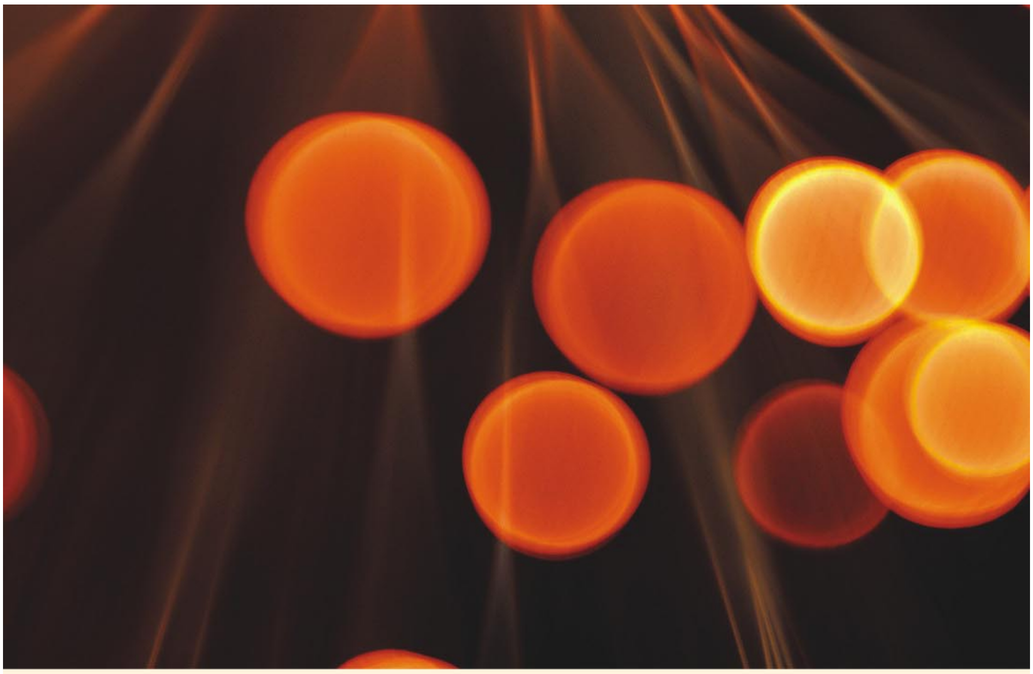

Globalisation, Domestic Market Integration and the Regional Disparities of India

Arne Melchior

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Contents

Abstract

Using a world trade model with India subdivided into states, the paper examines how regional disparities are affected by domestic inter-state trade as well as international trade. According to the analysis, international liberalisation promotes decentralisation and convergence, not divergence, so trade is not to blame for India's growing regional disparities. High economic growth within India makes domestic markets more important and the geographical effect of this is opposite to that of globalisation. This may counterbalance the geographical impact of international liberalisation and explain why recent changes in geographical clustering in India are limited. The empirical results are consistent with this. They also indicate that Indian services expansion is largely driven by increases in domestic demand due to growth and that domestic market integration is essential for India's manufacturing sector. We argue that, for larger nations, the domestic inter-regional trade is important and India should have a trade policy that addresses domestic as well as international market integration.

1
Introduction

While India's recent growth acceleration has contributed to poverty reduction, it has coincided with a significant increase in regional disparities and important states are still lagging behind, with low income levels and massive poverty. In 2006, the per capita income levels of the poorest Indian states (Bihar, Uttar Pradesh and Madhya Pradesh) were at 36-63 percent of the all-India average, while the richest states (Delhi, Goa and Chandigarh) were in the range 240-353 percent. The richest (Chandigarh) had ten times the income of the poorest (Bihar).

The increase in regional disparities is something that India shares with other emerging nations. For example, China experienced a similar increase until 2003 (Melchior 2010b). According to Williamson (1965), regional disparities tend to increase during the early stages of development and decrease thereafter. Brülhart and Sbergami (2009) find some support for this "U-shape" hypothesis and conclude that the turning point occurs at a per capita income level of about US$10,000.

A competing hypothesis is that regional divergence is related to globalisation: India's growth has occurred at the same time as a sharp increase in the country's openness to trade. From 1990 to 2008, imports of goods and services as a percentage of gross domestic product (GDP) increased from 8.6 to 28.0.[1] Hence, for India, increased openness and growing regional disparities coincided in time and some authors (e.g., Daumal 2010, see discussion in Section 2) have argued that there is a causal relationship: openness promotes inequality. From the literature in the field, however, it is neither theoretically clear nor empirically confirmed that increased openness will create more regional inequality. This ambiguity is confirmed in the recent survey of the literature by Brülhart (2010, see also Melchior 2009a), who concludes "Whether trade liberalisation raises or lowers regional inequality therefore depends on each country's specific geography".

This should not be misunderstood to say that the outcome is arbitrary or that theory has nothing to say: the point is that the analysis has to be sufficiently specific to account for the specific geography of a country (and its surroundings). Hence, we have to drop the common (and often implicit) assumption that openness should affect regional inequality in the same way in a variety of different situations.

For example, according to the new economic geography framework, one might expect more agglomeration for intermediate levels of trade costs. While this may be plausible as part of the general theory, it abstracts from the specific geography of countries and regions and along with, e.g., Bosker et al. (2010), also following the request for higher-dimensional modelling by Fujita and Mori (2005); see also Combes et al. (2008), we argue that it is necessary to "add geography to the new economic geography".

While two-region models are useful in order to examine general principles and model properties, we need an intermediate theoretical level with more specificity in order to link theory to empirical analysis. For this reason, multi-region models are necessary if we are to gauge the spatial impact of international trade for a particular country or region.

Melchior (2009a, b) shows that, for Europe, the impact of openness on regional patterns varies across different reforms.

For example, East-West integration has a different impact compared to the World Trade Organisation (WTO) liberalisation or reduction in transport costs. For China, growth has disproportionally benefited the coastal provinces and Melchior (2010b) shows that, in this case, it may indeed be the case that openness contributed to more regional inequality.

In order to examine the spatial impact of trade openness in India, our approach is, therefore, one of "geographical economics": We develop a world trade model with 166 countries and regions and simulate the impact of changes in trade costs. In this model, large countries, such as India and China, are subdivided into regions and we obtain predictions about how trade liberalisation affects regional disparities, that are later used to support the empirical analysis.

For the world, in general, and for India, in particular, an important message from recent research is that trade costs are high and include transport and distribution costs that are often much higher than tariffs and "political" trade obstacles (see, e.g., Irarrazabal et al. 2010 and Anderson and van Wincoop 2004).

In the analysis, we take into account infrastructure as well as standard trade policy barriers. A core message from the analysis is that, for India, trade costs due to bad roads may be as important as international trade tariffs and both have to be reduced in order to increase trade. For large countries such as India, inter-state trade is at least as important for welfare as international trade and, for this reason, India needs a trade and infrastructure policy that also addresses the country's domestic market and trade, and not only international trade.

The paper proceeds as follows: Section 2 presents up-to-date evidence on regional disparities in India and surveys some earlier research in the field. Section 3 motivates why inter-state trade in India should be part of the analytical framework and survey some relevant evidence concerning domestic trade barriers in India. Section 4 presents the theoretical framework, the simulation scenarios and the numerical modelling results. Section 5 presents data and compares simulation results with GDP growth as well as sector-level growth at the state level in India. Section 6 summarises main findings and implications. In Appendix A, more details of the model are presented.

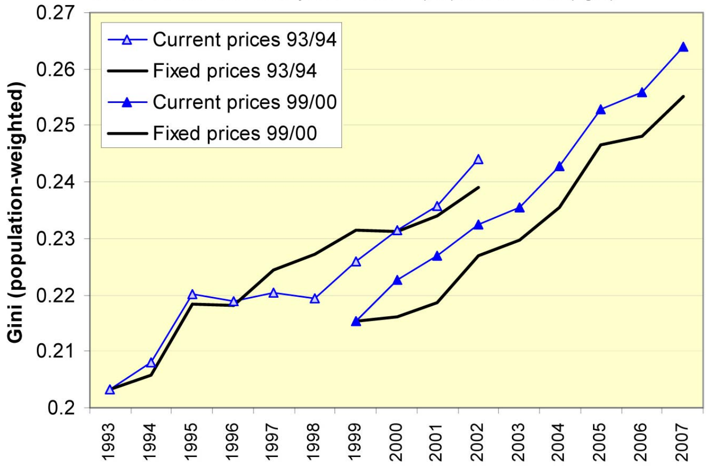
2

Regional Inequality, Openness and the Economic Geography of India: The Background

Along with faster economic growth, India's post-reform period after 1991 has featured accelerating regional disparities (see, e.g., Rao et al. 1999, Kurian 2000 and Sachs et al. 2002). Figure 1 shows population-weighted Gini coefficients in Gross State Domestic Product (GSDP) per capita across states for the period 1993-2007.[2]

Figure 1: Regional income inequality in India 1993-2007

Population weighted Gini coefficients for inequality in GSDP per capita across states, with base years 1993/94 (left) and 1999/00 (right)



Indian GSDP data are available with different base years and we show results using base years 1993-94 (for 1993-2002) and 1999-2000 (for 1999-2007). Observe that not only fixed-price results but also current-price calculations differ for the overlapping years 1999-2002 and we, therefore, do not mix data from the two series, but show them separately. We revert to these data challenges in Section 5.

The trend in regional inequality is unambiguous: there was a continuous increase from 0.20 in 1993-94 to 0.26 in 2007-08. In 2007, India was at the same level as China. Until recently, China was far ahead of India in terms of inter-provincial inequality, but with inequality after 2003 is falling in China (see Melchior 2010a) and still rising in India. However, the levels of regional inequality in the two giant nations were similar in 2007. Regional disparities in China are strongly related to a coastal-inland divide, with faster growth in south-east coastal provinces and can, therefore, be related to the coastal areas' advantages in terms of access to foreign markets (*Ibid*).

A similar coastal-inland divide may, to some extent, be observed in India. The colonial era promoted the development of ports such as Calcutta, Bombay and Madras (now Kolkata, Mumbai and Chennai), but during the post-colonial pre-reform period up to 1991, the so-called Freight Equalisation Policy of 1956 (see Chakravorty and Lall 2007) contributed to reducing spatial inequality in development. As part of India's reforms, these policies were abandoned. Chakravorty and Lall (2007) conclude that, during the post-reform period up to 1998, investment in India was disproportionately located in coastal areas. Hence, there is a coastal-inland issue for India. This is, however, by far not as strong and dominating as in China.[3] As a preliminary illustration using state-level data, Figure 2 shows per capita GSDP growth in fixed prices in Indian states during 1993-2007, using the same data source as above.

Figure 2: Growth Rates, GSDP Per Capita in Fixed Prices 1993-94 to 2007-08. Darker areas = higher growth.

Average annual growth rates in the diagram range from 2.6 percent (Madhya Pradesh) to 10.4 percent (Puducherry).[4] As seen from the diagram, some coastal areas had higher growth, but there was no unambiguous and strong coastal-inland divide. The economic geography of India may, therefore, be more complex than that of China and, in this paper, we search for mechanisms that could affect the spatial economic distribution.

India's trade openness increased from 20 percent in 1993 to 51 percent in 2008, measured as exports+imports of goods and services as a percentage of GDP.[5] After 1991, there was a substantial reduction in tariffs as well as non-tariff barriers for manufacturing (see, e.g., Das 2003). This fast increase in openness occurred simultaneously as the surge in regional inequality and an issue is, therefore, whether increased openness is a reason for larger inequality. Some authors have regressed measures of regional inequality on openness for India as a whole and concluded that there is a causal relationship.

Daumal (2010) uses data for 1980-2003, i.e. with only 24 observations, but using time-series econometric methods, she concludes that openness drives inequality. Milanovic (2005) obtains a similar conclusion using panel data for five countries, including India. The causal mechanism involved in these results is, however, not so clear. Is it because border regions grow faster; because openness interacts with the technological capacity or factor endowments of the regions; or what?

Since India's trade liberalisation has focused particularly on manufacturing, some authors have studied how trade liberalisation may affect regional inequality indirectly via manufacturing. Using state-level data for 1980-2000, Barua and Chakraborty (2010) found that regional inequality in GSDP per capita and manufacturing output were correlated and both increased until 1997. Bhattacharya et al. (2004) also find that manufacturing is an important driver of regional disparities. Aghion et al. (2008) arrive at a similar conclusion; with the qualification that liberalisation had a more positive impact on manufacturing output in pro-employer than in pro-worker states.

Mitra and Ural (2007) found that trade liberalisation led to increased productivity but the impact was more pronounced in states with more labour market flexibility. Some of these contributions support the view that liberalisation could create more regional inequality in manufacturing output and this could contribute to income inequality more generally. On the other hand, Mishra and Kumar (2005) found that trade liberalisation led to higher wages in sectors using more unskilled labour and this could contribute to less inequality. Hence, the evidence is ambiguous.

A problem in the study of openness and regional inequality in India is that state-level data on international trade do not yet exist. Some authors have tried to get around this problem by using state-level production data to construct proxies for state-level international trade. For example, if India is an exporter of clothing and a given state produces a higher share of clothing than the all-India average, one may assume that this state is a net exporter of clothing.

Using approaches along these lines, Marjit et al. (2007) as well as Barua and Chakraborty (2010) construct state-level indexes of trade openness. Marjit et al. (2007) find that open states have higher income. However, they do not establish a causal link between regional prosperity and trade, and conclude this is an important future research agenda. Barua and Chakraborty (2010) conclude that increased trade initially caused regional inequality in GDP as well as manufacturing, but this effect was dampened over time.

According to this brief survey, current evidence on the potential link between trade integration and regional inequality in India is partly contradictory, and far from conclusive. Many results are predominantly empirical in the sense that the exact causal mechanism from integration to regional inequality is not fully clear. The purpose of this paper is to provide a framework for analysis that makes these links clearer and present some new empirical evidence.

3
India: Inland vs International Trade

For a state in India, trade beyond its territory includes not only international trade but also domestic inter-state trade; in India often called *inland* trade. This basic feature of state-level openness is generally neglected in the literature, theoretically as well as empirically, and a purpose of this paper is to provide a new framework for analysis that includes domestic as well as international trade.

In the modern theory of international trade, it is common knowledge that firms in large markets and trade blocs may have an advantage due to their privileged access to the domestic or regional market. For this reason, domestic trade integration in large countries also promotes their performance in international markets (see, e.g., Martin and Rogers 1996). In the recent literature on firm-level exports, it has been shown that firms start by exporting to a few and often geographically close markets. For example, Eaton et al. (2008) show that small French firms often sell to one or two export markets and a major export destination is Belgium.

As shown by Ruhl and Willis (2008), new exporters start on a smaller scale and are more likely to exit than the more established exporters. In the context of India, the implication is that exports to neighbour states may serve as a platform to expand to new and more remote international markets at a later stage. For India, we argue that domestic trade should be part of the research perspective, and especially so if we focus on the impact of trade at the state level. Using model simulations, we will show that domestic and international trade can be complements or substitutes and the impact of trade strongly depends also on the inter-state trade component.

Inland trade is not only a statistical but also a political matter. As stated in 2003 by D. C. Pant, Deputy Chairman of India's Planning Commission: "It is ironic that during a period when as a nation we are embracing globalisation, we still persist with local protectionism. Unless we reverse this process decisively, a day may come when parts of our country become more closely integrated with the global economy than with their neighbouring States. This would place unbearable strain on the unity and integrity of our nation." [6]

When visiting India in 2004, Japan's foreign minister referred to statements from her industry saying that "shipping of goods from Japan to India took just two hours by air but takes up to 150 days to transport goods across state borders in India" (Tribune News Service, New Delhi, August 13, 2004).

In 2003, the cost of shipping a 20-feet container from Delhi to Mumbai was US$405, while from Mumbai to Singapore the cost was US$220. In this example, therefore, inland haulage costs accounted for 64 percent of the total transport cost of exporting goods.[7] In the research literature, the importance of inland transport costs has also been confirmed by De (2009).

How large is inter-state trade in India and how large is the international trade of each Indian state? In 2001, the government-appointed National Statistical Commission requested better statistics for inland trade as well as state-level exports (MOSPI 2001, Chapter 6). In 2009, the Directorate General of Commercial Intelligence and Statistics (DGCI&S) in Kolkata was still working to prepare such data, but it was uncertain when it would become available. For this reason, current evidence on state-level trade is still limited and indirect. Comparing to Europe, where intra-European trade has been a core issue for decades, it is a paradox that, for India, we essentially do not know much about it.

The presence of large income gaps within India suggests that the country is far from fully integrated. Labour migration is limited (see, e.g., Munshi and Rosenzweig 2009) and price disparities are still considerable (see, e.g., Deaton 2008) in spite of some recent convergence (Virmani and Mittal 2006, Das and Bhattacharya 2005). There are considerable inter-state differences in taxation that impede integration (see, e.g., Rao and Shah 2009). The planned General Sales Tax (GST) will replace the current Central Sales Tax on inter-state trade. The GST reform will go some way toward a common value added tax (VAT), but only partially, since important regulatory differences will remain.

According to Das-Gupta (2003), fiscal checkpoints still impede inter-state trade, but their fiscal role is still significant and their removal should, therefore, be part of a broader tax reform. Even if the so-called *octroi* (local sales tax at the municipal level for goods that enter into an area) has been abandoned in most states, it still exists and in the current planning of the GST, Maharashtra has refused to give up the octroi for fiscal reasons.[8]

Domestic trade costs in India also depend on infrastructure and the level of infrastructure varies strongly across Indian states (see, e.g., Barua and Chakraborty 2010, Kurian 2001 and Debroy and Bhandari 2002, pp. 23ff.). Conway et al. (2008) found that industry regulation varied considerably across Indian states and the more liberal and pro-competitive states were also more successful in infrastructure provision. Some studies indicate that weak infrastructure is a major bottleneck for manufacturing growth (Barua and Chakraborty 2010; Hulten et al. (2006); see also Panagaryia 2007).

According to Lall and Rastogi (2007), investment in infrastructure has not matched GDP growth after 1991, so its share in GDP has been falling. For this reason, there are doubts about whether India has invested sufficiently in infrastructure. While India developed her railway system at an early stage, the share of road transport in total freight volumes has increased from about 10 percent in the early 1950s to more than 60 percent today, with a further expected increase to 85 percent (Sriraman et al. 2006). The complexities of Indian road transport are described in Debroy and Kaushik (2002), including the various checks and taxes faced by the trucks passing though India.

For example, a truck ride from Calcutta to Chennai could take an estimated 143 hours, of which the moving time is only 38 percent. For the actual moving time, speed varies due to variable road quality and the incidence of congestion, for Calcutta-Chennai it was estimated to a modest 34 kilometres per hour. Conditions may have changed since then, but we have no more recent evidence. Substantial investments in infrastructure are planned, but it will take considerable time and resources to modernise the road and infrastructure system of India (Rastogi 2008).

Reducing trade costs is not only a matter of physical infrastructure such as roads and ports but also logistics in a wider sense. Severe limitations in India's transport and logistics systems were identified by Peters (1990) and although some of these have been remedied, others remain. India was a slow starter with respect to containerisation and since the early 1990s (see, e.g., World Bank 1994), there have been doubts as to whether infrastructure investments have been too small to keep up with increased demand for transport services. Efficient logistics can hardly be developed without strong private participation and a regulatory system that fosters competition and efficiency (rather than monopoly rents and inefficiency) is, therefore, vitally important.

According to Chandra and Jain (2007), transportation constitutes 40 percent of total logistics costs in India, with warehousing, packaging and losses (26 percent), inventory (24 percent) and order processing and administrative (10 percent) making up the rest. Warehousing is typically small-scale and low-tech, which is particularly detrimental to the food sector that – given the Indian climate – urgently needs cold chains.

On the whole, indirect evidence suggests that the extent of inter-state trade integration in India is limited by weak infrastructure and logistics, fiscal barriers and checkpoints, in addition to regulatory differences. The severity of the problem is, however, hard to assess and more data, research and knowledge are needed. In our further analysis, the extent of inter-state integration in India, therefore, deserves to be an important component. While still missing direct evidence on the magnitude of inland trade, the numerical model simulations will shed light on the role that such trade may play "behind the scene" and provide a new conceptual framework where inland and international trade are both included.

4
Model and Scenarios

For our "geographical economics" approach, we need a model which is tractable and has sufficient dimensionality. Modelling issues are discussed in greater detail in Melchior (2009a, 2010a) and we provide here an overview of some considerations underlying our model choice. Some of the algebra of the model is shown in Appendix A.

4.1 The Modelling Approach

A technical challenge with New Economic Geography (NEG) models is they generally have multiple equilibria. While this is tractable in two-region models, it is a greater challenge in multi-region models, where the number of potential equilibria may be daunting. Bosker et al. (2010) note that asymmetries in geography (region size, trade costs, etc.) may reduce the number of equilibria, but one can never know for sure "whether or not the equilibrium solution found is unique or not" *(Ibid., 802)*. A second challenge of the NEG approach is that the result is often "catastrophic agglomeration". For example, Bosker et al. (2010) simulate the impact of European integration and find that, with internationally mobile labour, all economic activity is concentrated in the Île-de-France region. In order to avoid these problems of the NEG approach in a multi-regional setting, we follow some other authors (see, e.g., Behrens et al. 2005, 2007) by taking one step back to the

New Trade Theory (NTT) approach, e.g., dropping ad hoc migration dynamics, and use a static trade model.

In models of the new trade theory (NTT) and the NEG, agglomeration mostly takes the form of specialisation in production: There is a "modern" or "manufacturing" sector with economies of scale and imperfect competition that is concentrated in the advantaged country or region (see, e.g., Krugman 1991, Krugman and Venables 1995). Behrens et al. (2005, 2007) and Melchior (2000) use a multilateralised version of Krugman's "home market effect" model in their modelling. This has a compact matrix form solution (see, e.g., Melchior 1996) and some analytical results are possible and for numerical simulation it is computationally simple.

There are two reasons why we do not follow this approach here, the first being that the standard assumption of sector diversification is problematic in a multi-region framework. In order to ensure factor price equalisation, all regions or countries have to produce a homogeneous "numeraire" good. As shown in Melchior (2000, 2009a), this is only sustainable for a limited range of parameter values and with multiple regions it implies a severe limitation of the analysis.

A second argument against the "home market effect model" is based on empirical research: Instead of factor price equalisation and sector agglomeration, we may empirically have less sector specialisation and more wage inequality. For India, the principle finding of Lall et al. (2003) is that industrial diversity is the only economic geography variable that positively affects the efficiency of firms across India's states. According to their results, growth is not fostered by spatial concentration of industries due to differences in market access. According to the authors (*Ibid*, 31) this "raises serious questions about the validity of much theorising on localisation economies". This strengthens the case for a model that does not rely on sector specialisation and agglomeration.

Already in Krugman (1980), however, it was observed that the advantage of better market access may show up in wage differences, rather than agglomeration of production, and the empirical survey of Head and Mayer (2004) suggests that the "wage version" of NTT/NEG models actually finds more support in the empirical literature. With this motivation, Melchior (2009a) develops a multi-region model where advantages of better market access show up in wage differences, rather than sector specialisation.

In Melchior (2009a, b) this "wage gap model" is used in the analysis of regional disparities in Europe. An advantage of the wage gap model is also that we do not have to handle the issue of complete specialisation, which may be a technical challenge in a multi-regional setting.

For the analysis of India (and China), we also face the problem that some regions have – internationally compared – extremely low wage and productivity levels. Comparing Uttar Pradesh with Germany without correcting for this difference could give the former too much of a "home market advantage". We, therefore, develop a modified model with the following characteristics:

- There are two factors of production; capital (K) and labour (L). We may think of K as human or physical capital. These factors are used in the production of two sectors.
- There is a traded sector with product differentiation, economies of scale and monopolistic competition, along the lines of standard NTT/NEG models, but with endogenous factor prices as in Markusen and Venables (2000).
- There is a non-traded sector with homogeneous goods or services. The assumption of no trade in this sector plays two roles: It eliminates any sector specialisation, so all trade is intra-industry and total trade for each country or region is balanced. For the non-traded sector, prices vary across

regions/countries, depending on factor endowments and prices.

We may think of this as a "modified Balassa-Samuelson model", referring to the standard model of international price differences based on Balassa (1964) and Samuelson (1964). The modification is that the traded sector has imperfect competition, so we add NTT/NEG effects on top of the "neoclassical" properties that follow from factor endowments. For this reason, prices for traded goods also differ across countries, even if trade costs are equal, contrary to the Balassa-Samuelson model.

Using the results of Caselli (2005), we find that empirically observed K/L ratios are very highly correlated with GDP per capita across countries and as an approximation, we, therefore, use data on GDP per capita (scaled) as a proxy for the K/L ratio. Missing data for the active working population, we use population as a proxy for the labour stock L. We thereby implicitly assume that the workforce has the same share of the population in all countries and regions, which is inaccurate but acceptable for the theoretical exercise to be undertaken here.

Given that per capita income varies strongly across regions and countries, the K/L ratios do as well. This creates large productivity differences across countries/regions: With the chosen model parameters, poor regions will have a "too small" capital stock and be less productive compared to the rich ones. We generally assume that the traded sector is more K-intensive than the non-traded sectors. Factor prices in each country or region are endogenous. The assumption of a non-traded sector simplifies the model considerably so we can solve explicitly and analytically for the quantity of production in the non-traded sector, the number of firms in the traded sector and the wage/capital rent ratio. What remain to be determined are the wage levels and the sales across markets for the traded sector. This is derived by means of numerical simulations. The model is well-behaved and we obtain a positive solution with sufficient accuracy. The model is technically documented in Appendix A and further in Melchior (2010).

For the analysis, the main parameters of interest are the factor prices of each region. In our base case, the model predicts wage levels that are 99.9 percent correlated with empirically observed GDP per capita. This is by assumption due to our method for calibration of K and L and the main determinants of factor prices are the factor stocks. Our interest lies, however, beyond this: We study the modification in factor prices and trade due to changes in market integration. In order to do so, we consider how factor prices, trade and welfare are changed in different scenarios, compared to a base case.

4.2 Scenarios and Trade Costs

If trade integration is to have a geographical impact across Indian states, a crucial distinction is between *spatial* and *non-spatial* trade costs. This distinction was known in the early gravity literature and was reintroduced more recently by Melchior (2000), Behrens et al. (2005, 2007) and also Bosker et al. (2010). Spatial trade costs depend on distance, whereas non-spatial trade costs do not. As an example of the former, we may think of road transports, where the fixed cost element is limited and the cost depends strongly on distance. At the other end of the scale, we may think of a tariff that is equal across trading partners and, therefore, has no spatial dimension. From this, we might think that transport costs are spatial and trade policy barriers non-spatial and, for the sake of language simplification, we may sometimes refer to the spatial trade costs as transport costs. This is partly appropriate, but not fully accurate.

For example, a larger part of the total transport cost for shipping is related to logistics and capital costs, so the distance gradient is weaker than for road transports. Trade policy barriers such as product standards may be more similar among neighbour countries and countries in a geographical region may be more integrated, thereby creating a spatial gradient also for trade policy costs. Hence, it is an empirical issue which trade costs are spatial and which are not. Our ambition here is not to sort out this empirically but to undertake stylised theoretical experiments where the various trade cost elements are changed *ad hoc*.

In the simulation model, we subdivide India, China, US and Russia into regions. The map is deliberately more detailed for Asia and more aggregated for other regions: For Africa and South America, which both have lower economic weight and are more remote, we reduce the number of units by merging some countries into country groups.[9] The country and region aggregation is shown in Appendix B. There are 166 countries/country groups/regions. For more discussion, see Melchior (2010), where the same model and country aggregation are applied.

For exports from an Indian state to another destination, we always include spatial as well as non-spatial trade costs. This applies also to exports to another Indian state: Non-spatial trade costs may then be thought of as non-geographical transaction costs related to trade, while the spatial element will reflect transport costs and other spatially dependent costs. We generally assume that the non-spatial trade cost within India, China, Russia and US is lower than the corresponding non-spatial international trade cost. We also take into account a number of regional trade blocs, where this "non-spatial" trade cost may be lower between participating countries. For technical simplicity, any trade cost is assumed to be a real trade cost and not a tax. Hence, in the model, there are no revenue effects.

The spatial trade cost is a function of distance d_{ij} between two units i and j. In order to avoid unduly large spatial trade costs for remote destinations, we use the exponential transformation $d_{ij}^{0.4}$ as the bases for calculating international spatial trade costs. We then scale this transformed distance variable up or down, usually with the assumption that the maximum trade costs should never exceed 100 percent.

We simulate six different scenarios, where trade costs are changed and we examine the impact across regions. In Table 1, we show the average level of trade costs faced by India's states in the different scenarios, differentiated into spatial and non-spatial, inter-state and international, trade costs. All figures are simple averages across Indian states. In the column to the far right, we also show the average total trade costs, including spatial as well as non-spatial trade costs in all markets. For each scenario, we have indicated in bold the component of trade costs that has been changed, compared to the base case scenario.

Table 1: Average Trade Costs for Indian States in Different Scenarios

Simple averages across states, in percent

Scenario	Spatial		Non-spatial		Total
	Inter-state	Inter-national	Inter-state	Inter-national	
	$f(d_{ij\text{-}India})$	$f(d_{ij})$	t_{India}	T	
Base case	17.4	31.6	15.0	40.0	65.0
Global village	8.7	15.8	15.0	40.0	50.4
WTO	17.4	31.6	15.0	20.0	48.3
Disintegration (spatial)	34.7	31.6	15.0	40.0	67.9
Disintegration (non-spatial)	17.4	31.6	30.0	40.0	67.5
Autarky	17.4	31.6	15.0	1040.0	895.3
Indian growth	As in base case				

In the base case, the exporters of India's provinces face on an average 65 percent trade barriers in their sales beyond the regional home market. In the light of WTO liberalisation such a figure may appear high, but recent research confirms that trade costs are generally quite high. For example, international trade costs are estimated at 35-45 percent by Irarrazabal et al. (2010) and 74 percent by Anderson and van Wincoop (2004). In this light, the level assumed in the model simulations appears plausible. It should nevertheless be added that this is a theoretical model where the purpose is to obtain knowledge about qualitative effects. Thus, what matters is the ranking across states and scenarios and not the absolute magnitude. Regarding the relative levels of the different trade cost components, our assumptions are ad hoc and a possible extension in future research might be to provide a better empirical underpinning.

The following scenarios are simulated:

- **Global village:** In this scenario, we assume that all the spatial or geographically dependent trade costs are cut by half. In this scenario, the world becomes smaller and distance matters less because the spatial component of trade costs is reduced, while the non-spatial component stays unchanged.
- **WTO:** In this scenario, the international non-spatial trade costs are cut by half. Trade costs within regional trade blocs, such as the EU, are expressed as a proportion of the international MFN (Most Favoured Nation) trade costs t and are, therefore, reduced proportionately. Trade costs within India, however, stay constant, so there is a relative reduction in international trade costs.
- In the light of section 2, we include two scenarios where domestic trade costs within India are increased, in order to demonstrate the impact of weaker inter-state trade integration. In the **spatial disintegration** scenario, transport

costs within India are doubled, while in the **non-spatial disintegration**, domestic non-spatial trade costs are doubled. For India as a whole, the impact of these two scenarios is very similar, but the geographical impact across states is different, so we, therefore, include both.

- In the **autarky** scenario, we increase international trade costs t by 1000 percent and thereby choke off almost all international trade. This scenario may shed light on the gradual opening of the Indian market during recent decades.
- Finally, we include an **Indian growth** scenario where the capital stock of all Indian states is increased by 50 percent. This is motivated by our experience from studies on China: High growth in countries such as China and India implies that the domestic market grows in importance and intra-national trade grows faster than international trade, due to a gravity effect (domestic regions are closer). This may lead to a fall in the share of international trade, which may incorrectly be taken as evidence of protectionism. Similarly, the share of domestic trade is affected by growth and a change in this share is not enough to draw conclusions about trade policy or the level of trade costs. In the real world, growth has not been proportional across states, but we use this assumption in order to show in a stylised way the impact of higher growth in India than elsewhere.

4.3 Simulation Results: Averages for India

A general observation from the results is that the common impact across all states is much stronger than the variation between them. This is a first hint that trade integration may not be the major driver of regional inequality. Beyond this common impact across states, however, there are differences across them that are at the focus of the study.

Considering the common general impact across states, Table 2 shows all-India average changes from the base case in different scenarios.

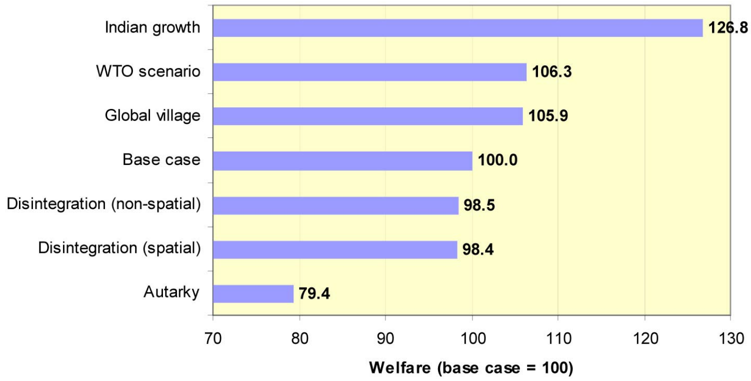
Table 2: Simulated Changes from Base Case to Other Scenarios: Simple Average across India's States

Scenario	Change in core variables (%)			Change in trade flows (%)		
	Wage	Price index	Welfare	Intra-regional	Intra-state	Intra-national
WTO	0.12	-9.94	6.55	-34	-34	9
Global village	0.10	-9.20	6.02	-32	-11	3
Disintegration (spatial)	-1.25	1.68	-1.74	11	-31	5
Disintegration (non-spat.)	-1.15	1.55	-1.60	10	-29	5
Autarky	-4.97	43.99	-22.05	404	375	-100
Indian growth	41.75	-4.34	26.61	82	82	32

The nominal wage change also corresponds to the nominal change in GDP and we observe that this is relatively small compared to the price index and welfare changes. Hence, the main driver of welfare changes is the price index changes, caused by changed factor prices and trade costs. Figure 3 shows the average welfare levels:

Table 2 and Figure 3 suggest that for income levels and welfare, trade is beneficial for India: Autarky is worst, domestic disintegration is bad and international trade integration through the WTO and Global village scenarios is considerably better. None of these scenarios, however, can match the growth scenarios in terms of income and welfare gains. The scaling is arbitrary and determined by *ad hoc* assumptions, but the comparison illustrates that investment in human and physical capital may be the most important driver of growth in India and may provide gains far beyond radical trade liberalisation. Hence, trade liberalisation is not a panacea for growth, even if it may have a positive impact.

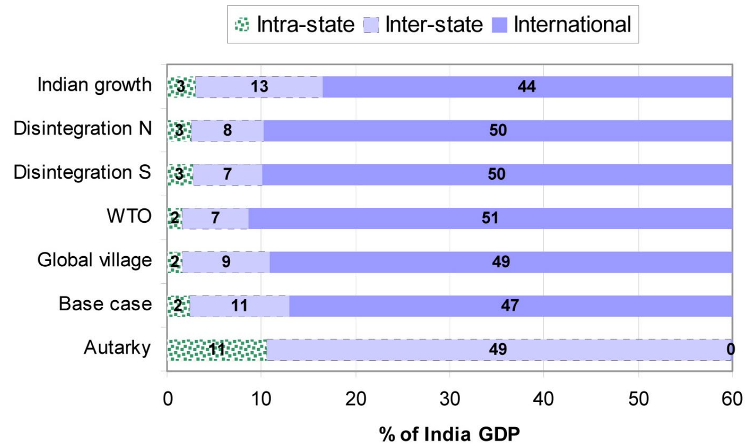
Figure 3: Welfare in different scenarios (base case = 100)
(population-weighted average across Indian states)



Each scenario corresponds to a specific pattern of trade flows between the 166 units in the simulation. Figure 4 shows the average composition of trade across Indian states, divided into local sales (within the state), inter-state trade (within India) and international trade. Regarding Figure 4, observe that the GDP share of the traded sector is by assumption set at 60 percent, so the bars in the diagram always add up to 60 percent. Trade shares are measured as imports/GDP and, since trade is balanced, the same share applies to exports/GDP.

In the base case scenario, a high 47 percent of India's output is internationally traded. The high GDP share for international trade in all scenarios, except autarky, may suggest that international trade costs for India might be even higher than applied here, or that other factors are at work that limit trade. For the purpose of simulating the qualitative effects theoretically, the model nevertheless provides an appropriate tool and we focus on the ranking across states and scenarios, rather than the absolute magnitudes.

Figure 4: Trade shares of GDP in different scenarios, aggregated for all Indian states, for the traded sector



India's domestic inter-state trade is a modest 11 percent of GDP in the base scenario, considerably lower than the shares predicted for, e.g., China (19 percent), but higher than for the vast territory of Russia (three percent). Thus, the low K/L ratio as well as small economic size (due to low income levels) reduce the proportion of domestic inter-state trade in GDP.

Using Table 2 and Figures 3-4, we may characterise the scenarios:

- Compared to the base case, autarky chokes off international trade, increases domestic (intra-state as well as inter-state) trade, cuts nominal wages and leads to a radical price increase and a corresponding welfare loss.
- International trade integration, in the form of MFN-type liberalisation (the WTO scenario) or reduced transport costs (the Global village scenario), boosts international trade and cuts the price level. Nominal wages are only modestly affected, so the welfare gains are mainly caused by lower prices. Both scenarios reduce intra-state sales considerably. In the WTO scenario, inter-state trade also falls sharply,

but this reduction is weaker in the Global village scenario, where domestic transport costs are also reduced and contribute to better inter-state integration.

- In the disintegration scenarios, inter-state trade is considerably reduced, but the negative welfare impact is limited due to the modest share of inter-state trade. A nominal wage reduction and higher prices nevertheless result in a significant welfare loss.
- The growth scenario leads to an increase in all three forms of trade, but weaker for international trade, so its share of GDP falls to a level far below the base case. The capital stock growth boosts nominal wages, but due to a higher number of firms, the price level falls due to increased diversity and intensified inter-state trade. The overall result is a strong welfare gain.

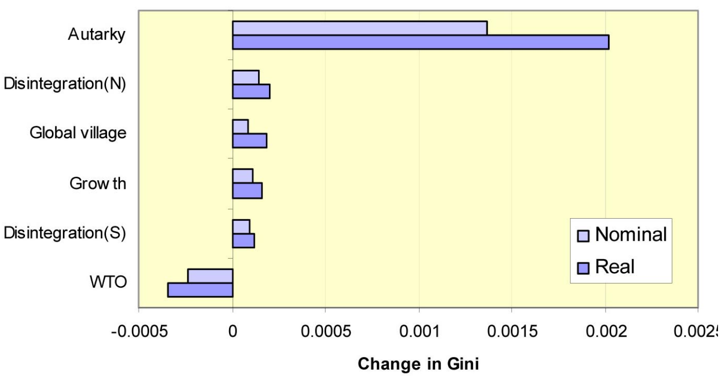
Observe the similarity between autarky and the growth scenario with respect to trade shares: In spite of their totally opposite impact on welfare, both scenarios lead to an increase in the share of domestic sales. In the following section, we will see that the similarity applies not only to the all-India average results, but also to the differential impact across states.

4.4 Simulation Results: The Economic Geography of India's States

Using the simulation results, we are finally able to shed some light on the issue about integration and regional disparities. As a first macro-check, we may calculate population-weighted Ginis for regional inequality as in Figure 1, but now using the simulation results. Figure 5 shows the results.

Observing that the simulated nominal Gini is about 0.22, these changes in the level of inequality are very small. Only the autarky scenario actually produces a significant change, suggesting that a passage from autarky to trade should generally lead to reduced inequality. Other changes are very small and suggest that increased trade integration can hardly be a main cause of increased regional disparities in India.

Figure 5: Regional inequality in India: Simulated changes in Gini coefficient from base case



Even if regional inequality is not changed much, there may be changes in the geographical distribution of income across states. In the following section, we use maps to show how these patterns change. Figure 6 shows welfare changes due to a change from the base case to autarky.[10] In Appendix C, we show the underlying figures (welfare levels in all scenarios).

While there is a substantial welfare loss for all states, the welfare reduction is weaker in the darker North-South belt, which is relatively better off in autarky, compared to the peripheral states in the North-West and North-East, which lose more from the elimination of international trade.

For empirical analysis it is important to observe that the spatial patterns in different scenarios are, to a considerable extent, correlated, negatively or positively. Table 3 shows the correlations between welfare level changes in different scenarios.

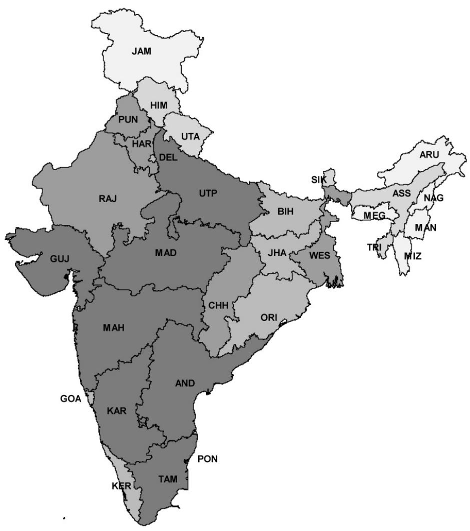


Figure 6: From base case to autarky: Simulated changes in welfare across India's states. Darker = higher values (i.e., less welfare reduction).

Table 3: Correlation between Predicted Welfare Changes from Case Case in Different Simulation Scenarios

		Disint-N	Disint-S	Growth	Village	WTO
Autarky	Correlation	0.294	0.927	0.999	-0.562	-0.970
	P-value	0.1083	<.0001	<.0001	0.001	<.0001
Disintegration - non-spatial	Correlation	1	0.471	0.310	-0.366	-0.214
	P-value		0.0075	0.0894	0.0431	0.2468
Disintegration - spatial	Correlation		1	0.930	-0.802	-0.82
	P-value			<.0001	<.0001	<.0001
Growth	Correlation			1	-0.565	-0.970
	P-value				0.0009	<.0001
Global village	Correlation				1	0.354
	P-value					0.0506

The autarky scenario, shown in Figure 6, is highly, positively and significantly correlated with the growth scenario as well as the spatial disintegration scenarios. In all these three cases, we obtain a pattern similar to the one shown in Figure 6. In the case of growth, the reason is that growth makes the domestic market more important and, therefore, benefits areas located more closely to India's economic "centre of gravity".

The peripheral Indian regions, however, are better off with international trade and autarky is, therefore, highly and significantly correlated with the WTO and (to a somewhat lesser extent) the Global village scenarios, however, this time negatively. Figure 7 shows the welfare changes in the WTO scenario.

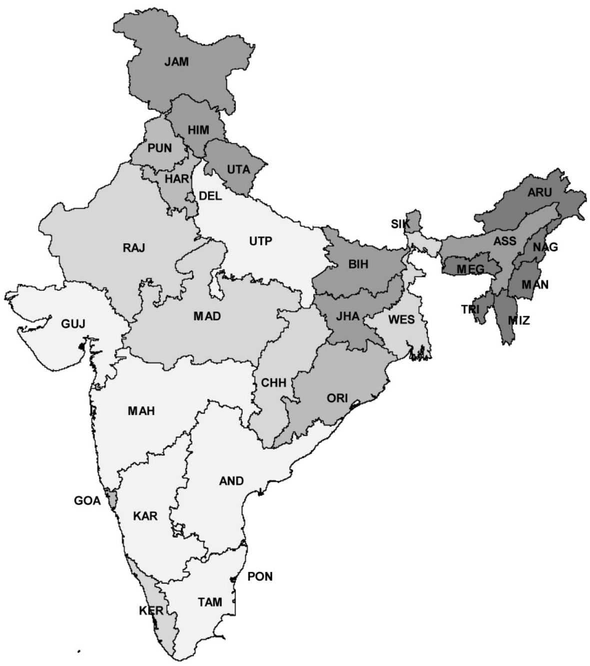


Figure 7: From base case to non-spatial international trade liberalisation (the WTO scenario): Simulated changes in welfare across India's states. Darker = higher welfare gain.

Hence, the impact of WTO-type liberalisation is a mirror image of Figure 6 for autarky, promoting the peripheral regions in the North-West and North-East. This is also the reason why autarky leads to more regional inequality, while the WTO scenario works in the opposite direction.

The spatial impact under the global village is significantly, but not very strongly, correlated with WTO and the spatial impact is, therefore, different, as shown in Figure 8.

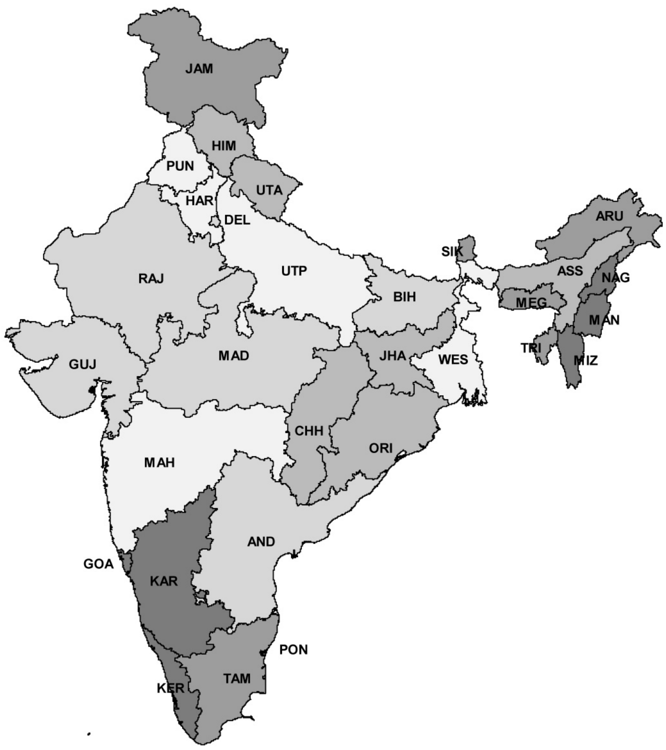


Figure 8: From base case to spatial international trade liberalisation (the Global village scenario): Simulated changes in welfare across India's states. Darker = higher welfare gain.

Spatial liberalisation also benefits South India to a larger extent and renders a mainly triangular pattern, with higher growth in all the three corners of the Indian triangle.

Thus, we have derived two partly overlapping, but distinct, patterns of spatial change; one corresponding to Figures 6 and 7, which we may call the "Central Cone" pattern and another corresponding to Figure 8, which we may call the "triangular" pattern. Neither of these two patterns has a very articulated coastal-inland divide.

Among the two disintegration scenarios, spatial disintegration has an economic geography impact that resembles the autarky case. The case with non-spatial disintegration, however, stands out as the one that has the lowest correlation with other scenarios. This is shown in Figure 9.

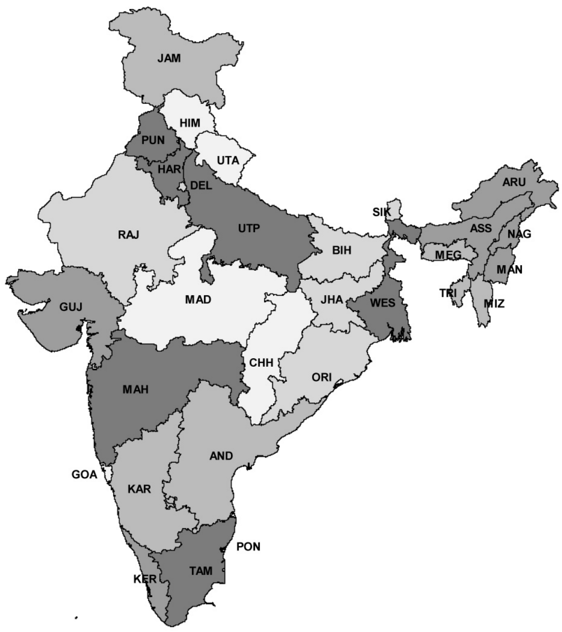


Figure 9: From base case to non-spatial trade disintegration in India: Simulated changes in welfare across India's states. Darker = smaller welfare losses.

Non-spatial trade disintegration tends to break up India into different spatial clusters with higher income levels, almost like a chessboard pattern. This represents a third pattern of spatial change, distinct from the two former, which we may call the "Fragmentation" pattern.

Summing up, the model simulations suggest that trade integration is hardly the reason behind India's recent increase in regional disparities: The impact of trade reforms on overall regional inequality is small, and to the extent there is an impact, more international trade should lead to convergence rather than divergence. In the analysis, we have derived three distinct patterns of spatial change: the "Central Cone", "Triangular" and "Fragmentation" patterns. In the following section, we shall see if any of these are present in the actual regional development of India.

5
Empirical Evidence

Even if the scenarios do not explain the increased regional disparities in India, it may still be the case that they explain spatial changes. As noted by Bosker et al. (2010), the same level of overall inequality may correspond to very different spatial patterns. For example, if economic mass is transferred from west to east or from north to south, this could hypothetically leave overall inequality unchanged, even if there were considerable changes in the pattern of economic geography. In the following, we will examine statistically whether simulations can shed light on the growth pattern observed in Figure 2.

In the analysis, we face two main problems. The first is related to data and we include a brief cautionary note on the problems involved. A second challenge is that while simulations may purify one mechanism at the time, real life is more complex and it may be the case that there is a dose of all the different scenarios. Indeed, that will be a main conclusion: There is not one strong and dominating spatial pattern in India's development and, therefore, not a very articulated change in its economic geography.

5.1 The Data

In Figure 2, we observed that for state-level data on GDP, or GSDP, there is a discontinuity from data using 1993-94 as the base year to those using 1999-2000. In fixed prices, there should indeed be a discontinuity, but also the nominal data show a jump from the old to the new series, with a significant increase for some sectors. Table 4 shows the change in nominal values for the overlapping years 1999-2000-2002-03. For these four years, we have data for 32 states and thereby 4x32=128 observations in each of the two series. In the Table, the unweighted average is the simple average of percentage changes from old to new data across these 2x128 observations, which indicates how a regression analysis with state-level data could be affected. The weighted average is obtained by summing all the 128 values in the old and new series and calculating the ratio between the two aggregates. This takes into account the size of each state and provides an indication of how all-India totals would be affected.

Table 4: Change from Old to New Data in India's Data on GDP by Sector at the State Level, at current Prices for 1999-2000 to 2002-03

	Change from old to new series (% change)	
	Unweighted	Weighted
State GDP (total)	5.82	5.09
Selected sectors		
Agriculture	2.40	3.41
Manufacturing	0.00	-3.83
Services	10.41	9.37
- Banking and insurance	2.67	-12.07
- Transport, storage and communication	6.97	8.81
- Trade, hotels and restaurants	9.52	11.89
- Real estate, ownership of dwellings and business services	19.32	28.37
- Public administration	4.70	5.50

Hence, with the new data, there is a five-percent jump in nominal GDP and a 10-percent increase for services. For real estate and business services, the increase was at 19-28 percent. For agriculture and manufacturing, the change was more modest and there was even a reduction for manufacturing, if we use the weighted average.

This data problem is not only related to sectors but also states: For GSDP, the increase ranges from +19 percent (Bihar) to -14 percent (Goa). It is evident that a span of 33 percent (from -14 to +19) could severely affect results where growth is compared across states. Seven states had increases above 10 percent (Bihar, Uttaranchal, Assam, Himachal Pradesh, Chandigarh, Jammu & Kashmir, Orissa and Punjab). At the other end, seven states had increases of less than two percent.

The reason underlying this discontinuity in data is most likely that technical methods and data collection practices change over time. Similar discrepancies between the 1993-94 series and the older series using 1980-81 as the base year were observed by Bhattacharya and Sakthivel (2004). Whatever the reason, an implication is that there is measurement error in the time series and data from different series are not comparable.

Our approach to this problem is to undertake all statistical checks using three different data sets: (i) data for 1993-2002 using the old series; (ii) data for 1999-2007 using the new series; and (iii) a combined series for 1993-2007 where deflators for the overlapping years 2000-01 to 2002-03 are average deflators from each series. Hence, series (iii) involved the data problem we have described, so we use series (i) and (ii) as a control that results are not spurious. In regressions for GSDP, we also include a variable reflecting the data change.[11] In spite of such checks, however, we cannot change the data and if the data jump reflects that the old series was wrong, it cannot be remedied.

A second potential measurement error relates to population data. Counting the 1.2 billion people in India is no easy undertaking and there is some uncertainty about data, especially for years between the censuses. The last census in India was in 2001 and a new one is planned for 2011 (see www.censusindia.gov.in). For the years between 2001 and 2007-08, we have used official estimates provided by Indian authorities, but there is nevertheless an uncertainty about these until the new census becomes available. Before that, there is no possibility of doing anything about possible errors that affect the per capita income estimates.

In India's recent growth, the services sector has played a prominent role (see e.g., Bhattacharya and Sakthivel 2004). Bosworth et al. (2007) emphasise that there is also uncertainty about price measurement for services. Together with the data problems described here, the implication is that considerable caution is needed about possible data inconsistencies that might affect the conclusions.

5.2 Do the Simulations Explain Actually Observed Growth?

While simulations may focus on one shock at a time, several scenarios are likely to be relevant in the real development for India:

- The transition from autarky to trade should be relevant for the major trade reforms in 1991 and after. Some of these reforms were implemented during the period covered by our data (1993 onwards) and in this period there could also be a lagged adjustment to reforms undertaken in 1991.
- The results of the Uruguay Round of the WTO (World Trade Organisation) were implemented from 1995 and the WTO scenario could be relevant for this.
- During the 1993-2007 period, there has been an effort in India to improve inter-state integration by means of

infrastructure development, removal of the octroi and harmonisation of other taxes or regulations. The disintegration scenarios should be relevant for this.

- Given the faster growth in India since the 1990s, the growth scenario is certainly also relevant.
- Finally, the Global village scenario could be relevant, to the extent that national and international transport costs or other spatial costs have been reduced. In particular, the ICT (Information and Communication Technology) revolution has occurred during this period and reduced the cost of seller-customer contact and logistics.

From the simulations, we have seen that some of the scenarios are similar in terms of their spatial effect and we have loosely grouped them in three patterns: the "southern cone", "triangular" and "fragmentation" images. For this reason, e.g., a transition from autarky to trade might not only be negatively correlated with the predicted changes in the autarky scenario but also negatively correlated with the growth and spatial disintegration scenarios and positively correlated with predicted changes in the WTO scenario! Based on our assessment of relevance, Table 5 summarises the correlations we might expect:

Table 5: Expected Correlations between Actual Growth and Model Simulations

Note: Assessments of strength of effects are based on correlations in Table 3.

Actual event	Scenarios (predicted changes)					
	Central Cone			Inter-mediate Disinteg. (S)	Trian-gular Global village	Fragmen-tation Disinteg. (N)
	Autarky	Growth	WTO			
From autarky to trade	---	---	+++	--	-	
WTO liberalisation	---	---	+++	--	+	--
Indian integration	--	--	++	---	++	--
Indian growth	+++	+++	---	++	--	+
ICT revolution etc.	--	--	+	--	+++	-
Combined effect (assessment)	?	?	?	-	+(?)	?

For the three "central cone" scenarios, Indian growth has an opposite effect, compared to the other actual events, so the overall impact is uncertain. This also applies to the remaining three scenarios, but the correlation with growth is weaker for the global village and spatial disintegration scenarios, so for these, we have an unambiguous expectation about the overall impact, which should be reflected in the correlation between model predictions and actual growth.

The message from Table 5 is that due to above-average growth in India, the spatial impact of trade integration is blurred, since growth has a spatial impact opposite to that of trade reforms and, therefore, tends to nullify their geographical impact. Disproportionally high growth within India turns the trade pattern inward and may, therefore, counterbalance the spatial impact of international liberalisation.

Proceeding to the data, we use simulation figures for nominal GDP growth (and not welfare), since these should correspond reasonably well to their empirical GDP counterparts. The prices indexes used in the numerical simulations are different from those underlying Indian GSDP statistics and a study of price effect is, therefore, more complicated and beyond the scope of this paper.

As a first check, Table 6 presents simple correlations between nominal (current price) growth in GSDP per capita and the predicted change in different scenarios, using the three different data sets.

In conformity with the predictions of Table 5, the only significant result is found for the Global village scenario: There is a significant positive correlation using datasets (i) and (iii), suggesting that the Global village scenario captures aspects of the change in India's economic geography during the 1990s.

According to Table 5, we might also expect a negative correlation for the spatial disintegration scenario. This is "almost" the case with dataset (i) since the correlation is negative and the P value at 0.15, just slightly larger than the 10 percent threshold.

Table 6: Correlations between Growth in GSDP Per Capita in Indian States and Predicted Change in Different Model Scenarios

Note: The number of observations is 29 for dataset (iii) and 30 for datasets (i)-(ii). P values are reported below each coefficient.

Dataset	Scenario					
	Autarky	Growth	WTO	Disinteg. (S)	Global village	Disinteg. (N)
(i) 1993/94 -1999/00	-0.10 0.5989	-0.10 0.5883	-0.05 0.7902	-0.27 0.1509	0.53*** 0.0024	-0.21 0.2643
(ii) 1999/00 -2007/08	0.17 0.3814	0.16 0.4112	-0.23 0.2244	0.05 0.7909	0.15 0.4390	-0.11 0.5500
(iii) 1993/94 -2007/08	0.04 0.8399	0.03 0.8919	-0.17 0.3877	-0.13 0.506	0.41** 0.0283	-0.18 0.3395

Running multiple regressions rather than simple correlations (also including the data correction variable in dataset (iii), the Global village scenario always remains statistically significant. In some cases, we also obtain significant estimates for other scenarios, but these results are less stable. As an illustration, we show some results in Table 7.

The regressions do not add much to the simple correlations and only the Global village scenario remains consistently significant (with datasets (i) and (iii)). The autarky and growth variables are "almost" significant for 1993-2002, with a negative sign suggesting that trade liberalisation was slightly more important for India's geography than the accelerated growth. A result of some interest, although not very robust statistically, is that the sign on non-spatial disintegration is negative (suggesting there was integration rather than disintegration), whereas the sign on spatial disintegration is positive (which might indicate weak infrastructure development, unless it is a spurious result due to growth).

Table 7: Regressions with Nominal Growth in GSDP Per Capita in Indian States as Dependent Variable and Predicted Change in Different Model Scenarios as Right-hand-side variables.

Note: P values are reported below each coefficient. ***, ** and *, respectively, indicate significance at the 1/5/10% level.

Variable	Dataset used					
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
Intercept	-1858** 0.0392	-419 0.5320	-3349* 0.0932	-1127** 0.0154	-392 0.2482	-2484** 0.0164
Autarky	-65 0.1105	-9 0.7666	-103 0.2664	Not included		
Growth	Not included			-647 0.1005	-170 0.5658	-1371 0.1412
Global village	597*** 0.0060	155 0.3230	1116** 0.0186	618*** 0.0058	196 0.2234	1293*** 0.0092
Disintegration (N)	-326* 0.0949	-125 0.3988	-660 0.1314	-319* 0.0909	-151 0.2897	-773* 0.0747
Disintegration (S)	1669* 0.0600	403 0.5432	3022 0.1262	1765* 0.0553	596 0.3847	3951* 0.0650
Data adjustment variable	Not included		1.88 0.4641	Not included		0.93 0.7283
R^2	0.43	0.14	0.37	0.43	0.14	0.39
Adjusted R^2	0.34	-0.00	0.23	0.34	0.01	0.26
N	30	30	29	30	30	29

On the whole, this limited empirical evidence is in conformity with our expectation that during the post-reform period, trade liberalisation and growth had opposite effects on the economic geography of India, so that their spatial impacts cancelled out. The only effect that comes out relatively clearly in the data is some support for the global village scenario. This suggests that reduced spatial trade costs were reduced due to better infrastructure or the ICT revolution and this had a decentralising effect in India that is reflected in the observed growth pattern.

5.3 Sector-level Evidence

In the model we have used, there is no sector specialisation in trade: international trade is just a mixture of differentiated products and all of it is intra-industry trade. The GDP shares for the traded and non-traded sectors are also fixed by assumption. Thus, the model does not provide prediction about sector changes or sector-specific patterns of trade. As noted in Section 3 and shown in greater detail in Melchior (2009a), economic models with trade effects and with wage effects are, to some extent, twins: advantages in terms of market access may show up in either way, as trade specialisation or wage differentials. Another possibility is that sectors are different in terms of trade costs and real-life events so that the various scenarios vary in importance across sectors.

With this motivation and as a tentative check, we might, therefore, also consider whether sector-level growth is correlated with predictions of changes in GDP from the simulations. A full-fledged sector analysis is beyond the scope of this paper, but we present here some preliminary evidence using data for agriculture, manufacturing and services. Table 8 shows the correlations between changes in sector shares of GSDP with predicted change in nominal GDP in the simulations, using GSDP dataset (iii) for the whole period.

For agriculture, the significant estimates for autarky and WTO for period (i) (1993-94 to 2002-03) may suggest that, during the 1990s, internationalisation contributed positively to state-level agricultural production. There is, however, also a negative and significant estimate for growth in period (i) and a competing and alternative interpretation which is more plausible is that growth was accompanied by a decreasing GDP share for agriculture. The results, however, indicate that this effect was temporary, since with datasets (ii) and (iii) we do not find any significant coefficients in the three scenarios.

For manufacturing, we find positive correlations with the global village scenarios and negative correlations with the two disintegration scenarios (insignificant in one case) and the pattern is somewhat stronger in the second part of the period. Hence, the results indicate that manufacturing development

Table 8: Correlations between Changes in Sector Shares of GSDP with Predicted Change in Nominal GDP in Different Simulation Scenarios

Note: ***, ** and *, respectively, indicate significance at the 1/5/10% level.

Sector	Dataset	Autarky	Growth	WTO	Disinteg. (S)	Global village	Disinteg. (N)
Agriculture	(i)	-0.45** 0.0125	-0.44** 0.0162	0.47*** 0.0087	-0.31* 0.0917	0.09 0.6407	0.04 0.8202
	(ii)	0.06 0.7709	0.07 0.7121	-0.06 0.7564	0.10 0.6107	-0.11 0.559	-0.04 0.8499
	(iii)	-0.07 0.7015	-0.05 0.7793	0.04 0.8390	-0.04 0.8558	0.04 0.8372	0.04 0.8278
Manufac-turing	(i)	-0.16 0.4011	-0.16 0.3875	0.06 0.7388	-0.28 0.1321	0.37** 0.0432	-0.40** 0.0279
	(ii)	-0.18 0.3423	-0.18 0.3353	0.06 0.7455	-0.38** 0.0362	0.45** 0.0115	-0.56*** 0.0013
	(iii)	-0.25 0.1936	-0.25 0.1897	0.13 0.5022	-0.43** 0.0208	0.46** 0.0123	-0.58*** 0.0010
Services	(i)	0.48*** 0.0075	0.47*** 0.0082	-0.46** 0.0115	0.44** 0.014	-0.25 0.183	0.34* 0.0644
	(ii)	0.50*** 0.0044	0.49*** 0.0055	-0.42** 0.0193	0.56*** 0.0012	-0.41** 0.0259	0.55*** 0.0015
	(iii)	0.46** 0.0125	0.44** 0.0158	-0.35* 0.0617	0.52*** 0.0041	-0.43** 0.0189	0.45** 0.0146

depends on reduced transport costs and stronger inter-state integration and this has become increasingly important over time. Again, the insignificant results for the three "central cone" scenarios could be because growth and trade integration have opposite effects, so we cannot draw a firm conclusion about their relevance.

Perhaps, the most interesting result in Table 8 is for services: 17 out of the 18 coefficients are significant and, if we compare with Table 5, we find that the sign pattern is fully identical to the growth scenario of the simulations. While the growth of services in India is often associated with India's success as an exporter of computer-related services, the results here indicate that Indian services growth is at least as much driven by domestic market expansion.

A closer look at the data also reveals that the export-oriented business services constitute a small share of GDP (see also Bosworth et al. 2007). Some traditional sectors such as trade, hotels and restaurants are larger and also major components of Indian growth and the results in Table 8 suggest that services development driven by increased domestic demand for such services is a core ingredient.

The sector-level evidence presented here is more loosely linked to the simulation model, since it rules out sector specialisation, but the results nevertheless suggest that the model captures important phenomena that are visible at the sector level and not at the aggregate (GSDP) level. A task for future research is to clarify the causal mechanisms underlying this circumstance.

6
Major Findings and Implications

For most economic transactions, geography plays an important role: the intensity of trade, investment and migration falls with distance. For this reason, we find distinct spatial patterns of economic density and income distribution within as well as between nations. In Europe, income growth recently had a very characteristic V-shaped pattern along the east-west dimension, with the lowest growth rates at a longitude passing through Western Germany (and an inverse pattern for initial income levels, see Melchior 2009b). In China, there is a strong coastal-inland divide, with coastal regions as hubs for international trade (Melchior 2010).

India represents a more difficult case, since there are relatively few significant correlations between theoretical predictions and the growth patterns of India's states. With inspiration from the study of China, the dilemma was nevertheless (at least partly) resolved: A key observation is that disproportionally high economic growth in India automatically makes the country more introvert and has a geographical impact that resembles that of autarky. Growth in India increases domestic, inter-state and international trade, but due to proximity to the growing areas, the former two increase faster and their shares of GDP rise. For geography, this has the opposite impact of trade liberalisation and nullifies the geographical impact of globalisation. This may be a reason why we do not find spectacular changes in India's economic geography during 1993-2007. Based on the numerical simulations, we derive three spatial patterns of growth that correspond to different scenarios:

- In the "Central Cone" pattern, the divide is between a southern cone and the north-west and north-east parts. Autarky and Indian growth promote this pattern and WTO liberalisation is a mirror image that reverses it.
- The second pattern is triangular, with higher growth in the north-west, north-east and southern corners of the Indian subcontinent. This pattern is promoted by global reduction in transport costs and other spatially dependent trade costs, as reflected in our "Global village" scenario.[12]
- The third pattern is the "fragmentation" image: high domestic transaction costs within India lead to fragmentation with several clusters with higher income levels.

For the empirical analysis, a key observation is that some of the major reforms affecting India after 1991 should lead to decentralisation and a weakening of the Central cone pattern, while faster Indian growth should have the opposite effect and strengthen this pattern. It is consistent with this that we find no significant correlations between actual GSDP growth and the theoretical predictions from the relevant three scenarios.

The "triangular" pattern is more distinct from the impact of growth and, for the period 1993-2002, we find a positive and significant correlation between actual growth and the pattern predicted by the "global village" scenario. Hence, according to this result, globalisation has led to decentralisation in India and a reduction of regional disparities.

In the paper, we have shown that regional disparities in India have increased considerably during 1993-2007 and now approach the level of China. The analysis unambiguously suggests that international trade integration is not the cause:

- According to the numerical simulations, increased trade integration, inter-state as well as internationally, should lead to decentralisation and a reduction in regional disparities. This is supported empirically for the "Global village" scenario.
- In all scenarios, the common effects across Indian states are much stronger than the differences between them.

Thus, trade as such is hardly to blame for increased regional disparities in India and we should look for other causes. Inter-state differences in skills, infrastructure, regulations and policies are likely candidates with support in the current literature. In this respect, it should be observed that in the theoretical analysis here, we assume that Indian states are facing the same trade barriers, except for the differences that follow from their geographical location. Individual state-level differences in infrastructure could have a larger impact on regional inequality and also interact with globalisation, but that is another story.

For technical reasons and motivated by the empirical research literature, we use a model where differences in market access show up in the form of wage differences, rather than trade specialisation. In the empirical analysis, we nevertheless show that the simulation results capture important phenomena related to sector specialisation rather than aggregate GSDP:

- Agriculture faced a positive transitional shock from globalisation during 1993-2002.
- Manufacturing development depends strongly on inter-state integration in India and the reduction in transport costs.
- The spatial pattern of services sector expansion conforms well to the "Indian growth" scenario and suggests that this sector is driven at least as much by domestic demand

increases as by international high-tech exports and outsourcing.

In the analysis, we have argued that, for large countries such as India, it is essential that domestic inter-state trade is included and we have presented a new conceptual framework where inter-state trade is included along with international trade. While data on inter-state trade as yet do not exist, the simulations confirm the importance of inter-state trade. For India, the model suggests that the current level of inter-state trade is low, due to India's poverty and low economic mass, and economic growth in India will increase the role of inter-state trade. Our survey of the literature suggests that India's domestic market is still underdeveloped and a major effort should be done to harmonise regulations and taxes and improve infrastructure. Some of this can be done by the state, but the development of modern logistics has to be supported by a strong and competitive business environment, so regulations should be reformed for this purpose.

In the debate on India's growth, it has been argued that manufacturing expansion is essential to provide enough new jobs and promote structural change. Our analysis supports, theoretically and empirically, the view that inter-state integration in India is essential for manufacturing development. In this respect, it should also be recalled that a large share (about 6-7) of employment in the Indian manufacturing sector is in the small-scale "unorganised" segment (Kotwal et al. 2009, Ray 2004). When these small firms expand, the first target markets outside their own state may not be the US or EU countries, but their neighbour states in India. Domestic market integration in India is important also as a "training ground" for international exports. There is no contradiction between inter-state and international trade: they are generally complementary and both contribute to higher welfare. India's trade strategy should, therefore, not only focus on international markets but also on India's own "single market".

While our analysis provides a new framework for the analysis of the trades of India and other large countries, it is based on a number of stylised assumptions and some of these could limit the generality of the results. For example, we have assumed that trade may be shipped shortest distance with no distinction between road, train or sea freight. For India's northern peripheries, we have not explicitly accounted for natural barriers such as the Himalayas. A possible extension of the analysis could, therefore, be to model the costs of transports and infrastructure more realistically, based on better data.

Another extension could be to explore the sector-level effects in greater depth, theoretically as well as empirically. When data become available, it will, of course, be of great interest to examine inter-state trade in the light of our model predictions. The theoretical framework also contains detailed predictions concerning price level changes and that is another dimension that could be explored. We have discovered substantial measurement errors in India's state-level data at the aggregate GSDP as well as at the sector level and an interesting issue is whether the large data discrepancies for services are caused by better data collection or changed methods. Price measurement for services is a challenging task and there is some uncertainty about the quality of current deflators (see Bosworth et al. 2007).

This paper is part of a broader effort to make economics more realistic by creating models that take into account geography and are more directly related to empirics (Melchior 2000, 2009a, b, 2010). For India, this link between theory and data was harder to find, but finally we found some tentative evidence that the invisible hand of economics works – even there.

Appendix

Appendix A: The Simulation Model

Table A1 summarises main symbols, variables and auxiliary expressions in the model:

Table A1: Summary of Model Symbols and Expressions	
Description	Symbols/expressions
Countries/regions	
There are N countries or regions	Subscripts i,j=1,…,N
Factors of production	
Factor endowments (exogenous)	K_i, L_i
Factor prices (endogenous)	w_i, r_i
Tradables sector with monopolistic competition	
Number of firms in each region/ country	n_i
Sales from a firm in region i to region j	x_{ij}
Corresponding price	p_{ij}
Corresponding trade cost	$t_{ij} \geq 1$
Elasticity of substitution	$\sigma > 1$
Aggregate quantity index for consumption in region j	(A1) $X_j = \left[\Sigma_i \; x_{ij}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$
Aggregate price index for consumption in region j	(A2) $P_{xj} = \left[\Sigma_i \; p_{ij}^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$
Unit marginal production cost	$c_{xi}(w_i, r_i)$
Fixed production costs	$f \times c_{xi}(w_i, r_i)$

Total costs of a firm in region i	(A3)	$C_{xi} = \lfloor f + \sum_j x_{ij} t_{ij} \rfloor \times c_{xi}(w_i, r_i)$
Profits if a firm in region i	(A4)	$_i = \sum_j x_{ij} p_{ij} - C_{xi}$
Factor use in sector X		K_{xi}, L_{xi}
Equilibrium firm size (value expression)	(A5)	$\sum_j x_{ij} p_{ij} = \quad f c_{xi}(w_i, r_i)$
Equilibrium firm size (quantity expression)	(A6)	$\sum_j x_{ij} t_{ij} = (\quad -1) f$
Equilibrium price	(A7)	$p_{ij} = \frac{}{\sigma - 1} c_{xi}(w_i, r_i) \times t_{ij}$
Production function for implicit "production and transport services"	(A8)	$K_{xi}^{\alpha} L_{xi}^{1-\alpha}$
Cost function for marginal cost units	(A9)	$c_{xi} = Z_x r_i^{\alpha} w_i^{1-\alpha}$
Constant in cost function	(A10)	$Z_x = \alpha^{-\alpha} (1-\alpha)^{\alpha-1}$
Per firm factor demand for K	(A11)	$\frac{K_{xi}}{n_i} = \sigma f \alpha Z_x \left(\frac{w_i}{r_i}\right)^{1-\alpha}$
Per firm factor demand for L	(A12)	$\frac{L_{xi}}{n_i} = \sigma f (1-\alpha) Z_x \left(\frac{w_i}{r_i}\right)^{-\alpha}$
Non-traded sector		
Quantity produced = quantity consumed (since it is non-traded)		S_i
Price		P_{si}
Factor use in sector S		K_{si}, L_{si}
Production function for S	(A13)	$K_{si}^{\alpha} L_{si}^{1-\alpha}$
Unit cost function for S	(A14)	$c_{si} = Z_s r_i^{\beta} w_i^{1-\beta}$
Constant in unit cost function for S	(A15)	$Z_s = \beta^{-\beta} (1-\beta)^{\beta-1}$
Factor demand for K	(A16)	$K_{si} = S_i \beta Z_s \left(\frac{w_i}{r_i}\right)^{1-\beta}$
Factor demand for L	(A17)	$L_{si} = S_i (1-\beta) Z_s \left(\frac{w_i}{r_i}\right)^{-\beta}$

Aggregate and Firm-level Demand		
Total income	(A18)	$Y_i = w_i L_i + r_i K_i$
Utility function (a_i = budget share for X)	(A19)	$X_i^{a_i} S_i^{1-a_i}$
Demand for X aggregate	(A20)	$X_i = P_{xi}^{-1} a_i Y_i$
Demand for S	(A21)	$S_i = P_{si}^{-1}(1-a_i)Y_i$
Demand for variety x_{ij}	(A22)	$x_{ij} = p_{ij}^{-\sigma} P_j^{\sigma-1} a_j Y_j$

The tradable sector is a standard setup with monopolistic competition where each firm produces a distinct product variety and there is free entry and exit of firms that drive profits to zero. Maximisation of profits (A4) leads to the standard mark-up pricing condition (A7): the price is a mark-up on marginal costs that depends on the elasticity of substitution ó. Trade costs t_{ij} are real costs and expressed as a mark-up on marginal costs (A3, A7). Free entry and exit imply π_i=0 (zero profits) and this leads to the determination of firm size (A5, A6). The produced quantity (A6) is independent of factor prices whereas the value of the production of the firm (A5) is scaled proportionally with the marginal cost c_i, which depends on factor prices w_i, r_i.

Following, e.g., Markusen and Venables (2000), we assume that factor proportions are the same for marginal costs, trade costs and fixed costs. All these costs therefore depend on the cost element c_i. With a Cobb-Douglas production function (A8), we obtain the standard cost function (A9). Substituting costs (A9) and firm size (A6) into total costs (A3) and differentiating with respect to factor prices, we obtain factor demands from sector X (A11, A12).

In the non-traded sector, there is perfect competition, no fixed production costs, and trade costs do not matter due to non-tradability. Assuming Cobb-Douglas production functions

(A13), unit costs (A14) follow and the factor demands (A16, A17) can be derived. For more detail on this standard neoclassical case, see Melchior (2004).

Aggregate demand in each sector is Cobb-Douglas (A19-A21) and there is a standard CES (Constant Elasticity of Substitution) demand for individual varieties (A22).

The first step in the partial solution of the model is obtained through the factor market clearing equations, which have the form

(A23) $K_{Xi}+K_{si}=K_i$ and $L_{Xi}+L_{si}=L_i$

Substituting the factor demands (A11, A12, A16, A17) into (A23), we obtain 2N equations with 3N unknowns (n_i, S_i and w_i/r_i). But since X is the only tradable sector and trade must be balanced, the total value of X production must be equal to consumption. This gives (also using A9):

(A24) $n_i \quad f c_i \; w_i, r_i \quad n_i \quad f Z_x r_i \; \text{v}$

Substituting for the product n_i óf in the factor demand equation (A11), the factor price ratios cancel out and we obtain:

(A25) $K_{Xi} \quad a_i Y_i r_i^{\;1}$

Similarly, we obtain the expression

(A26) $L_{Xi} \quad 1 \quad a_i Y_i w_i^{\;1}$

For the non-traded/services sector, production and consumption must be equal and price must be equal to marginal cost. From this we obtain, using (A21) and (A14)

(A27) $S_i P_{si} \quad S_i Z_s r_i \; w_i^1 \quad 1 \quad a_i \; \text{Y}$

We use (A27) to substitute for S_i in the factor demand equations (A16, A17) and obtain expressions of the same type as (A25, A26). Now substituting the four expressions for sector factor demand into (A23), we obtain the two equations:

(A28) $K_{Xi} \quad K_{si} \quad a_i Y_i \quad 1 \quad a_i \; Y_i$

(A29) $L_{Xi} \quad L_{si} \quad 1 \quad a_i Y_i \quad 1$

Dividing the two equations by each other, Y_i cancels out and we obtain the factor price ratio:

(A30) $\frac{w_i}{r_i} \quad \frac{K_i}{L_i} \quad -$

θ and γ are the consumption-weighted "average factor intensities" for the two sectors; with

(A30a) $\gamma=\alpha^{*}a_i+\beta^{*}(1-a_i)$ and
(A30b) $\theta=(1-\alpha)^{*}a_i+(1-\beta)^{*}(1-a_i)$.

It is easily shown that $\theta+\gamma=1$. Observe that total income $Y_i= w_iL_i + r_iK_i$ can now, using these results, be expressed as

(A30c) $Y_i \quad w_i \quad L_i \quad \frac{K_i}{w_i / r_i} \quad w_i \quad \frac{L_i}{\quad}$

Thus, for given L_i and θ, total income is proportional to the wage. Since the w/r ratio is fixed, external shocks (e.g. trade liberalisation) will scale w and r up or down in equal proportions for each country/region.

Using (A24) and (A27), we can transform the expressions, put n_i and S_i on the left hand side, and substitute for w_i/r_i. We thereby obtain the solutions for n_i and S_i, shown as equations (2) and (3) in the main text. These are:

$$\text{(A31)}\quad n_i \quad \frac{a_i}{f Z_x} \quad \underline{K_i} \quad \underline{L_i} \quad {}^{1}$$

$$\text{(A32)}\quad S_i \quad \frac{a_i}{Z_s} \quad \underline{K_i} \quad \underline{L_i} \quad {}^{1}$$

For the factor price *levels*, we cannot find any straightforward analytical solution and we therefore use numerical simulation. For each firm in country i, sales across all markets must add up to the firm size determined by the model of monopolistic competition (A5). This gives N equations of the form:

$$\text{(A33)}\quad {}_j x_{ij} p_{ij} \qquad f Z_x r_i \;\; w_i^1$$

For sales in market j, we form the ratio

$$\text{(A34)}\quad \frac{x_{ij} p_{ij}}{x_{jj} p_{jj}} \quad \frac{p_{ij}^1 \;\; P_j \;\; {}^1 a_j Y_j}{p_{jj}^1 \;\; P_j \;\; {}^1 a_j Y_j} \quad \frac{p_i^1}{p^1}$$

where we have used the demand functions (A22) and the prices (A7) together with costs (A9). Expressing $x_{ij}p_{ij}$ as a function of $x_{jj}p_{jj}$ and rearranging, and using the notation $v_{ii}=x_{ii}p_{ii}$ for the home market sales of individual firms, we obtain N equations of the form (for region i)

$$\text{(A35)}\quad {}_j v_{ii} w_j \;\; {}^1 \;\; \frac{w_j}{r_j}^{1} \quad \frac{t_{ij}}{t_{jj}}^{1}$$

Since the factor price ratio is known, we have 2N unknowns; the v_{ii}'s and the w_i's. Observe that we allow positive trade costs in the domestic market. This is for computational purposes: If we merge countries into single units it would be unreasonable to assume that trade costs within these units were zero. For most countries and regions, however, we will assume that t_{ii}=1.

(A33) can be expressed in matrix form, as follows:

$$\text{(A36)}\quad T_{N\ N}\ \ Diag\ w_i^{\ \ 1}{}_{N\ N}\ \ Diag\ \frac{w_i}{r_i}$$

$$f\,Z_x\ Diag\ w_i\ {}_{N\ N}\ \ \frac{w_i}{r_i}$$

Where T is the matrix with $(t_{ij}/t_{jj})^{1-\sigma}$ as elements and the diagonal matrixes have typical elements as shown.

Next, sales from all firms and sources in each market must add up to total demand (=$a_i Y_i$). This gives N equations of the form (for market i, after rearranging):

$$\text{(A37)}\quad {}_j n_j w_j^1 \ \frac{w_j}{r_j}^{\ \ 1} \ \frac{t_{ji}}{t_{ii}}^{\ 1} \ \ a_i$$

Expressing this in matrix form, we have:

$$\text{(A38)}\quad T\,'_{N\ N}\ \ Diag\ n_i\ {}_{N\ N}\ \ Diag\ w_i^1$$

$$Diag\ a_i\ {}_{N\ N}\ \ Diag\ Y_i\ {}_{N\ N}\ \ Diag\ v_{ii}^{\ 1}$$

(A36) and (A38) constitute 2N equations with 2N unknowns (v_{ii}, w_i). In the simulations, we use (A36) to express v_{ii} and insert this into (A38). In this way we reduce the number of equations and unknowns to N.

In the numerical simulations, the model parameters are set as follows:

Table A2: Parameter Values Used in Simulations		
Symbol	Description	Value
σ	Elasticity of substitution	5
α	Capital intensity of traded sector	0.9
β	Capital intensity of non-traded sector	0.5
a	Consumption share of traded sector	0.6
L_i	Proxied by population (using 2004 data)	
K_i/L_i	Proxied using observed data on income per capita (scaled)	
T	Trade costs: defined by scenarios, see text	

For more detail about technical issues related to the simulation methods, see Melchior (2010). Equation (A38) is a highly non-linear equation system with 166 unknowns, but its solution turned out to be feasible with a high degree of accuracy. Details concerning stopping criteria etc. for the model simulations are available to interested readers upon request.

Appendix B: Country and Region Aggregation

Units	N	Note
Chinese provinces	30	Chongqing is merged with Sichuan since separate data are not available before 1997
Indian states	29	Punjab+Haryana+Chandigarh merged, a couple of small territories dropped
Russia	7	Regions merged into 7 major regions: Northwest, Central, South, Volga, Ural, Sibir, East, following public Russian subdivision
USA	11	States merged into 11 major geographical regions following public U.S. subdivision
EU27	27	Individual countries
Other individual countries/units	50	Afghanistan, Albania, Armenia, Australia, Azerbaijan, Bangladesh, Belarus, Bosnia-Herz, Brunei, Darussalam, Cambodia, Canada, Chile, Croatia, Georgia, Hong Kong, Indonesia, Iran, Iraq, Israel, Japan, Kazakhstan, Korea Dem., Korea Rep., Kyrgysz Rep., Lao PDR, Macao, Macedonia, Malaysia, Mexico, Moldova, Mongolia, Myanmar, Nepal, New Zealand, Norway, Pakistan, Philippines, Serbia Montenegro, Singapore, Sri Lanka, Switzerland, Syrian Arab Rep., Taipei, Tajikistan, Thailand, Turkey, Turkmenistan, Ukraine, Uzbekistan, Vietnam
Merged country groups:		
SACU (5)	1	Botswana, Lesotho, Namibia, South Africa, Swaziland
Other SADC (10)	1	Angola, Congo, Dem. Rep., Madagascar, Malawi, Mauritius, Mozambique, Seychelles, Tanzania, Zambia, Zimbabwe
Western Africa (16)	1	Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo

Africa central parts (8)	1	Burundi, Cameroon, Central African Republic, Chad, Congo, Rep., Equatorial Guinea, Gabon, Rwanda
Eastern Africa (8)	1	Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan, Uganda
Africa, Mediterranean (5)	1	Algeria, Egypt, Arab Rep., Libya, Morocco, Tunisia
Other Middle East (10)	1	Bahrain, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, United Arab Emirates, West Bank and Gaza, Yemen, Rep.
CARICOM (11)	1	Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and theGrenadines, Trinidad and Tobago
CACM (6)	1	Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama
Andean countries (5)	1	Bolivia, Colombia, Ecuador, Peru, Venezuela,RB
Mercosur (4)	1	Argentina, Brazil, Paraguay, Uruguay
Other central America (5)	1	Bermuda, Cuba, Dominican Republic, Haiti, Puerto Rico
Note: 35 smaller countries/ territories have been dropped from the analysis.		

Appendix C: Simulation Results – Welfare Levels for Indian Regions in Different Scenarios

Region	Base case	WTO	Global village	Spatial disintegration	Non spatial disintegration	Autarky	Indian growth
Andhra Pradesh	20.09	21.34	21.28	19.78	19.78	16.12	25.50
Arunachal Pradesh	19.06	20.39	20.23	18.70	18.77	14.36	24.08
Assam	16.66	17.79	17.66	16.36	16.40	12.76	21.06
Bihar	10.76	11.46	11.39	10.57	10.58	8.42	13.62
Chattisgarh	17.51	18.64	18.56	17.21	17.20	13.77	22.19
Delhi	31.21	33.24	33.03	30.69	30.69	24.50	39.53
Goa	35.03	37.29	37.27	34.37	34.41	27.18	44.33
Gujarat	23.23	24.70	24.60	22.85	22.87	18.46	29.45
Himachal Pradesh	23.46	25.03	24.86	23.06	23.06	18.15	29.69
Jammu& Kashmir	18.03	19.26	19.13	17.70	17.75	13.75	22.80
Jharkhand	17.17	18.29	18.19	16.87	16.88	13.44	21.74
Karnataka	20.10	21.37	21.36	19.76	19.79	15.93	25.48
Kerala	22.07	23.48	23.53	21.66	21.73	17.21	27.94
Madhya Pradesh	15.61	16.61	16.53	15.36	15.35	12.40	19.80
Maharashtra	24.21	25.67	25.57	23.87	23.88	19.71	30.76
Manipur	17.37	18.58	18.44	17.04	17.10	13.11	21.94
Meghalaya	19.23	20.56	20.41	18.88	18.92	14.62	24.31
Mizoram	19.46	20.80	20.66	19.09	19.15	14.76	24.59
Nagaland	18.31	19.59	19.44	17.96	18.03	13.81	23.13
Orissa	16.57	17.65	17.57	16.28	16.29	12.97	20.98
Pondicherry	27.91	29.72	29.72	27.39	27.42	21.66	35.33
Punjab Haryana	25.22	26.85	26.67	24.82	24.85	19.92	31.96
Rajasthan	16.82	17.90	17.80	16.54	16.54	13.28	21.31
Sikkim	20.67	22.08	21.92	20.29	20.33	15.80	26.13
Tamil Nadu	21.84	23.20	23.18	21.48	21.51	17.40	27.69
Tripura	19.29	20.61	20.47	18.93	18.98	14.72	24.39
Uttar Pradesh	14.24	15.13	15.04	14.03	14.03	11.42	18.07
Uttaranchal	19.56	20.86	20.72	19.22	19.22	15.17	24.76
West Bengal	19.47	20.72	20.59	19.15	19.18	15.42	24.67

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Endnotes

1 Based on data from World Bank: World Development Indicators Online, downloaded June 2010. The corresponding increase for exports of goods and services as percentage of GDP was from 7.1 percent in 1990 to 22.7 percent in 2008.

2 Data source: MOSPI/CSO (Ministry of Statistics and Programme Implementation, Central Statistical Office), data on State Domestic Product (State Series), available at http://mospi.nic.in . Observe that India's fiscal year runs from April to March, so e.g. 2007 on the horizontal axis is shorthand for April 2007-March 2008.

3 In the south of India, all states have a coastline, so the coastal-inland distinction is not very useful, unless the analysis is undertaken at a more disaggregated level.

4 With current prices, the range of growth rates is 7.7-16.4, and the spatial pattern is similar.

5 Source: World Bank: World Development Indicators online.

6 Inaugural address by K.C. Pant, Deputy Chairman, Planning Commission at a National Seminar on "India as one Common Market: Prospects and Challenges to Trade & Services" at Kolkata on January 16, 2003.

7 Business Standard, September 09, 2003: "Inland haulage costs hit trade", New Delhi.

8 The Financial Express, February 13, 2010: "Maharashtra octroi still hurdle in GST road map", at www.financialexpress.com.

9 In these cases, we allow non-zero trade costs within the country groups, see Appendix A and Melchior (2010).

10 For all scenarios, nominal and real (welfare) changes are highly (almost perfectly) and positively correlated, while these are highly (almost perfectly) and negatively correlated with the price index changes. It is, therefore, sufficient to show one graph for each scenario.

11 This is equal to the new/old nominal ratio for each of the years 1999-2000 to 2002-03, and thereafter remains at the 2002-03 value for the remaining years 2003-04-2007-08.

12 The scenario "spatial disintegration", where transport costs within India rise, is an intermediate case between the "Central cone" and "triangular" patterns.

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