum_n X_{ni} \propto \gamma_i^{\frac{\sigma-(1-\kappa_3)}{\sigma(1-\kappa_2)-(1-\kappa_3)(1-\kappa_1)}} \delta_i^{\frac{\kappa_1-\kappa_2}{\sigma(1-\kappa_2)-(1-\kappa_3)(1-\kappa_1)}}.$$

As a result, applying Corollary 2, there is a unique solution to equilibrium system of equations if

$$\frac{\sigma-(1-\kappa_3)}{\sigma(1-\kappa_2)-(1-\kappa_3)(1-\kappa_1)} > 1, \tag{55}$$

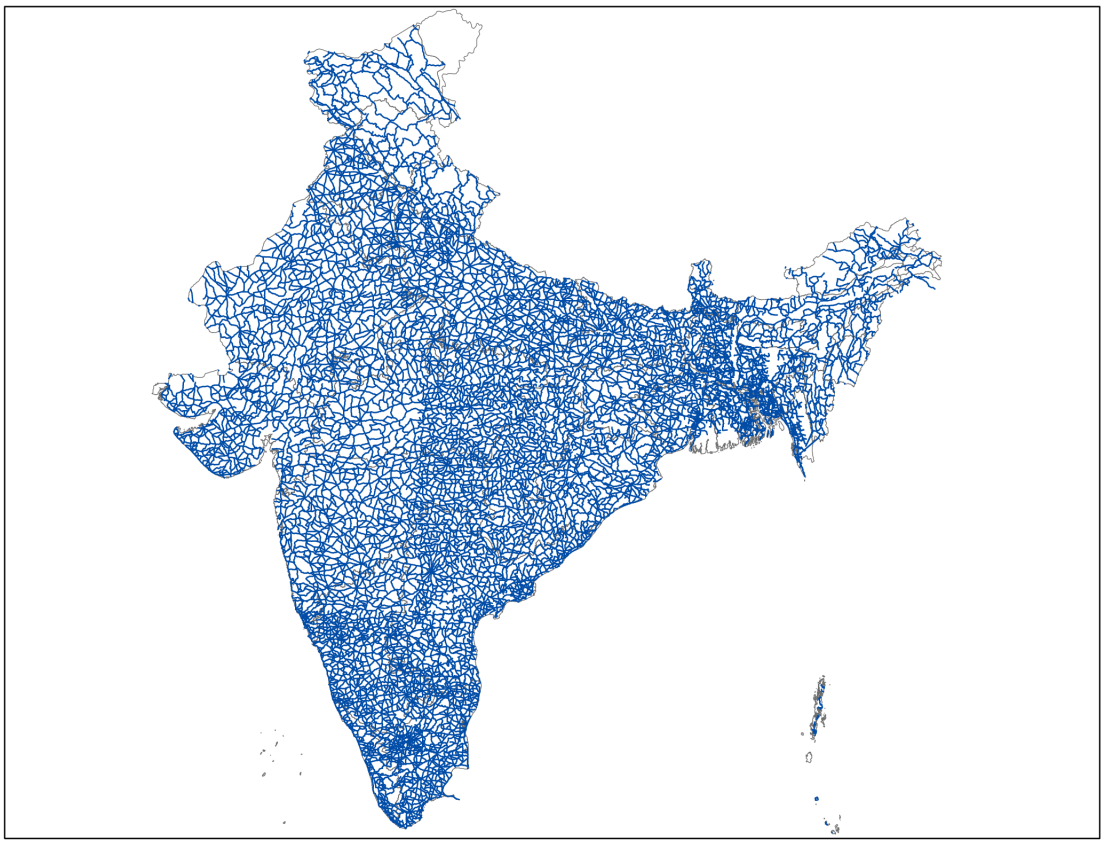
$$\frac{\kappa_1-\kappa_2}{\sigma(1-\kappa_2)-(1-\kappa_3)(1-\kappa_1)} > 1. \tag{56}$$

Both of these conditions are satisfied in our benchmark parametrization.

C Additional Figures

Figure 9 shows the road network used for our counterfactual exercises. In all our experiments, we consider only roads classified as part of the primary and secondary road network of each country.

Figure 9: Road Network



Notes: We consider only roads classified as part of the primary and secondary road network of each country.

D Construction of Actual and Counterfactual Travel Times

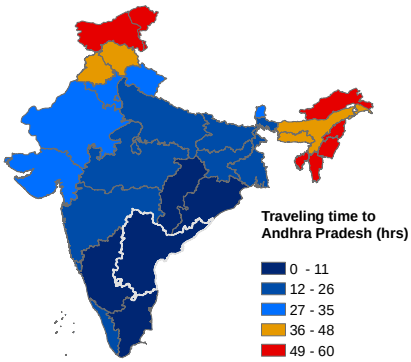
To construct the origin-destination matrix (OD matrix) containing the shortest route between any two regions[7] in our data, we used official GIS data of the route and highway

[7]Districts in the case of Bangladesh, and divisions for the Indian case.

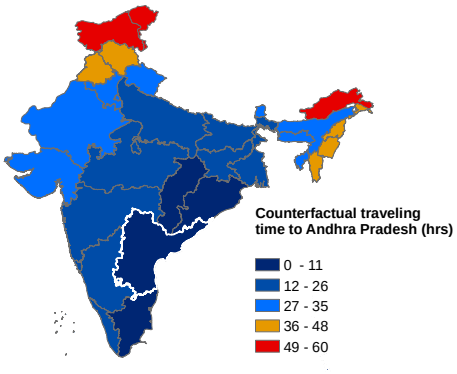
system in India and Bangladesh. Along with the road network, we have data on whether each segment of the network is a highway, and whether it is in a rural zone or not. The former allows us to weight each road-segment using the average speeds per district in each region. Using the speeds and distances, we can compute the time to travel on each segment of the network, which allows to compute the trade cost as a function of this weighted distance in our model.

To construct the counterfactual OD matrix used in each counterfactual exercise, we change the traveling times between 2 locations resulting from the additional routes outlined in the MVA. To illustrate, consider the traveling time needed to reach the region of Andhra Pradesh from any other region changes if Indians could use the Bangladeshi road network. This is represented by Figure 10, where some regions gain over 100 hours in traveling time as compared with routes going over the Indian road network only.

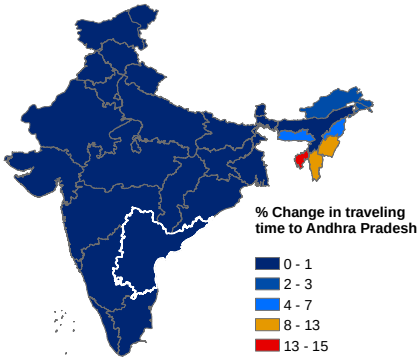
Figure 10: Example: Changes in Traveling Time to Andhra Pradesh



Actual traveling time



Counterfactual traveling time

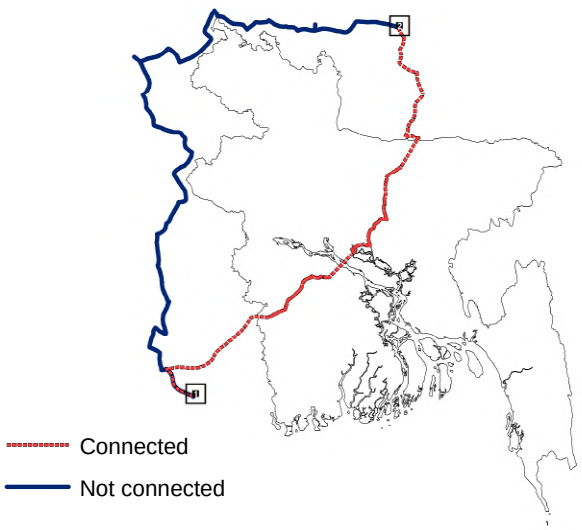


Change in traveling time

Notes: The figure shows the change in traveling time (in hours) from the population center of each location to the region of Andhra Pradesh (contoured in white) comparing the time required if using only the Indian road network, with the time required if using both the Indian and Bangladeshi road networks.

Another example is shown in Figure 11, where we indicate the shortest route to travel between 2 points in India through the Indian Road network (in blue), and through the connected Indian-Bangladeshi road network (in red) which is shorter.

Figure 11: Example: Connecting Both Road Networks



Notes: The figure shows the shortest route to travel between 2 points for cases where the Indian and Bangladeshi road networks are connected and disconnected.

Finally, to compute changes in the distance traveled, first, we find shortest route connecting any two districts[8] before the MVA, given the existing roads in India and the average speed per district by road type. This allows us to create an Origin-Destination (OD) matrix, with the traveling time between any 2 districts, given the network of roads and optimal routes between any two points. Then, we decrease the time to travel along by incorporating the routes outlined in the MVA to the existing Indian network; and we recompute the full OD matrix. Note that to obtain the relative changes in trade cost, $\hat{\tau_{ni}} = \frac{\tau'_{ni}}{\tau_{ni}}$, we can simply take the ratio between elements of the new OD matrix, and of the initial one.

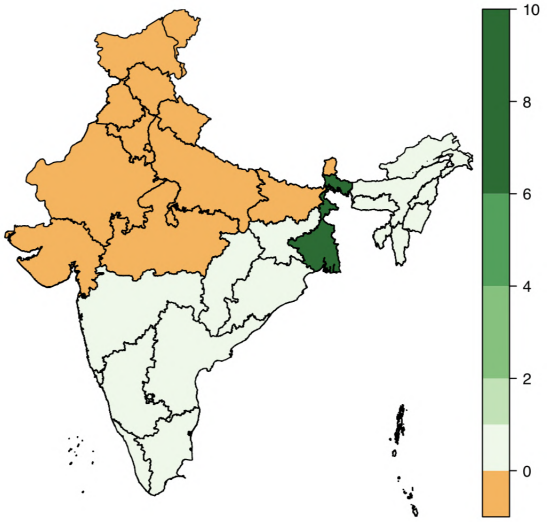
E The spatial effects from the MVA and regional integration

E.1 Change in transit

Labor, wage and price changes The detail of labor, wage and price changes is presented in Figures 12 and 13.

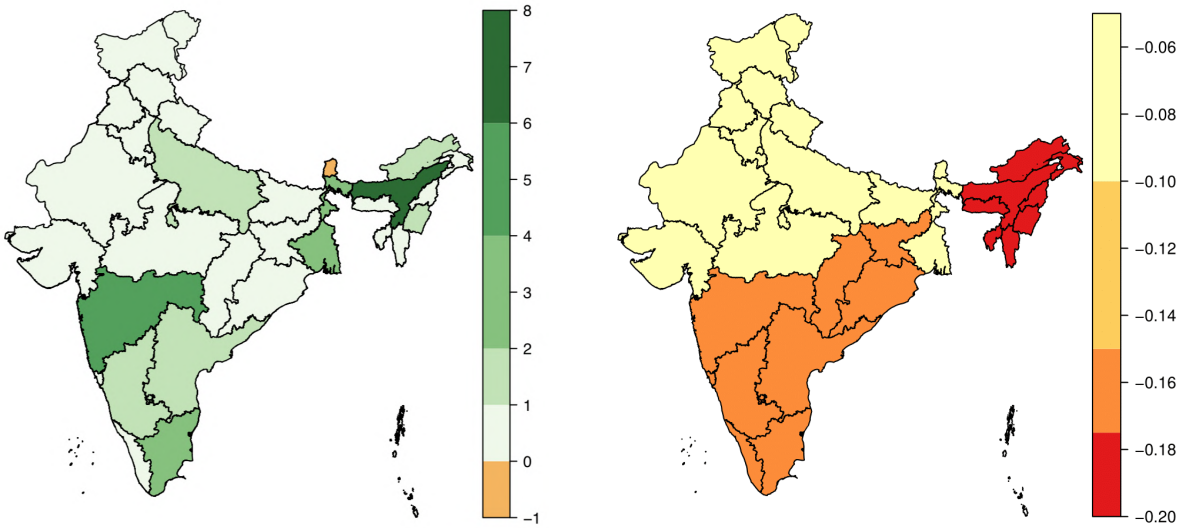
[8]To be more precise, connecting any two centroids of a pair of districts. We choose each centroid to be the most populated region within each region, i.e., a "population center".

Figure 12: Labor Changes in India



Notes: The figure shows the percentage change in labor in each region as a result of our counterfactual, as compared with their baseline levels.

Figure 13: Changes in Prices and Wages



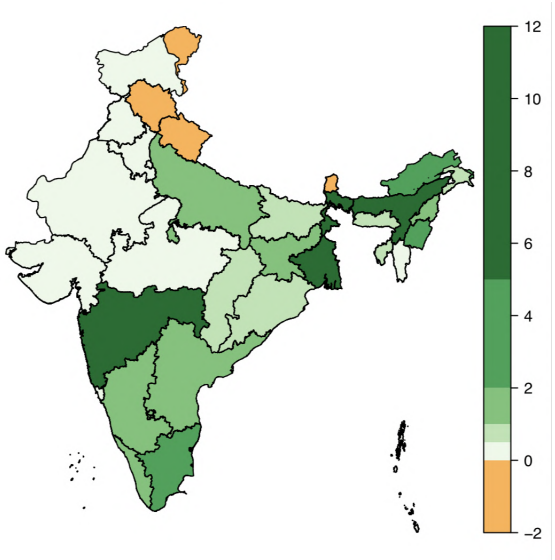
Wage Changes

Price Changes

Notes: The figure shows the percentage change in wages and prices in each region as a result of our counterfactual, as compared with their baseline levels.

Changes in Real GDP The detail of changes in real GDP is presented in Figure 14.

Figure 14: Changes in Real GDP

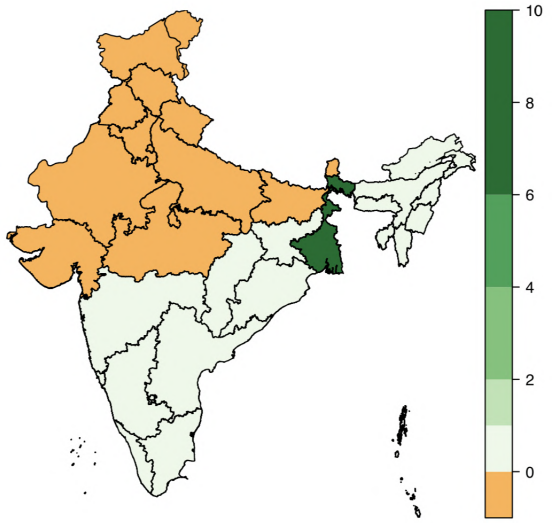


Notes: The figure shows the percentage change in real GDP (defined as wage bill over price) in each region as a result of our counterfactual, as compared with their baseline levels.

E.2 Counterfactual 2: One-Way Trade

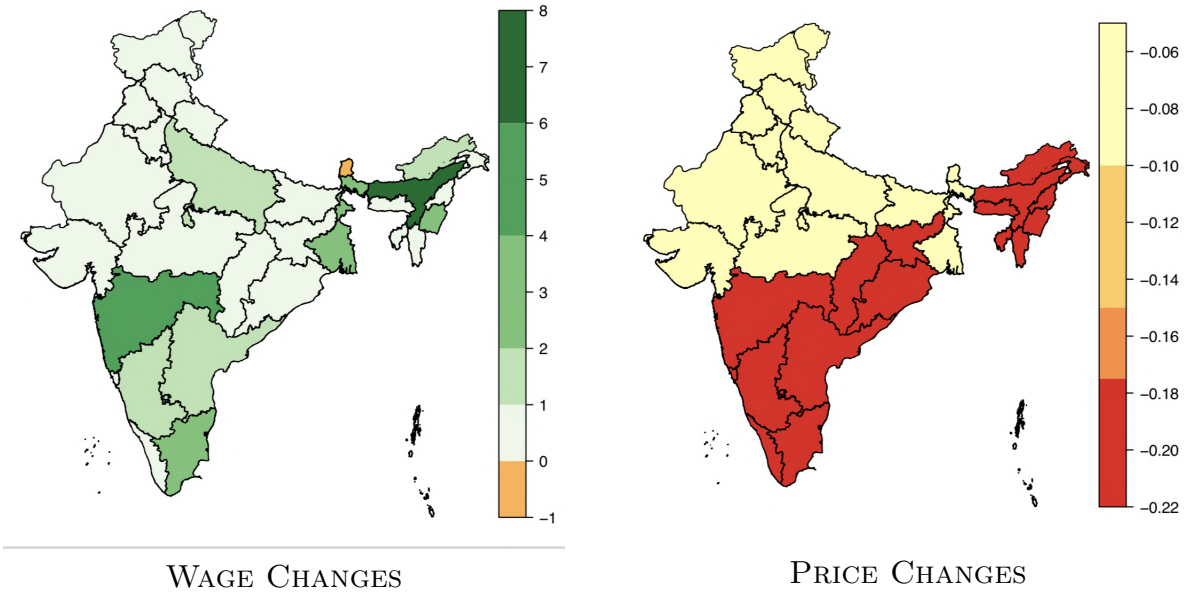
Labor, wage and price changes The detail of labor, wage and price changes is presented in Figures 15 and 16 , while changes in Bangladesh are presented in Figures 17 and 18.

Figure 15: Labor Changes in India



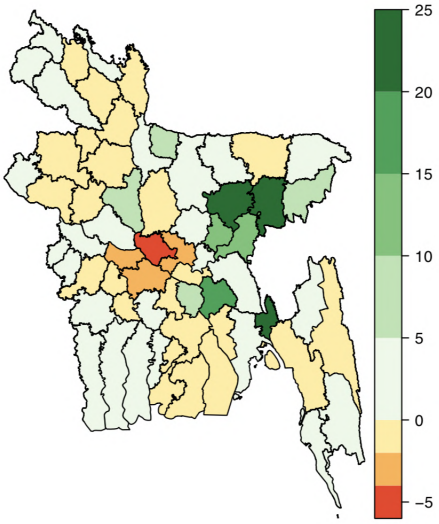
Notes: The figure shows the percentage change in labor in each region as a result of our counterfactual, as compared with their baseline levels.

Figure 16: Changes in Prices and Wages in India



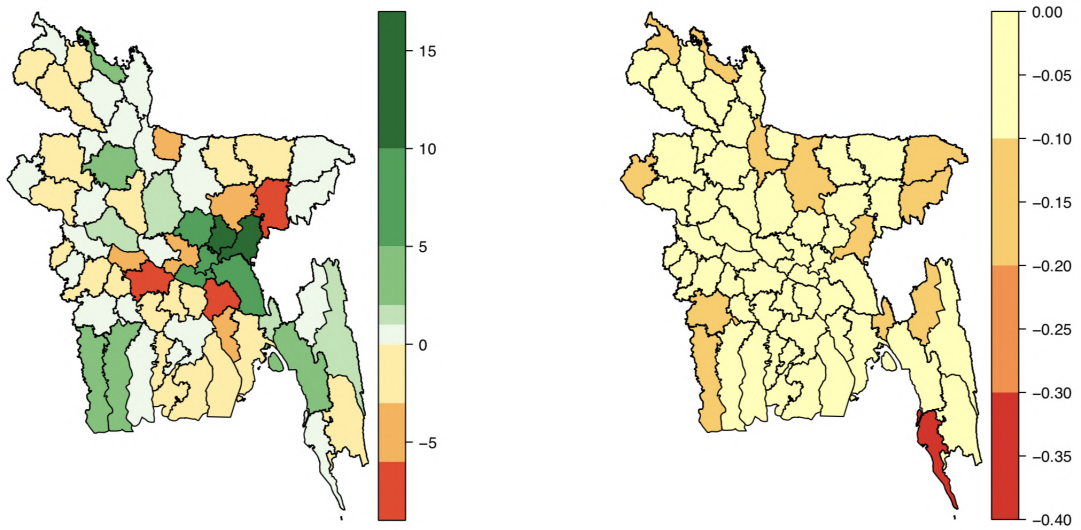
Notes: The figure shows the percentage change in wages and prices in each region as a result of our counterfactual, as compared with their baseline levels.

Figure 17: Labor Changes in Bangladesh



Notes: The figure shows the percentage change in labor in each region as a result of our counterfactual, as compared with their baseline levels. Ports of entry are shown in black.

Figure 18: Changes in Prices and Wages in Bangladesh

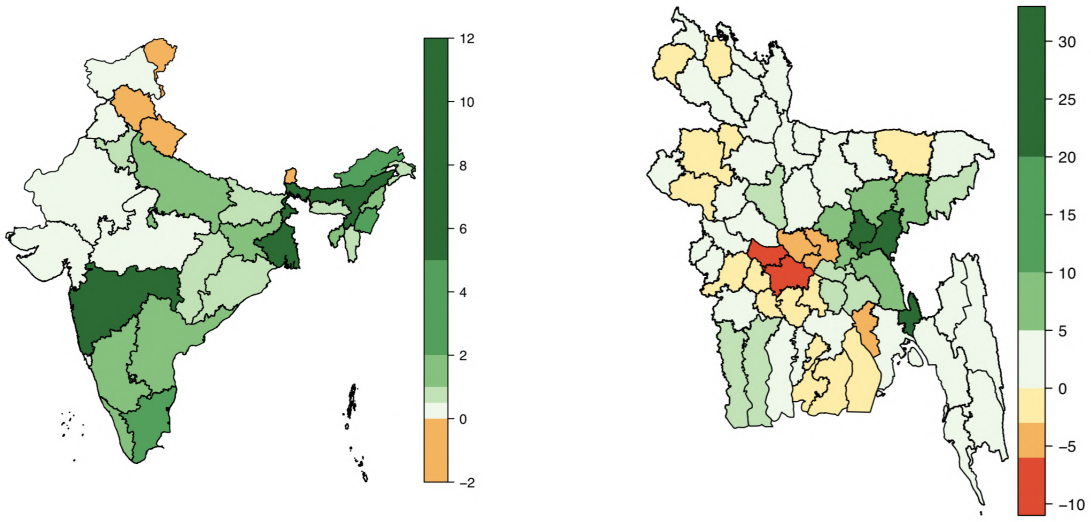


Wage Changes Price Changes

Notes: The figure shows the percentage change in wages and prices in each region as a result of our counterfactual, as compared with their baseline levels. Ports of entry are shown in black.

Changes in Real GDP The detail of changes in Real GDP in India is presented in Figure 4, while changes in Bangladesh are presented in Figure 19

Figure 19: Changes in Real GDP



Notes: The figure shows the percentage change in real GDP (defined as wage bill over price) in each region as a result of our counterfactual, as compared with their baseline levels.

E.3 Complete Integration

Labor, wage and price changes The detail of labor, wage and price changes is presented in Figures 20 and 21, while changes in Bangladesh are presented in Figures 22 and 20.

Figure 20: Labor Changes in India

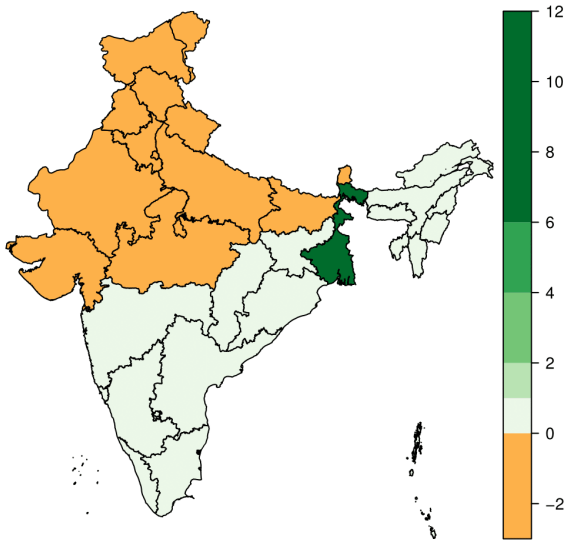
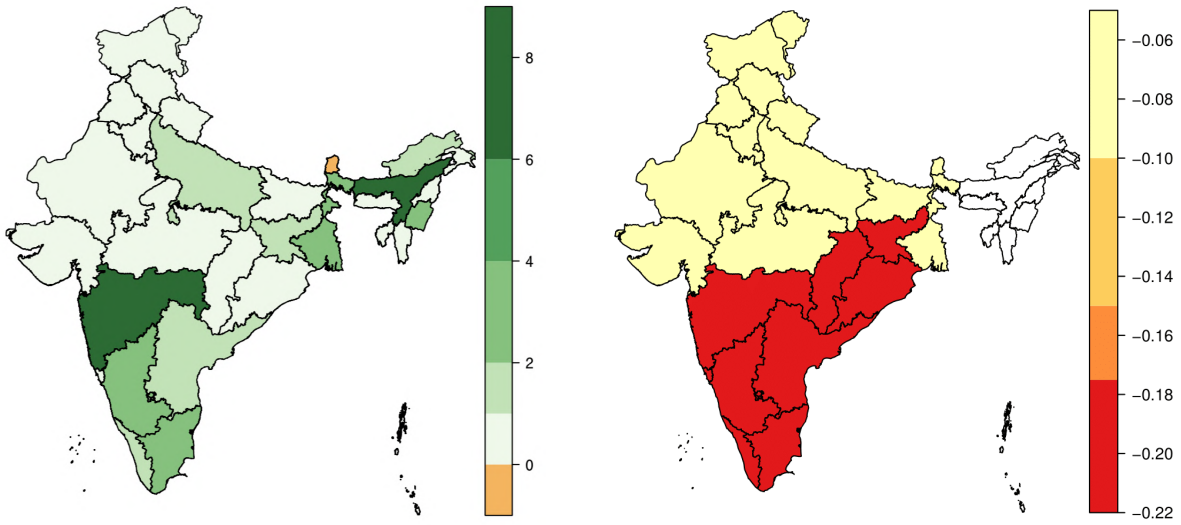


Figure 21: Changes in Prices and Wages in India

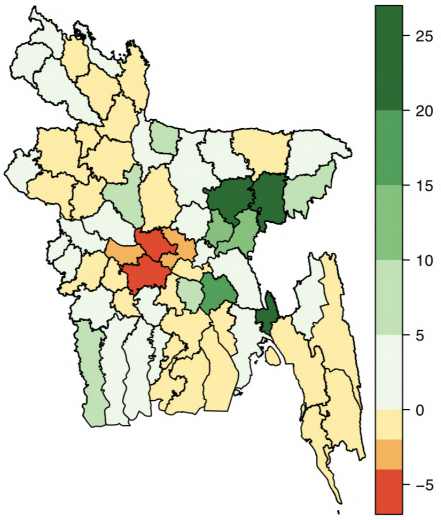


Wage Changes

Price Changes

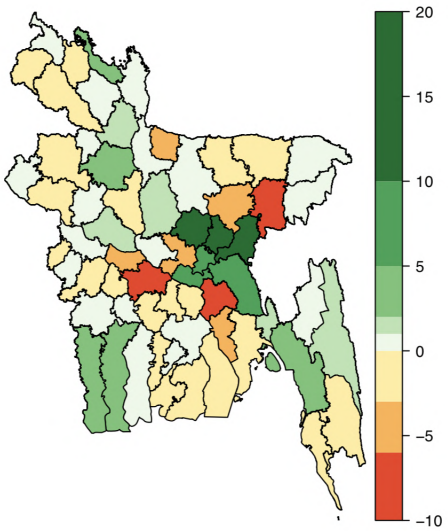
Notes: The figure shows the percentage change in wages and prices in each region as a result of our counterfactual, as compared with their baseline levels.

Figure 22: Labor Changes in Bangladesh

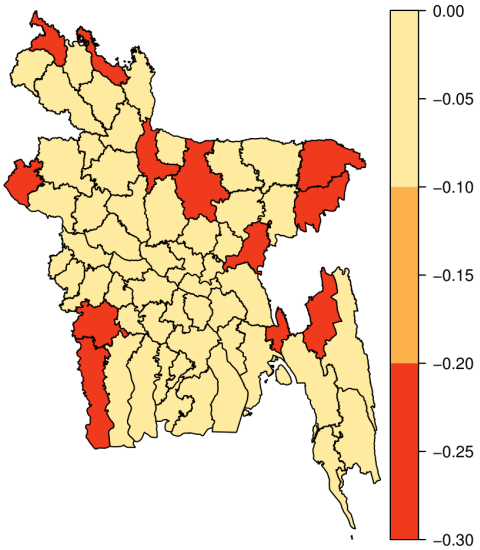


Notes: The figure shows the percentage change in labor in each region as a result of our counterfactual, as compared with their baseline levels. Ports of entry are shown in black.

Figure 23: Changes in Prices and Wages in Bangladesh



Wage Changes

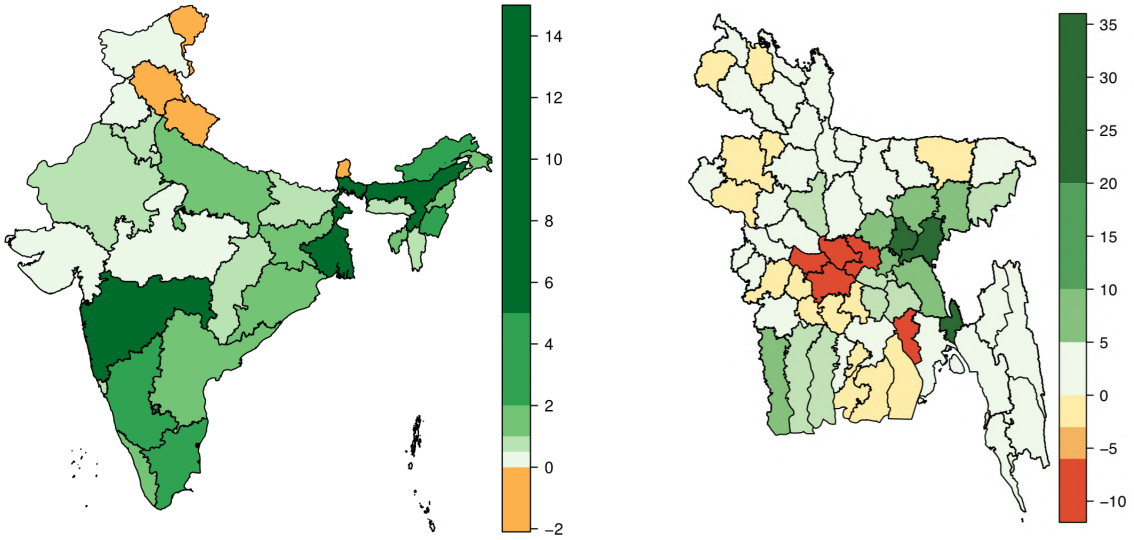


Price Changes

Notes: The figure shows the percentage change in wages and prices in each region as a result of our counterfactual, as compared with their baseline levels. Ports of entry are shown in black.

Changes in Real GDP The detail of changes in Real GDP is presented in Figure 24. The detail of the changes in Bangladesh is presented in Figure 24.

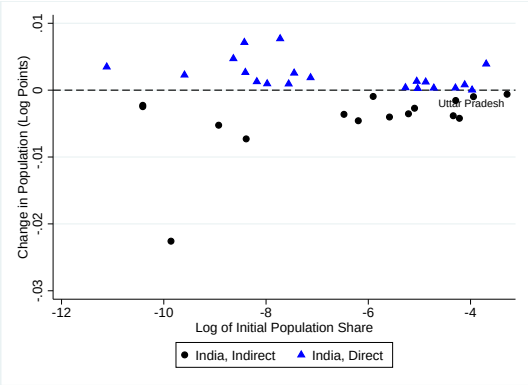
Figure 24: Changes in Real GDP in India



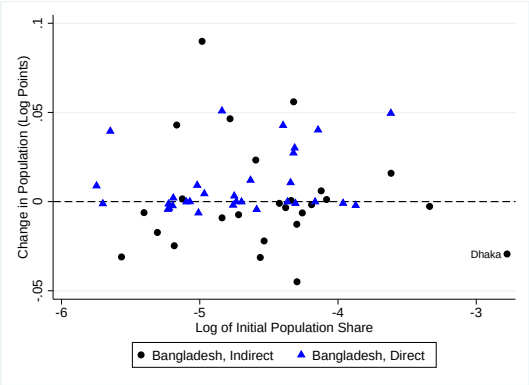
F Drivers of spatial effects

Figure 25: Initial size versus growth per region for complete integration

India



Bangladesh



Notes: The figure shows the change in population (in log points) plotted against the initial labor share, resulting from the most general counterfactual allowing for free transit and trade. Indian regions shocked directly are those for which the transport cost to other parts of India changed.

A simple regression can help us understand the relative contribution of the forces outlined above in the overall population changes. We consider the following regression:

$$\log(\hat{L}_i) = \beta_1 \log\left(\frac{\hat{w}_i}{\hat{P}_i}\right) + \beta_2 \log\left(\sum_n \hat{\tau}_{ni}\right) + \beta_3 \log\left(\frac{L_i}{L}\right) + \varepsilon_i. \tag{57}$$

That is, we regress the changes in populations in each region[9] with the changes in real wages, the change in total transport costs and the initial labor shares of that location.

Table 6: Labor Changes and Key Correlations

Dependent Variable: Log Labor Changes in each Location $\left(\log(\hat{L}_i)\right)$.

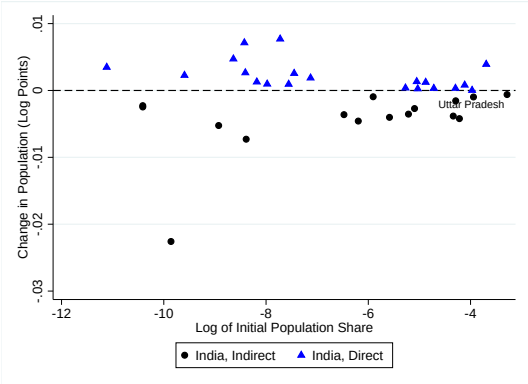
Log Variables	Elasticities
Δ Real wage $\left(\frac{\hat{w}_i}{\hat{P}_i}\right)$	0.07^{**}
	(0.003)
Δ Trade Costs $(\sum_n \hat{\tau}_{ni})$	-0.27^{***}
	(0.001)
Initial Labor Shares $\left(\frac{L_i}{L}\right)$	-0.10^{***}
	(0.002)
Robust SE	✓
Adj R^2	0.99

Notes: Table 6 reports the regression results when the dependent variable is the log change in population of each region. Independent variables are in logs. The table shows the results for the counterfactual where both transit and trade are allowed. In all cases, the number of observations equals 101. Robust SE are in parentheses. Significance levels: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

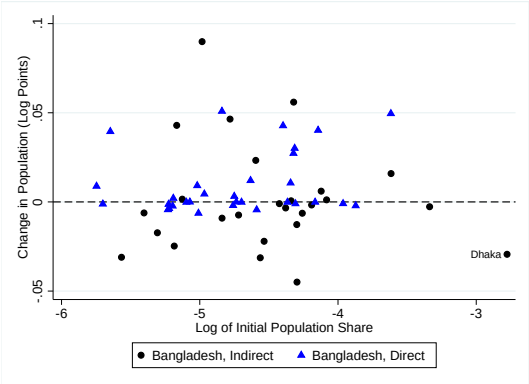
[9]Note that $\hat{x} = \frac{x'}{x}$ is never a negative number.

Figure 26: Initial size versus growth per region for complete integration

India



Bangladesh



Notes: The figure shows the change in population (in log points) plotted against the initial labor share, resulting from the most general counterfactual allowing for free transit and trade. Indian regions shocked directly are those for which the transport cost to other parts of India changed.