

**Trade Liberalisation and Regional Disparities: Evidence from a Multi-Regional
General Equilibrium Model of India**

By

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Abstract

Recent focus on poverty alleviation under the United Nation's Millennium Development Goals has led to a renewed interest in understanding the link between trade reforms and regional disparities, particularly, within emerging and developing countries. India makes a fascinating case study to understand this linkage as it has the largest concentration of poor people in the world despite being one of the world's fastest growing economies and also trade reforms were carried out in the early nineties (Topalova, 2008). In this study, in contrast to the partial equilibrium framework adopted in the existing literature, we identify and quantify the regional impact of trade liberalisation within a general equilibrium framework and develop the first ever single-country multi-regional computable general equilibrium (CGE) model for the Indian economy. In addition, this model incorporates economies of scale and imperfect competition. Overall, our results suggest that, in the short-run, trade liberalisation has a beneficial impact on the rich and fast growing middle income states and marginal or negative impact on the poor states. Thus, in the short-run, trade liberalisation would tend to widen the gap between the rich and the poor states in India. We suggest that trade reforms should be complemented by other policy measures that would promote regional equality.

Keywords: – trade liberalisation, economic growth, regional disparities, computable general equilibrium model, South Asia, India

1. INTRODUCTION

Over the last few decades, there has been a growing interest among researchers and policy makers in understanding the regional economic impact of trade reforms. Recent focus on poverty alleviation under the United Nation's Millennium Development Goals has led to a renewed interest in understanding the link between trade reforms and regional disparities, particularly, within emerging and developing countries.

In this paper, to understand the link between trade reforms and regional disparities, we examine India, an emerging economy in South Asia. India makes a fascinating case study to understand this linkage as it has the largest concentration of poor people in the world despite being one of the world's fastest growing economies (Topalova, 2008).

After decades of following inward looking development strategy, India embarked on the path of trade reforms in 1991, along with other macroeconomic reforms. Interestingly, in recent years, policy makers all over the world including India are concerned with distributional impacts of trade reforms and particularly interested in "inclusive growth path". For example, the main theme of the Approach Paper to the Eleventh Five-Year Plan (2007-12) in India was 'faster and more inclusive growth'.

To the best of our knowledge, the existing empirical studies on the trade and regional disparities within the Indian context have adopted a partial equilibrium analytical framework (see for example Cashin & Sahay 1996; Dasgupta, *et al.* 2000; Nagaraj 1998; Rao, *et al.* 1999; Subramanyam 1999, Bhattacharya and Sakhtivel 2004, Ghosh 2010; and Das, *et al.* 2010). Many researchers have, however, highlighted the drawbacks in partial equilibrium framework in analysing the impact of policy or external shocks that are likely to have economy-wide implications and operate within multiple channels in the economy (see Chen and Ravallion, 2004 and Coxhead, 2003). Therefore, in this paper we develop a multi-regional Computable General Equilibrium (CGE) model for India in order to analyse the above linkage within a general equilibrium framework.

The main objective of this study is to identify and quantify the regional impact of trade liberalisation within a general equilibrium framework. We, therefore, develop the first ever single-country multi-regional computable general equilibrium (CGE) model for the Indian economy. In addition to the standard neoclassical assumptions, this model incorporates economies of scale as well as imperfect competition. A simulation is carried

out to analyse the economy-wide and regional impact of across the board tariff reductions.

The remainder of this paper is arranged as follows. Section 2 presents some stylised facts on trade liberalisation in India, while Section 3 lays out a brief overview on regional disparities. Section 4 spells out the details of the Indian multi-region CGE model. Section 5 discusses the short-run effects of trade policy reforms using simulation experiments and the final section provides concluding remarks and some policy recommendations.

2. TRADE LIBERALIZATION IN INDIA : STYLISTED FACTS

After decades of following inward looking development strategy, wherein import substitution constituted a major element of both trade and industrial policies and production for domestic market was shielded behind high tariff walls and high effective protection, India embarked on the path of trade reforms in 1991, along with other macroeconomic reforms. This, although initially was with the objective of resolving balance of payments crisis, yet aimed at the long-term broad objectives of accelerating economic growth and eliminating poverty. The trade liberalisation measures included devaluation of exchange rate and move to a unified market determined exchange rate system in 1993; reduction in the list of prohibited exports and imports; lowering of nominal tariffs; withdrawal of quantitative restrictions on imports and phasing out the system of import licensing; changes in export incentives and a switch from direct subsidies to indirect export promotion measures. Below we highlight some of the key facts on trade liberalisation in India.

i) India's share in World Trade

Since the reforms in 1991 India's share in total world trade has increased. Table 1 shows percentage share of exports and imports of few developed and developing countries including India in the total world trade since 2000. Indian exports constituted 2.2 per cent of the world's total exports at the time of country's independence in 1947. With the initiation of planning in 1951, followed by highly regulated and controlled trade regime the share of exports in total world exports plummeted to a mere 0.6 per cent in 1993. As a result of these policy shifts, imports too dropped significantly from 3.1 per cent in 1947 to 0.6 per cent in 1993. By 2010 India's share in total world exports at 1.4 per cent is still far less than other

countries such as, China and United States, though it is higher than many developing economies for instance, Thailand, Argentina, Indonesia and Malaysia.

ii) Rise in trade openness and fall in tariff barriers

Trade openness ratio, that is, the ratio of exports and imports to GDP reflects the increasing trade liberalisation (see Table 2). Except Japan, where the trade openness ratio declined in the nineties, rest in all the countries the ratio has actually increased in the nineties. In India average trade openness ratio increased by more than three times to 46.8 per cent during the period 2006-10 from 14 percent during the eighties.

Table 1: India's share in Total World Merchandise Trade (percent)

	Exports								Imports							
Year s	India	United States	Argentin a	France	United Kingdo m	Austral ia	China	Russi a	India	United States	Argenti na	Franc e	United Kingdo m	Austr alia	Chin a	Russi a
2000	0.66	12.11	0.41	5.07	4.42	0.99	3.86	1.64	0.77	18.73	0.37	5.04	5.18	1.06	3.35	0.66
2001	0.70	11.78	0.43	5.22	4.41	1.02	4.30	1.65	0.78	18.19	0.31	5.07	5.30	0.99	3.76	0.83
2002	0.76	10.68	0.40	5.11	4.32	1.00	5.02	1.65	0.84	17.80	0.13	4.88	5.40	1.08	4.38	0.90
2003	0.78	9.55	0.39	5.17	4.03	0.93	5.78	1.79	0.92	16.56	0.18	5.07	5.08	1.13	5.25	0.97
2004	0.83	8.84	0.38	4.90	3.77	0.94	6.44	1.99	1.04	15.95	0.23	4.92	4.92	1.14	5.87	1.02
2005	0.95	8.59	0.38	4.42	3.67	1.01	7.26	2.32	1.32	15.96	0.26	4.64	4.73	1.15	6.08	1.16
2006	1.01	8.47	0.38	4.09	3.70	1.02	8.00	2.51	1.43	15.42	0.27	4.36	4.84	1.12	6.36	1.32
2007	1.07	8.20	0.40	4.00	3.14	1.01	8.72	2.53	1.60	14.12	0.31	4.41	4.36	1.16	6.68	1.56
2008	1.21	7.99	0.43	3.82	2.85	1.16	8.88	2.93	1.94	13.13	0.35	4.33	3.83	1.21	6.85	1.77
2009	1.32	8.44	0.44	3.87	2.82	1.23	9.60	2.42	2.02	12.62	0.30	4.40	3.80	1.30	7.91	1.51
2010	1.44	8.39	0.45	3.42	2.66	1.39	10.36	2.63	2.12	12.79	0.37	3.93	3.64	1.31	9.06	1.61

Source: World Trade Organisation.

Table 2: Trade Openness Ratio*

(Averages)

Country Name	1980s	1990s	2000-05	2006-10
Argentina	15.2	18.7	35.2	42.3
Australia	31.3	35.7	40.1	40.9
Chile	52.2	57.4	67.9	76.7
China	24.1	37.0	54.3	61.0
Germany	47.7	50.2	69.6	85.9
India	14.0	20.9	32.1	46.8
Indonesia	47.8	57.6	62.9	52.6
Japan	23.4	18.3	22.8	30.7
Malaysia	112.0	178.1	206.6	188.2
Mexico	29.4	49.0	56.6	58.4
Philippines	50.9	80.3	101.4	79.0
Thailand	54.7	87.1	130.2	138.8
United Kingdom	52.0	52.9	55.2	59.6
United States	18.7	22.4	24.6	28.3

*Measured as ratio of exports and imports to GDP. Source: World Bank Indicators Online.

A key aspect of India's trade reforms in the 1990s was the reduction of import duties. Prior to reforms, import duties were one of the highest in the world and were even above 200 per cent for some commodities (Kotwal, *et al.* 2011). The peak tariff rate has come down from its high level in 1991-92 to 25 per cent in 2003-04. The average tariff rate has also declined over the 1990s. Table 3 displays cross-country average tariff barriers since the nineties. The table clearly displays the drastic fall in the tariff barriers in India from their high levels in 1990.

Table 3: Cross-Country Tariff barriers

Countries	Year s	Tariff rate, applied, simple mean (%)			Tariff rate, applied, weighted mean (%)		
		All products	Primary Manufactured		All products	Primary Manufactured	
Argentina	1992	14.18	14.81	8.06	12.66	13.73	5.83
	2010	11.44	11.87	7.52	6.22	7.04	1.62
Bangladesh	1989	105.36	109.33	78.85	88.43	112.12	53.54
	2008	13.89	13.58	16.33	13.0	14.04	8.79
Brazil	1990	33.5	34.91	23.27	18.95	28.7	6.47
	2010	13.44	14.01	8.1	7.64	9.83	1.47
China	1992	39.71	40.75	34.67	32.17	36.41	13.96
	2010	8.02	7.97	8.29	4.29	6.04	1.82
India	1990	81.56	83.0	71.56	54.0	76.28	27.13
	2009	11.5	10.25	20.13	8.22	8.31	7.54
Indonesia	1990	16.83	16.88	16.48	13.32	15.82	5.26
	2010	4.79	5.03	3.21	2.49	2.93	1.57
Korea	1990	12.98	12.87	13.8	9.54	11.51	6.19
	2010	10.33	7.35	26.31	8.71	5.06	12.74
Malaysia	1988	14.07	14.67	10.28	9.38	10.91	4.62
	2009	6.75	6.07	10.14	3.95	3.66	5.04
Mexico	1991	14.29	14.45	12.98	11.91	13.03	8.25
	2010	7.82	7.51	10.65	6.07	4.66	11.54
Pakistan	1995	50.09	51.38	40.9	43.47	49.54	36.17
	2009	14.78	14.84	14.46	9.53	12.28	6.46
Thailand	1991	37.8	38.78	29.57	31.36	32.83	25.67
	2009	11.22	10.47	15.86	4.92	6.14	2.91

Source: Compiled from World Bank Indicators Online.

Non-tariff barriers are considered less desirable than the tariffs. Among the most common non-tariff barriers are the restrictions or prohibitions on imports maintained through import licensing requirements. Prior to the reforms in India, quantitative restrictions on imports of wide range of products were most commonly used as non-tariff barriers. During the period 1980-85, 98 per cent of the manufactured imports of intermediate inputs and 95 per cent of the capital goods were subject to non-tariff barriers. This was almost 100 per cent in case of consumer goods (Kotwal *et al.* 2011). In the initial phase of reforms in 1991-92, about 3000 tariff lines covering raw materials, intermediates and capital goods were freed from licensing restrictions. By 1996-2000, only 28 per cent of manufactured imports in intermediate inputs category and 8 per cent of the capital goods were subject to non-tariff barriers.

iii) Changing Pattern of World Trade and India

Along with increase in the volume of world trade, the pattern of world trade also changed following structural shifts in production caused by new technologies, demand pattern, ways of organising and locating production and new international trade rules. Non-primary products and non-resource based manufactured goods have gained importance in the recent years. The developing countries too have transformed themselves from being primary commodity exporters to exporters of manufactured goods.

In India, the importance of primary products in the export basket has witnessed a steady decline since the nineties with a downward trend in manufactured products too. On the other hand, the proportion of petroleum products in total has increased in the recent years (Table 4). The increase in the exports in petroleum products is a reflection of increase in quantity as well as increase in the price of oil and other petroleum products.

Table 4: Changing Composition of India's Exports (in percent)

Years	Primary Products	Manufactured Products	Petroleum Products	Other Commodities
1987-88 to 1990-91	24.1	71.0	3.0	1.9
1991-92 to 1994-95	21.5	75.4	2.1	1.0
1995-96 to 1998-99	22.4	75.4	1.0	1.1
1999-00 to 2002-03	16.6	77.6	3.5	2.3
2003-04 to 2006-07	15.8	71.6	10.0	2.6
2007-08 to 2009-10	14.9	65.3	16.2	3.7

Source: Computed from Handbook of Statistics on Indian Economy, Reserve Bank of India.

iv) Technology Intensity of India's exports

India's export basket can be grouped into primary commodities, manufactures based on labour and natural resources, manufactures characterised by low technology intensity; medium technology intensity and high technology intensity. The structural transformation and diversification in India's exports is reflected in a shift from the primary goods to low and medium technology exports, although most of the exports are still concentrated in manufactures based on labour and natural resources (RBI 2004).

In recent years, India's exports have tended to move away from low technology intensive manufactures to medium and high intensive manufactures (IIFT 2011). Thus, the proportion of low intensive manufacturing exports has come down from 33 per cent in 2004 to 28 per cent in 2008; while that of medium and high intensive manufactures has increased from 14 to 17 per cent and 5 to 7 per cent respectively. The increase in the share of capital intensive products exports (medium and high technology) has been mainly due to refined petroleum products (Veeramani 2012). Veeramani and Saini (2011) noted that India's export structure is increasingly looking similar to that of OECD high income countries. The geographical direction of exports has also changed from the traditional markets (Australia, New Zealand, Europe, Japan and North America) to new markets (Eastern Asia including China, South eastern Asia, South Asia, West Asia and Africa) (Veeramani 2012).

v) Growing Services Trade

During the years 2005-06 to 2010-11, the services sector in India grew at an average rate of 10 per cent. Its share in GDP also is impressive at an average of 63.9 per cent compared to 15.8 per cent in agriculture and 20.3 per cent in industry during the similar period. India has also made rapid strides in services trade within which the share of commercial services is high at 77.4 per cent. The compound annual growth rate of services exports was 27.8 per cent during 2000-01 to 2007-08. Within services, the software services showed a growth rate of 30.2 per cent during the similar period; while the non-software services grew by 33.9 per cent. Table 5 displays ranking of different services in world exports and imports of services.

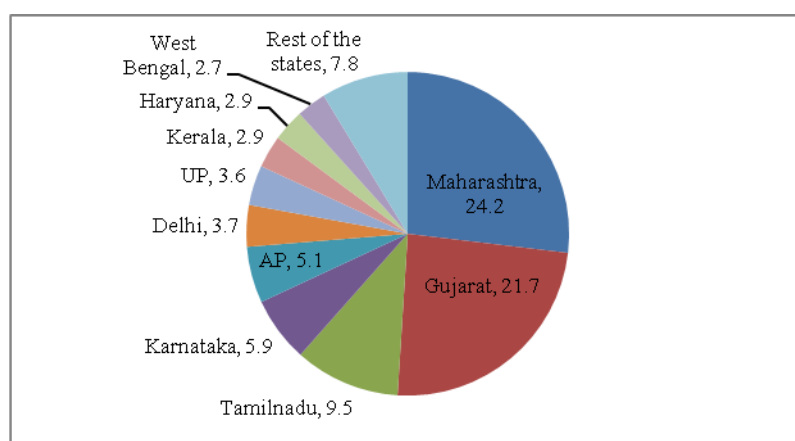
Table 5: Ranking of Indian Services' Trade in World's Services Trade

Components of Services Sector	Ranking in World Services (2009) (per cent)	
	Exports	Imports
Transportation Services	13	13
Travel Services	14	-
Other Commercial Services	4	8
Communication Services	4	11
Construction Services	12	13
Insurance Services	7	7
Financial Services	7	5
Computer & Information Services	2	4
Other Business Services	6	6
Personal, Cultural & Recreational Services	5	12

Source: Economic Survey, Government of India.

vi) Inter-state concentration in Trade

Within the country, trade is concentrated among the high income and more developed states. Data on the state origin of exports of goods reveals domination of Maharashtra and Gujarat. Among the 15 major states, it is Maharashtra and Gujarat which accounted for 46 per cent of the total country's exports followed by Tamilnadu and Karnataka during the period 2008-10 (see Figure 1).

**Figure 1: Percentage Contribution of States' to Total Exports (Average 2008-10)**

3. REGIONAL DISPARITIES

Regional disparities have increased significantly in the post-reform period in India. A large number of studies have examined whether the states have diverged or converged with each other.² This is a question which has bothered the policy makers and academia for the past two decades. Bhattacharya and Sakhtivel (2004) built a common state income series for the period 1980-81 to 1999-2000 by applying 1993-94 base year backwards up to 1980-81. The results of their study revealed that regional disparity has indeed increased during the nineties since the reforms. The authors concluded that states with faster growth rates in 1980s continued to grow even faster in the post-reform period, thus widening the gap between the lagging and fast growing states with no evidence of convergence. They also found negative relationship between population growth rates and states' income growth rates. Thus, states with high population growth rates have experienced lower growth rates since the reforms with the rise in associated issues of high unemployment, migration and other social conflicts. The recent studies on convergence have however, noted mixed results depending on the period of study and the number of states chosen.

Ghosh (2010) examined whether the states have converged or diverged in the pre and post-reform period. The study found that two sets of growth paths emerged among the 15 major states during the period 1960-61 to 2006-07 within which some states are converging and rest are diverging from the national average. The factors leading to convergence are variations in human capital; production structures; and physical and social infrastructure.

Das *et al.* (2010) in a study on 14 major states examined whether the states in India are converging with respect to per capita consumption; inequality and poverty. The authors examine this convergence hypothesis using unit root tests. Using household survey data for rural and urban areas separately the results of the study show that inequality and poverty have converged across both rural and urban areas. Consumption has converged at the urban level but diverged at the rural level.

Agriculture's role in economic development has been well known and documented in the literature. Birthal, *et al.* (2011) examined whether income levels across Indian states have converged and the role of agriculture within. They examined data for 15 states covering the period 1980-81 to 2004-05. They observed that since the economic reforms while the lower income states have lagged behind, the rich states with high per capita incomes have also low

² We have reviewed some of the recent studies on the subject.

rates of growth in the agricultural sector and only the middle income states have performed well. The authors found no evidence of convergence of per capita incomes across the states. The authors further argued that investment in physical infrastructure and human capital is not enough for convergence, and it is the labour market linkages between agriculture and non-agriculture sectors which hold the key to reducing the proportion of people employed in the agricultural sector.

Agarwalla and Pangotra (2011) in their study on 25 Indian states for the period 1980-2006 examined whether Indian states are converging. . The authors besides including major states (also called non-special category states) included special category states in their study as well.³ Special category states are so called as they are small in terms of population and are ethnically, culturally, socially and economically different to the rest of the country. Testing the two tests of convergence, the authors find evidence of conditional convergence in regional incomes with faster convergence taking place during the post-reform period 1992-2006.

Gaur (2010) examined inter-state disparities in India for the period 1980-81 to 2001-02. Using standard measures of inequality, Gini coefficient, Theil's index, Kakwani index and Atkinson's index, the results of the study reveal increase in inequality across the states especially since the reforms in 1991. The study argues for narrowing inter-state inequalities through devolution of taxes and grants.

Kanbur (2010) also argued that inter-state disparities have increased widely in the post-reform period since the reforms, particularly the gap between rural and urban areas. This has taken place even within the fast growing states where the less developed areas have lagged further behind. The increase in disparities has taken place both in the income and non-income indicators. The lagging regions are not only within fast growing states but they also exist in the border areas surrounding other states. The author suggests that instead of abandoning the regional policies aimed at redistribution of resources including strategic investments to lessen poverty, these should be strengthened even further as otherwise presence of fissiparous tendencies due to regional inequalities could pose a real danger to the country.

³ These are 11 in number and are Arunachal Pradesh, Assam, Himachal Pradesh, Jammu & Kashmir, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, and Uttarakhand. The typical features of a special category state, i.e., hilly terrain, sparsely populated habitation and high transport costs, etc. lead to high cost of delivering public services. With the relatively lower level of economic activity in most special category States, their tax base is limited vis-à-vis non-special category States. These States, to a large extent, depend on transfers from the Centre (comprising grants and tax devolutions) for their resource needs.

In a study on regional concentration of industrial location, regional industrial structure and industrial diversification in the post-liberalisation period, Saikia (2011) similar to the studies on inter-state disparities, observed that the concentration of industries has increased since the reforms and the less developed states have failed to catch up with more developed ones.

What has been the impact of trade openness on regional inequality? Does trade liberalisation lead to increase in regional disparities? The economic theory (Heckscher-Ohlin model) stipulates that countries will specialise and trade in goods in which they are well endowed. Thus labour abundant countries will trade in labour intensive products in exchange for capital intensive goods. It, however, presumed homogeneity of factors of production, perfect competition in commodity and factor markets, immobility of factors between countries etc. These assumptions, however, have been challenged by many studies as the trade liberalisation and regional disparities have increased simultaneously in many countries.

Changing trade composition and trade openness were thus, found as important factors in escalating regional disparities and regional inequalities (Daumal 2010; Rodriguez-Pose & Gill 2006). Rodriguez-Pose and Gill (2006) argued that the changing composition of trade, with the lessening importance of primary sector, aggravates intra-regional disparities. Conversely, the regional disparities lessen with the increase in agricultural exports. Daumal (2010) in a comparative study on the effect of trade openness on regional inequality found that while trade openness led to decline in regional inequality in Brazil, it had the opposite effect in India. However, foreign direct investment led to increase in inequalities in both the countries. Barua and Chakraborty (2010) examined the impact of economic reforms on regional inequality in India. The authors find evidence of increased regional inequality in the post-reform period. The reason for increased inequalities lies in the disparities in manufacturing and agriculture and the trade openness was a major factor leading to differential response of the regions. Barua and Sawhney (2010) examined the relationship between regional disparity and economic structure of 31 states. Topalova (2007) found that poverty incidence increased by 2 per cent in the rural districts in India with industries exposed to trade reforms. Some of the major reasons for increase in poverty were lack of geographical and inter-sectoral mobility. The study established that different regions in India experienced different effects of trade liberalisation and the regions exposed to foreign competition suffered in terms of poverty reduction.

Having scrutinised the available literature on the impact of economic reforms on regional disparities, it is evident that the empirical support for economic reforms and regional

disparities nexus is inconclusive within the Indian context. Furthermore, all available empirical studies in this area have utilised the partial equilibrium framework and general equilibrium impacts are not investigated.

4. MULTI-REGIONAL COMPUTABLE GENERAL EQUILIBRIUM (CGE) MODEL FOR INDIA

In this study, we develop a comparative static multi-regional CGE model for India in a “top down” mode which encompasses 17 regions (see Table 6). To our knowledge, this is the first such multi-regional CGE model developed for India. The Global Trade and Analysis Project (GTAP)⁴ model Indian database is used as the core CGE database and the projections of the national output and employment are disaggregated into 17 regions. The model contains 57 commodities produced by 57 industries.

The theoretical structure of the core model closely follows the ORANI model (Dixon *et al.*, 1982) with neoclassical assumptions. In addition, this model incorporates economies of scale and imperfect competition following Abayasiri-Silva and Horridge (1996). Hence this Indian CGE model is capable of modelling monopolistic competitive market structure with increasing returns to scale technology at firm level.

In the monopolistic competitive market structure, it is assumed that users differentiate between the products of different firms. Hence, firms are not price takers as in the perfect competitive markets. The model contains two alternative pricing rules to model the monopolistic competition. These are, optimal markup rule or Lerner pricing rule (LP) and the Harris’s (1984) pricing rule (HP) (for detailed description of these pricing rules see Abayasiri-Silva and Horridge, 1996; 1999). Lerner pricing rule assumes that markup has inverse relationship with the perceived elasticity of demand for firms’ products.

$$LP = [E_p / E_p - 1] C_M$$

Where,

LP = Lerner price

E_p = absolute value of the perceived elasticity of total demand for a firm

C_M = marginal cost

⁴ GTAP database version 7 (base year is 2004). See Hertel (1997) for details of the GTAP model and the database.

In percentage change form:

$L_p = c_m + e_p / (1 - E_p)$ where, l_p , c_m and e_p are percentage changes in L_P , C_M and E_p respectively.

Harris pricing rule is based on a mixed pricing rule presented in Harris (1984). It is a combination of Lerner pricing rule and the import parity pricing rule (Eastman-Stykolt's, 1966). In percentage form:

$$h_p = \partial p_m + (1 - \partial) l_p$$

Where,

h_p = Harris price

P_m = import price

∂ = parameter ($0 < \text{value} < 1$). In this simulation experiment we set $\partial = 0.5$

In the standard neoclassical model with perfect competition and constant returns to scale technology, zero pure profit condition is maintained as there are no entry barriers to new firms. However, in this monopolistic competitive model with increasing returns to scale technology we assume that in the short-run number of firms is fixed. Hence, existing firms enjoy a super normal profit in the short-run.

Regional disaggregation of the model is based on the ORANI Regional Equation System (ORES) (Dixon *et al.*, 1982). ORES is based on a technique developed by Leontief *et al.* (1965) in order to disaggregate the results of a national input-output model into regions. This method has been widely adopted by many researchers in disaggregating national CGE model results into regions in “top down” fashion (for some applications see Haddad *et al.*, 2002; Giesecke 2004; Dixon *et al.*, 2007; and Giesecke, 2008).

The shares of regional industry output, employment, household consumption and exports have been used to generate the regional results from the national results. In the “top down” regional disaggregation approach, we assume that each industry uses the same technology in each region. Furthermore, in this approach, the regional industries are divided into 2 groups, i.e., *national industries* and *local industries*. *National industries* include industries producing tradable goods which are freely traded among regions and regional output of such industry is assumed to follow the corresponding *national industry*. In contrast, *local industries* produce

commodities or services which are scarcely traded across regions. Hence, the outputs of these industries are assumed to follow local demand for those commodities. This, in turn, captures local multiplier effects within the region (Horridge, 2003). Although the “top down” approach has some limitations such as, inability to capture impact of regional policy shocks (see Dixon, *et al.*, 1982), it has some advantages such as, limited data requirement and ability to capture regional consequences of a national shock in terms of regional industry structure and regional multiplier effects (Giesecke, 2004). According to Dixon, *et al.* (2007: P. 53) “Tops-down approaches are most suitable for analysis of national policy changes (such as the removal of tariffs and quotas) that could be expected to have little effect on the relative costs of sourcing commodities from different regions”.

We adopt the “top down” regional disaggregation method due to lack of reliable regional input-output tables for India. A detailed description of this ORES based regional disaggregation method is given in Dixon *et al.*, (1982) and Horridge (2003).

Table 6: Regions in the multi-regional CGE model of India

Regions
Delhi
Punjab
Haryana
Rajasthan
Uttar Pradesh
Madhya Pradesh
Bihar
West Bengal
Assam
Orissa
Gujarat
Maharashtra
Andra Pradesh
Karnataka
Kerala
Tamil Nadu
Rest of India

5. REGIONAL IMPACT OF TRADE LIBERALISATION: SIMULATION RESULTS

In this study, we conducted a simulation experiment to understand the short-run impact of trade liberalisation on the regional growth of India. Accordingly we reduce the existing import tariffs for all tradable commodities by 50 per cent.

The experiment was carried out within a short-run macro environment (or closure). In the short-run closure⁵, all sectoral capital is exogenised and as we assume a slack labour market, the total employment is endogenised. Furthermore, sectoral rates of return and real private consumption are also considered endogenous. In this simulation the nominal exchange rate, which is exogenous, is considered as the numeraire. The CGE model was solved using the GEMPACK software suite (Harrison & Pearson, 1998).

As a sensitivity analysis, we conducted the above simulation using monopolistic competitive market structure with increasing return to scale. In this simulation Harris pricing (HP) rule was used in addition to marginal cost pricing. Furthermore, we assumed only the manufacturing sector was operating within a monopolistic competitive market with increasing return to scale technology. Agricultural and service sectors were assumed to follow perfectly competitive market structure with constant return to scale technology.

a. Macroeconomic and industry effects

The percentage change results of important macro variables over the base year values for the simulation experiment with the standard model (with perfectly competitive market structure with constant returns to technology) are summarized in Table 7.

Preliminary results of the simulation exercise suggest that trade liberalisation bodes well for the national economy wherein real GDP increases by 1.04 percent and the aggregate employment increases by 1.54 per cent from the basecase.

Under the monopolistic competitive and increasing returns to scale model, GDP increases by 2.65 per cent and the aggregate employment increases by 4.3 per cent from the basecase (see Table 8).

⁵ The following variables are assumed to be exogenous: agricultural land, all technological change, real wages, real investment, real government demand, demand for inventories by commodity, all sales tax rates and commodity specific shifters, foreign prices of imports and exports, number of households and their consumption preferences and real unit cost of 'other cost tickets' (Production subsidies etc.)

Both simulations, with the standard model and the monopolistic competitive manufacturing sector with increasing returns to scale, yield a positive increase in real GDP and aggregate employment which suggests that trade liberalisation stimulates growth as found in many empirical studies in the literature. However, it can be seen that the effects are more pronounced in the monopolistic competitive and increasing returns to scale model compared to that of the standard model. These results are consistent with the outcome of Harris (1984) for the Canadian economy. Under the monopolistic competitive market structure the manufacturing industries enjoy a super normal profit in the short-run. Similarly, under increasing returns to scale technology assumption, firm's unit cost falls as output increases. Thus, in the event of a reduction in tariffs, the export industries that would benefit by cheap imported inputs will increase their existing supernormal profit margins and expand their production compared to manufacturing industries under perfectly competitive market structure. This is evident from comparing the manufacturing industry output and employment results presented in Tables 9 and 10 for the standard model and the monopolistic competitive model.

Table 7

Projections of percentage change in macro variables under standard model assumptions

Macro Variable	Short-run projections
Employment	1.54
Real Imports	6.16
Real Exports	11.37
Real Household consumption	0.61
Real GDP	1.04
Consumer Price Index	-2.52

% change from the basecase

Table 8

Projections of percentage change in macro variables under increasing returns to scale and monopolistic competitive model assumptions

Macro Variable	Short-run projections
Employment	4.30
Real Imports	6.93
Real Exports	17.14
Real Household consumption	1.84
Real GDP	2.65
Consumer Price Index	-1.31

% change from the basecase

Under the standard model, the Industry level value added results suggest that the manufacturing industries such as *meat products, wearing apparel, textiles, leather products* and *manufacturing nec* have been positively affected in the short-run (see Table 9). Furthermore, service industries such as *business services* and *sea transport* have also been stimulated. In contrast, agricultural industries such as *vegetable oils and fats, sugarcane, sugar beet, oil seeds, wool, silk-worm cocoons, vegetables, fruit, nuts* and *crops nec* and manufacturing industries such as, *beverages and tobacco products, sugar* and *paper products, publishing* have shown a contraction in the short-run. It is evident that export industries which face elastic demand are the main winners under this policy shock and the import substitution industries tend to suffer from cheaper imports. Furthermore, these results are consistent with the proposition that previously heavily protected industries suffer when trade is liberalised.

Under the monopolistic competitive model (see Table 10) industries, particularly the manufacturing industries perform well compared to those under the standard model. As described previously the export industries expand their production taking the advantage of cheaper imported inputs as well as the increasing returns to scale technology. The other industries also enjoy some gains by gaining from the reduction in the cost of imported inputs as well as the increase in derived demand for intermediated goods from the expanding industries.

Table 9
Short-run projections of percentage change in industry variables under standard model assumptions

Industry	Industry output	Industry employment
Paddy rice	0.38	0.99
Wheat	0.38	1.00
Cereal grains nec	0.37	0.96
Vegetables, fruit, nuts	-0.20	-0.52
Oil seeds	-0.58	-1.52
Sugar cane, sugar beet	-0.34	-0.91
Plant-based fibers	1.12	2.94
Crops nec	-0.05	-0.13
Cattle,sheep,goats,horses	0.09	0.24
Animal products nec	0.47	1.24
Raw milk	0.54	1.43
Wool, silk-worm cocoons	-0.21	-0.56
Forestry	0.35	0.77
Fishing	0.30	1.03
Coal	-0.71	-3.07
Oil	-0.14	-0.56
Gas	0.93	3.78
Minerals nec	0.30	0.92
Meat: cattle,sheep,goats,horse	1.98	5.04
Meat products nec	12.33	20.38
Vegetable oils and fats	-8.22	-21.57
Dairy products	0.49	1.07
Processed rice	0.56	0.72
Sugar	-1.80	-4.24
Food products nec	0.83	1.77
Beverages and tobacco products	-1.70	-4.41
Textiles	2.17	2.87
Wearing apparel	8.21	10.85

Continued

Industry	Industry output	Industry employment
Leather products	3.29	7.60
Wood products	1.22	1.80
Paper products, publishing	-0.39	-0.81
Petroleum, coal products	2.17	8.26
Chemical, rubber, plastic prods	1.25	5.60
Mineral products nec	1.64	6.10
Ferrous metals	1.07	5.00
Metals nec	0.91	2.59
Metal products	1.56	5.95
Motor vehicles and parts	0.22	0.45
Transport equipment nec	0.61	0.88
Electronic equipment	3.23	9.23
Machinery and equipment nec	0.68	2.88
Manufactures nec	4.93	10.10
Electricity	0.88	2.73
Gas manufacture, distribution	0.58	1.17
Water	0.56	1.14
Construction	0.15	0.19
Trade	0.80	2.30
Transport nec	0.98	1.56
Sea transport	2.92	4.72
Air transport	1.34	2.17
Communication	0.98	4.16
Financial services nec	1.01	3.57
Insurance	1.12	3.99
Business services nec	3.55	5.65
Recreation and other services	0.95	1.51
PubAdmin/Defence/Health/Educat	0.29	0.35
Dwellings	0.24	3.91

% change from the basecase

Table 10
Short-run projections of percentage change in industry variables under increasing returns to scale and monopolistic competitive model assumptions

Industry	Industry output	Industry employment
Paddy rice	0.98	2.59
Wheat	0.89	2.35
Cereal grains nec	0.76	2.00
Vegetables, fruit, nuts	0.30	0.80
Oil seeds	1.02	2.69
Sugar cane, sugar beet	0.78	2.07
Plant-based fibers	3.26	8.59
Crops nec	0.44	1.17
Cattle,sheep,goats,horses	0.93	2.44
Animal products nec	1.22	3.20
Raw milk	1.50	3.94
Wool, silk-worm cocoons	-0.10	-0.27
Forestry	0.88	1.91
Fishing	0.84	2.91
Coal	-0.27	-1.16
Oil	-0.13	-0.50
Gas	2.49	10.13
Minerals nec	0.94	2.86
Meat: cattle,sheep,goats,horse	5.52	14.06
Meat products nec	38.73	64.03
Vegetable oils and fats	1.86	4.88
Dairy products	2.41	5.20
Processed rice	1.51	1.95
Sugar	0.87	2.05
Food products nec	3.33	7.08
Beverages and tobacco products	1.47	3.80
Textiles	6.49	8.59
Wearing apparel	16.42	21.70

Continued

Industry	Industry output	Industry employment
Leather products	8.24	19.05
Wood products	2.74	4.05
Paper products, publishing	1.26	2.62
Petroleum, coal products	3.66	13.95
Chemical, rubber, plastic prods	3.94	17.67
Mineral products nec	2.57	9.55
Ferrous metals	4.51	21.03
Metals nec	5.49	15.66
Metal products	3.45	13.17
Motor vehicles and parts	3.80	7.78
Transport equipment nec	2.25	3.28
Electronic equipment	2.32	6.61
Machinery and equipment nec	2.46	10.36
Manufactures nec	10.41	21.33
Electricity	2.61	8.10
Gas manufacture, distribution	1.70	3.45
Water	1.43	2.89
Construction	0.25	0.32
Trade	2.29	6.64
Transport nec	2.46	3.93
Sea transport	3.22	5.21
Air transport	2.68	4.33
Communication	1.32	5.63
Financial services nec	2.15	7.63
Insurance	1.54	5.45
Business services nec	2.92	4.65
Recreation and other services	2.48	3.94
PubAdmin/Defence/Health/Educat	0.66	0.79
Dwellings	0.72	11.54

% change from the basecase

b. Regional effects

Under the standard model, when we consider short-run impact of trade liberalisation on economic growth at the state level results such as, gross domestic product at the state level, it is evident that poor states such as *Orissa*, *Uttar Pradesh*, *Assam* and *Rajasthan* show a marginal growth, while *Bihar* and *Madhya Pradesh* portray a negative growth. In contrast, middle income states such as *Karnataka* and *Kerala* demonstrate higher economic growth compared to other middle income states. Of the richer states, *Tamil Nadu* shows the highest growth, while *Punjab* shows a moderate growth.

It is evident that middle income states such as *Karnataka* and high income states such as *Tamil Nadu* benefit substantially by trade liberalisation as manufacturing industries are largely located in these states. In addition, service industries that are having direct link to manufacturing operations such as *Trade*, *Business services* and *Financial services* also tend to contribute to higher growth in above states. Appendix Table 1A presents the industry contribution to percentage change of Gross State Domestic Product (GSDP) under standard model assumptions. According to Appendix Table 1A it can be observed that *Textiles*, *Wearing apparel* and *Trade* contribute mostly to the higher growth in *Tamil Nadu*. Industries such as *Manufacturing nec*, *Trade* and *Business services* mainly contribute to the growth in *Karnataka* while manufacturing industries such as *Food products nec* and service industries such as *Trade* having a higher contribution to growth in *Kerala*. *Delhi* shows the highest growth among all states. It can be observed that service industries such as *Financial services nec*, *Trade*, *Business services nec*, *Transport nec*, *Construction* and *Electricity* contribute most to the higher growth in *Delhi*.

Simulation results indicate that, in general, poor states benefited least by the trade liberalisation in the short-run. Among the poor states *Bihar* and *Madhya Pradesh* affected most. It is evident that agriculture related industries which were enjoying higher protection such as *Vegetable oils and fats*, *Oil seeds*, *Vegetables*, *fruit*, *nuts* mainly contribute to the negative growth in above states. In addition, service industries such as *Trade*, *Construction*, *Financial services nec* tend to detract from growth in these states.

Table 11**Projections of percentage change in Gross State Domestic Product (GSDP) under standard model assumptions**

Region	Short-run projections
Delhi	3.30
Punjab	0.67
Haryana	0.85
Rajasthan	0.12
Uttar Pradesh	0.20
Madhya Pradesh	-0.27
Bihar	-0.16
West_Bengal	0.57
Assam	0.22
Orissa	0.48
Gujarat	0.74
Maharashtra	0.75
Andhra_pradesh	0.60
Karnataka	1.25
Kerala	1.13
Tamilnadu	1.25
Rest of India	0.61

% change from the basecase

Under the monopolistic competitive model, short-run impact of trade liberalisation on economic growth at the state level seems better compared to that of the standard model (see Table 12 and Figure 2). However, *Bihar*, *Assam* and *Madhya Pradesh* experience lowest growth among all the states. Appendix Table 2A presents industry contribution to percentage change in Gross State Domestic Product (GSDP) under monopolistic competitive model assumptions. According to Appendix Table 2A agricultural industries contribute positively to growth in the above states, while service industries detract from growth.

Tamil Nadu and *Karnataka* demonstrate highest regional growth compared to all the other states. It is evident that manufacturing industries and service industries contribute a substantially to growth in the above states. As described previously, the manufacturing industries expand their production taking advantage of cheaper imported inputs as well as increasing returns to scale technology.

Table 12

Projections of percentage change in Gross State Domestic Product (GSDP) under increasing returns to scale and monopolistic competitive model assumptions

Region	Short-run projections
Delhi	2.11
Punjab	2.11
Haryana	2.54
Rajasthan	1.56
Uttarpradesh	1.30
Madhyapradesh	1.24
Bihar	0.10
West Bengal	1.56
Assam	0.62
Orissa	1.26
Gujarat	2.57
Maharashtra	2.26
Andrapradesh	1.57
Karnataka	3.03
Kerala	1.82
Tamilnadu	3.35
Rest of India	1.81

% change from the basecase

Overall, our results suggest that, in the short-run, trade liberalisation has a beneficial impact on the rich and fast growing middle income states and marginal or negative impact on the poor states. Thus, in the short- run, trade liberalisation would tend to widen the gap between the rich and the poor states in India. These results are consistent with previous investigations on India by Birthal, *et al.* (2011); Gaur (2010); and Barua and Chakraborty (2010).

It is also evident that under monopolistic competitive market structure with increasing returns to scale technology in the manufacturing sector, the national economy and regional economies are stimulated significantly compared to the results of the standard model.

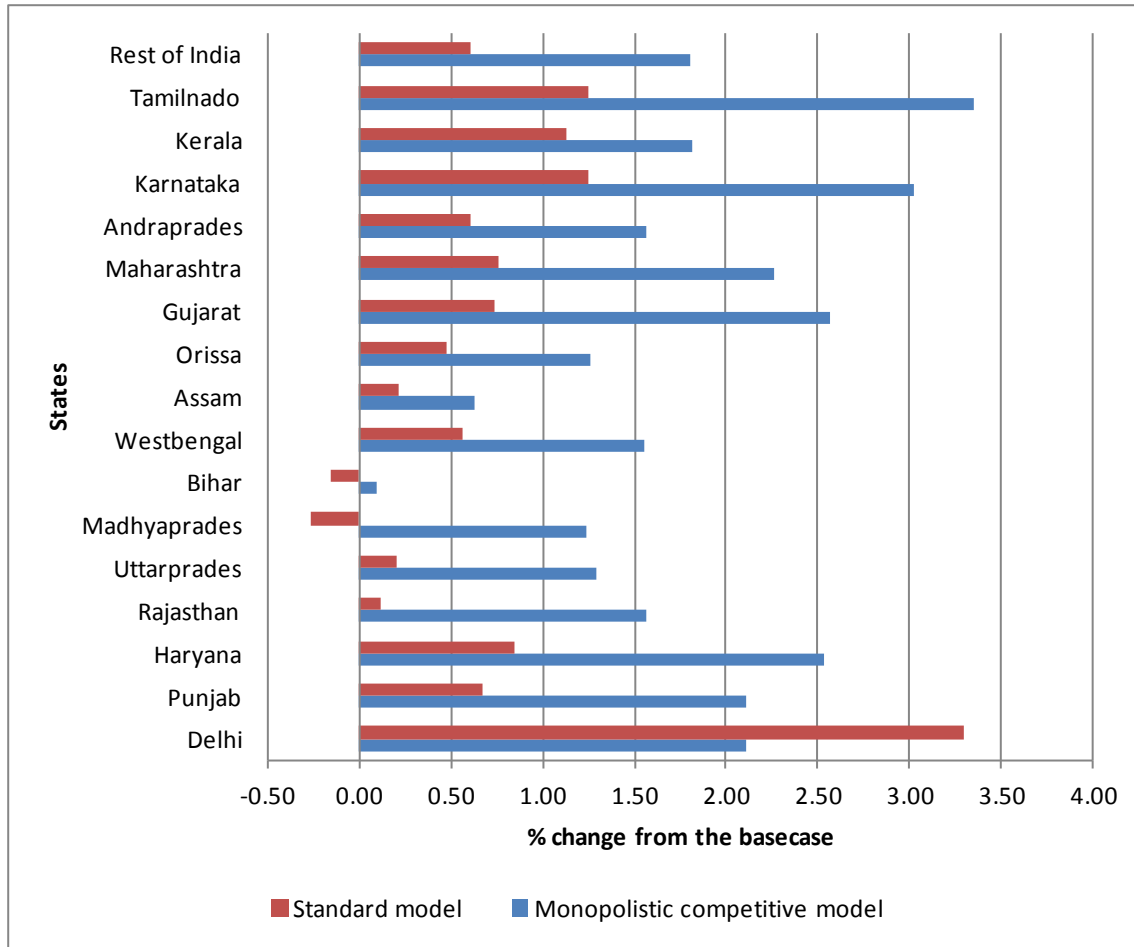


Figure 2 Comparison of Gross State Domestic Product under the standard model and the monopolistic competitive model

6. CONCLUDING REMARKS AND POLICY IMPLICATIONS

In this study we attempted to identify and quantify the regional impact of trade liberalisation within a general equilibrium framework using a multi-regional CGE model for India. Two model simulations were conducted under perfect competition with constant returns to scale technology assumption and the monopolistic competitive market structure with increasing return to scale technology assumption.

Overall results imply that, in the short-run, trade liberalisation has a positive impact on the rich and fast growing middle income states and marginal or negative impact on the poor states. Thus, in the short-run, trade liberalisation is likely to widen the gap between the rich and the poor states in India. Further, it is evident that under monopolistic competitive market structure with increasing returns to scale technology in the manufacturing sector, the national

economy and the regional economies are stimulated significantly compared to the results of the standard model.

Based on the above general equilibrium analysis, it is evident that to create a more 'inclusive' growth, trade reforms should be complemented by other policy measures that would promote regional equality. Policies such as providing tax concession to manufacturing industries to locate their businesses in less developed states, promoting agro-based manufacturing industries within backward states, increasing government investments and promoting public-private participation in infrastructure development in less developed states, increase spending on education in less developed states to increase the quality and quantity of human capital and implementing measures that would increase productivity in less developed states would reduce the gap between the rich and the poor states. Furthermore, policies that would promote capital and labour mobility will also help to reduce regional inequality in India.

Understanding regional impact of trade reforms will also help in designing better targeted and robust poverty reduction programmes within vulnerable states in India.

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APPENDIX

Table A1: Industry contribution to percentage change of Gross State Domestic Product under standard model assumptions

Industry	Delhi	Punjab	Haryana	Rajasthan	Uttarprades	Madhyaprades	Bihar	Westbengal	Assam	Orissa	Gujarat	Maharashtra	Andraprades	Karnataka	Kerala	Tamilnado	Rest of India
Paddy rice	0.00006	0.02412	0.00780	0.00050	0.01239	0.00283	0.01270	0.01954	0.01993	0.01961	0.00116	0.00178	0.01408	0.00588	0.00138	0.00614	0.00030
Wheat	0.00000	0.03978	0.02744	0.01698	0.03403	0.01478	0.01410	0.00108	0.00034	0.00002	0.00253	0.00123	0.00002	0.00045	0.00000	0.00000	0.00016
Cereal grains nec	0.00000	0.00111	0.00258	0.01307	0.00281	0.00373	0.00429	0.00039	0.00007	0.00047	0.00148	0.00372	0.00458	0.00875	0.00000	0.00174	0.00026
Vegetables, fruit, nuts	-0.00123	-0.00533	-0.00512	-0.00130	-0.01399	-0.00535	-0.03234	-0.01787	-0.01224	-0.01879	-0.00545	-0.00747	-0.00923	-0.00967	-0.00591	-0.00869	-0.00561
Oil seeds	0.00000	-0.00132	-0.01622	-0.08266	-0.00951	-0.10828	-0.00302	-0.00562	-0.00581	-0.00391	-0.02688	-0.01900	-0.01901	-0.01518	-0.00003	-0.00926	-0.00121
Sugar cane, sugar beet	0.00000	-0.00216	-0.00238	-0.00017	-0.02391	-0.00123	-0.00290	-0.00042	-0.00123	-0.00037	-0.00277	-0.00901	-0.00356	-0.00779	-0.00014	-0.00776	-0.00005
Plant-based fibers	0.00000	0.02101	0.01715	0.00615	0.00000	0.00706	0.01418	0.04078	0.01508	0.00301	0.02491	0.01413	0.01781	0.00576	0.00002	0.00088	0.00001
Crops nec	0.00000	-0.00189	-0.00164	-0.00096	0.00000	-0.00308	0.00000	0.00000	0.00000	-0.00020	-0.00678	-0.00129	-0.00340	-0.00055	0.00000	-0.00051	0.00000
Cattle,sheep,goats,horses	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Animal products nec	0.00001	0.00353	0.00957	0.00174	0.00159	0.00224	0.00502	0.01594	0.02484	0.00874	0.00171	0.00689	0.02054	0.01008	0.00555	0.02165	0.00491
Rawmilk	0.00018	0.00466	0.00286	0.00434	0.00457	0.00305	0.00372	0.00115	0.00091	0.00104	0.00161	0.00119	0.00238	0.00163	0.00130	0.00144	0.00086
Wool, silk-worm cocoons	0.00000	-0.00013	-0.00036	-0.00347	-0.00021	-0.00010	-0.00009	-0.00011	0.00000	0.00000	-0.00033	-0.00016	-0.00067	-0.00153	0.00000	0.00000	-0.00073
Forestry	0.00016	0.00239	0.00131	0.00808	0.00564	0.00659	0.00538	0.00260	0.00686	0.00601	0.00311	0.00626	0.00363	0.00626	0.00451	0.00164	0.00508
Fishing	0.00001	0.00067	0.00050	0.00026	0.00137	0.00056	0.00334	0.01106	0.00465	0.00335	0.00153	0.00099	0.00872	0.00135	0.00405	0.00252	0.00177
Coal	0.00000	0.00000	0.00000	0.00000	-0.00019	-0.00715	-0.00008	-0.00600	0.00000	-0.03106	0.00000	-0.00124	-0.00361	0.00000	0.00000	0.00000	-0.01206
Oil	0.00000	0.00000	0.00000	0.00000	-0.00008	-0.00293	-0.00003	-0.00246	0.00000	-0.01273	0.00000	-0.00051	-0.00148	0.00000	0.00000	0.00000	-0.00494
Gas	0.00000	0.00000	0.00000	0.00000	0.00028	0.01057	0.00011	0.00887	0.00000	0.04595	0.00000	0.00184	0.00534	0.00000	0.00000	0.00000	0.01783
Minerals nec	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.02116	0.00114	0.00110	0.00000	0.00000	0.00000	0.00098
Meat: cattle,sheep,goats,horse	0.00135	0.00016	0.00259	0.00002	0.00329	0.00061	0.00782	0.00953	0.00228	0.00229	0.00025	0.00267	0.00806	0.00253	0.00211	0.00214	0.00235
Meat products nec	0.00001	0.00000	0.00002	0.00000	0.00003	0.00001	0.00007	0.00009	0.00002	0.00002	0.00000	0.00003	0.00008	0.00002	0.00002	0.00002	0.00002
Vegetable oils and fats	0.00000	-0.00150	-0.01846	-0.09408	-0.01082	-0.12323	-0.00344	-0.00639	-0.00661	-0.00445	-0.03059	-0.02162	-0.02164	-0.01727	-0.00003	-0.01054	-0.00138
Dairy products	0.00054	0.01438	0.00883	0.01340	0.01410	0.00941	0.01149	0.00356	0.00280	0.00321	0.00496	0.00367	0.00735	0.00502	0.00400	0.00445	0.00266
Processed rice	0.00009	0.03740	0.01209	0.00077	0.01921	0.00439	0.01969	0.03030	0.03090	0.03041	0.00180	0.00275	0.02182	0.00911	0.00214	0.00951	0.00047
Sugar	0.00000	-0.00188	-0.00208	-0.00014	-0.02086	-0.00107	-0.00253	-0.00037	-0.00108	-0.00033	-0.00242	-0.00786	-0.00311	-0.00680	-0.00012	-0.00677	-0.00004
Food products nec	0.01514	0.03447	0.02482	0.01640	0.02924	0.04667	0.00289	0.01395	0.02897	0.00784	0.03896	0.03032	0.03549	0.02826	0.13351	0.02546	-0.01931
Beverages and tobacco products	-0.00163	-0.01567	-0.00546	-0.00507	-0.01406	-0.00372	-0.00916	-0.00501	-0.00954	-0.00255	-0.00255	-0.00709	-0.01743	-0.02091	-0.00287	-0.00609	-0.00299
Textiles	0.00471	0.11043	0.03457	0.07276	0.01887	0.03807	0.00045	0.02439	0.00187	0.00120	0.07846	0.05301	0.02125	0.01142	0.00975	0.12595	0.04163
Wearing apparel	0.09084	0.06410	0.13005	0.01086	0.02561	0.00433	0.00000	0.00820	0.00015	0.00000	0.00734	0.02514	0.00437	0.09889	0.00470	0.12991	0.00432

Continued

Industry	Delhi	Punjab	Haryana	Rajasthan	Uttarprades	Madhyaprades	Bihar	Westbengal	Assam	Orissa	Gujarat	Maharashtra	Andraprades	Karnataka	Kerala	Tamilnado	Rest of India
Leather products	0.01208	0.00603	0.01881	0.00342	0.02531	0.00503	0.00075	0.01920	0.00000	0.00000	0.00026	0.00276	0.00121	0.00253	0.00421	0.03664	0.00386
Wood products	0.00004	0.00221	0.01432	0.00859	0.00240	0.00090	0.00095	0.01313	0.00508	0.00181	0.00753	0.00276	0.00266	0.00410	0.01491	0.00528	0.00395
Paper products, publishing	-0.00049	-0.00309	-0.00139	-0.00108	-0.00195	-0.00085	-0.00012	-0.00044	-0.00224	-0.00216	-0.00298	-0.00168	-0.00211	-0.00230	-0.00108	-0.00267	-0.00172
Petroleum, coal products	0.00001	0.00000	0.00003	0.00022	0.00520	0.00021	0.01008	0.00455	0.01925	0.00077	0.01769	0.01138	0.00041	0.00994	0.01034	0.00648	0.00358
Chemical,rubber,plastic prods	0.00405	0.01326	0.01408	0.02250	0.01763	0.00937	0.00016	0.02522	0.00872	0.03361	0.08761	0.04572	0.02342	0.01571	0.01287	0.01444	0.02193
Mineral products nec	0.00009	0.00454	0.00342	0.02887	0.00382	0.01546	0.00138	0.00400	0.00327	0.00932	0.01166	0.00635	0.01613	0.00905	0.00238	0.01053	0.00650
Ferrous metals	0.00097	0.01069	0.00743	0.00596	0.00529	0.00415	0.00100	0.01445	0.00154	0.03098	0.01096	0.01350	0.00733	0.01112	0.00426	0.00500	0.02089
Metals nec	0.00020	0.00224	0.00156	0.00125	0.00111	0.00087	0.00021	0.00303	0.00032	0.00650	0.00230	0.00283	0.00154	0.00233	0.00089	0.00105	0.00438
Metal products	0.00468	0.01661	0.01500	0.00915	0.00996	0.00419	0.00034	0.00603	0.00043	0.00290	0.02526	0.03012	0.01112	0.00884	0.00068	0.02831	0.00796
Motor vehicles and parts	0.00014	0.00077	0.01071	0.00049	0.00132	0.00070	0.00000	0.00004	0.00000	0.00031	0.00325	0.00015	0.00189	0.00000	0.00600	0.00070	0.00070
Transport equipment nec	0.00036	0.01060	0.03235	0.00054	0.00104	0.00041	0.00003	0.00279	0.00000	0.00000	0.00285	0.00819	0.00125	0.00394	0.00253	0.00384	0.00174
Electronic equipment	0.00434	0.00193	0.00263	0.01825	0.02585	0.00138	0.00000	0.00276	0.00003	0.00000	0.00424	0.01570	0.00699	0.01299	0.00432	0.01468	0.01988
Machinery and equipment nec	0.00137	0.00769	0.01709	0.00221	0.00669	0.00419	0.00024	0.00237	0.00012	0.00030	0.01148	0.02723	0.00334	0.02017	0.00111	0.01644	0.01431
Manufactures nec	0.01132	0.01376	0.02284	0.03236	0.03177	0.00085	0.00032	0.00444	0.00000	0.00000	0.14002	0.24747	0.01560	0.25900	0.00403	0.08407	0.02038
Electricity	0.15165	0.01793	0.02336	0.01005	0.01043	-0.00885	-0.00425	0.02603	0.00974	0.02372	0.02405	0.00774	0.02587	0.05695	0.05634	0.04927	0.05549
Gas manufacture, distribution	0.00059	0.00005	0.00009	-0.00004	-0.00003	-0.00010	-0.00007	0.00005	0.00000	0.00003	0.00007	0.00001	0.00003	0.00020	0.00018	0.00019	0.00013
Water	0.00585	0.00080	0.00086	0.00009	0.00003	-0.00042	-0.00029	0.00104	0.00011	0.00108	0.00136	0.00020	0.00264	0.00191	0.00219	0.00198	0.00159
Construction	0.17771	0.00303	0.01266	-0.02959	-0.01791	-0.03316	-0.04360	0.00042	-0.01422	0.00047	0.00732	0.00463	0.00603	0.03528	0.04212	0.03073	0.00387
Trade	0.64558	0.05736	0.14031	-0.01273	0.00102	-0.07428	-0.09307	0.06805	0.01061	0.04632	0.10508	0.02012	0.05776	0.17298	0.21323	0.21846	0.17396
Transport nec	0.20248	0.03909	0.04743	0.01265	0.01415	-0.01389	-0.00765	0.03747	0.01658	0.03015	0.03984	0.00904	0.04049	0.08050	0.07228	0.08268	0.08423
Sea transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.07269	0.00000	0.10887	0.03711	0.01361	0.07091	0.05037	0.08539	0.06366	0.00000
Air transport	0.07080	-0.00001	0.00000	-0.00067	-0.00035	-0.00143	-0.00050	0.00062	-0.00090	-0.00021	0.00015	0.00419	0.00088	0.00587	0.00086	0.00381	-0.00003
Communication	0.04093	0.00519	0.00469	0.00237	0.00295	-0.00214	-0.00188	0.00864	0.00199	0.00375	0.01031	0.00023	0.01061	0.01301	0.02938	0.01803	0.03338
Financial services nec	0.81096	0.04116	0.02876	-0.00030	-0.00388	-0.02829	-0.03138	0.02582	0.00411	0.03012	0.02129	0.03030	0.02164	0.07277	0.08616	0.05258	0.00895
Insurance	0.10349	0.00884	0.00494	0.00266	0.00138	-0.00139	-0.00173	0.00666	0.00904	0.00821	0.00402	0.00570	0.00442	0.01188	0.01414	0.00915	0.00232
Business services nec	0.47225	0.05272	0.15228	0.07079	0.02253	0.05183	0.03198	0.04366	0.06018	0.07389	0.01832	0.03299	0.08957	0.14831	0.19202	0.09119	0.01595
Recreation and other services	0.07578	0.01119	0.00633	0.00229	0.00250	-0.00735	-0.00444	0.01455	0.00766	0.00771	0.00803	0.04839	0.00986	0.01915	0.02364	0.01888	0.02100
PubAdmin/Defence/Health/Educat	0.13629	0.01385	0.01013	-0.00687	-0.00567	-0.02109	-0.01531	0.01460	0.00193	0.00645	0.01003	0.08036	0.07706	0.03087	0.03317	0.03046	0.02697
Dwellings	0.25217	0.00492	0.02479	-0.04505	-0.03974	-0.07437	-0.05465	-0.00198	-0.02969	-0.00612	0.01866	0.00034	0.00105	0.07252	0.05476	0.06808	0.01580

Table A2: Industry contribution to percentage change of Gross State Domestic Product under increasing returns to scale and monopolistic competitive model assumptions

Industry	Delhi	Punjab	Haryana	Rajasthan	Uttarprades	Madhyaprades	Bihar	Westbengal	Assam	Orissa	Gujarat	Maharashtra	Andraprades	Karnataka	Kerala	Tamilnado	Rest of India
Paddy rice	0.00015	0.06279	0.02029	0.00129	0.03225	0.00736	0.03305	0.05086	0.05187	0.05105	0.00302	0.00462	0.03664	0.01530	0.00358	0.01597	0.00079
Wheat	0.00000	0.09349	0.06448	0.03991	0.07996	0.03472	0.03313	0.00253	0.00079	0.00006	0.00595	0.00290	0.00005	0.00106	0.00000	0.00000	0.00038
Cereal grains nec	0.00000	0.00231	0.00535	0.02707	0.00582	0.00772	0.00888	0.00082	0.00015	0.00096	0.00306	0.00770	0.00948	0.01813	0.00001	0.00361	0.00054
Vegetables, fruit, nuts	0.00188	0.00813	0.00781	0.00198	0.02135	0.00816	0.04935	0.02727	0.01867	0.02866	0.00831	0.01140	0.01409	0.01476	0.00902	0.01326	0.00856
Oil seeds	0.00000	0.00235	0.02884	0.14695	0.01690	0.19249	0.00537	0.00998	0.01032	0.00695	0.04778	0.03377	0.03380	0.02698	0.00005	0.01646	0.00215
Sugar cane, sugar beet	0.00000	0.00492	0.00542	0.00038	0.05451	0.00281	0.00660	0.00096	0.00281	0.00085	0.00631	0.02054	0.00812	0.01776	0.00031	0.01770	0.00010
Plant-based fibers	0.00000	0.06133	0.05007	0.01795	0.00001	0.02062	0.04140	0.11907	0.04403	0.00878	0.07275	0.04125	0.05201	0.01682	0.00004	0.00258	0.00002
Crops nec	0.00000	0.01705	0.01482	0.00868	0.00000	0.02783	0.00000	0.00000	0.00176	0.06127	0.01165	0.01165	0.03075	0.00494	0.00002	0.00458	0.00001
Cattle,sheep,goats,horses	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00001	0.00001	0.00000	0.00000	0.00000	0.00000	0.00001	0.00000	0.00000	0.00000	0.00000
Animal products nec	0.00002	0.00911	0.02471	0.00448	0.00410	0.00579	0.01297	0.04114	0.06413	0.02257	0.00442	0.01779	0.05302	0.02602	0.01433	0.05589	0.01268
Raw milk	0.00048	0.01282	0.00788	0.01194	0.01257	0.00839	0.01024	0.00317	0.00250	0.00286	0.00442	0.00327	0.00655	0.00448	0.00357	0.00397	0.00237
Wool, silk-worm cocoons	0.00000	-0.00006	-0.00017	-0.00165	-0.00010	-0.00005	-0.00005	-0.00005	0.00000	0.00000	-0.00016	-0.00008	-0.00032	-0.00073	0.00000	0.00000	-0.00035
Forestry	0.00039	0.00595	0.00328	0.02014	0.01406	0.01643	0.01341	0.00647	0.01710	0.01498	0.00774	0.01560	0.00905	0.01561	0.01125	0.00408	0.01268
Fishing	0.00003	0.00189	0.00142	0.00075	0.00389	0.00158	0.00944	0.03128	0.01316	0.00947	0.00432	0.00279	0.02468	0.00383	0.01146	0.00714	0.00500
Coal	0.00000	0.00000	0.00000	0.00000	-0.00007	-0.00270	-0.00003	-0.00226	0.00000	-0.01172	0.00000	-0.00047	-0.00136	0.00000	0.00000	0.00000	-0.00455
Oil	0.00000	0.00000	0.00000	0.00000	-0.00007	-0.00264	-0.00003	-0.00222	0.00000	-0.01148	0.00000	-0.00046	-0.00133	0.00000	0.00000	0.00000	-0.00446
Gas	0.00000	0.00000	0.00000	0.00000	0.00076	0.02836	0.00031	0.02378	0.00001	0.12322	0.00000	0.00493	0.01432	0.00000	0.00000	0.00000	0.04783
Minerals nec	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.06589	0.00354	0.00342	0.00000	0.00000	0.00000	0.00305
Meat: cattle,sheep,goats,horse	0.00378	0.00044	0.00722	0.00005	0.00918	0.00171	0.02184	0.02662	0.00636	0.00640	0.00069	0.00746	0.02251	0.00708	0.00588	0.00597	0.00655
Meat products nec	0.00004	0.00001	0.00008	0.00000	0.00010	0.00002	0.00023	0.00028	0.00007	0.00001	0.00001	0.00008	0.00024	0.00007	0.00006	0.00006	0.00007
Vegetable oils and fats	0.00000	0.00034	0.00418	0.02130	0.00245	0.02790	0.00078	0.00145	0.00150	0.00101	0.00693	0.00490	0.00490	0.00391	0.00001	0.00239	0.00031
Dairy products	0.00263	0.07010	0.04307	0.06532	0.06876	0.04587	0.05602	0.01736	0.01367	0.01564	0.02420	0.01791	0.03584	0.02450	0.01953	0.02171	0.01296
Processed rice	0.00024	0.10103	0.03265	0.00207	0.05189	0.01184	0.05319	0.08184	0.08346	0.08215	0.00485	0.00744	0.05895	0.02462	0.00577	0.02570	0.00127
Sugar	0.00000	0.00091	0.00100	0.00007	0.01007	0.00052	0.00122	0.00018	0.00052	0.00016	0.00117	0.00379	0.00150	0.00328	0.00006	0.00327	0.00002
Food products nec	0.06052	0.13780	0.09922	0.06556	0.11691	0.18661	0.01156	0.05577	0.11584	0.03134	0.15576	0.12122	0.14189	0.11297	0.53380	0.10179	-0.07721
Beverages and tobacco products	0.00140	0.01351	0.00471	0.00437	0.01213	0.00321	0.00790	0.00432	0.00822	0.00220	0.00220	0.00611	0.01502	0.01802	0.00248	0.00525	0.00258
Textiles	0.01408	0.33029	0.10341	0.21763	0.05644	0.11388	0.00135	0.07295	0.00558	0.00358	0.23467	0.15857	0.06357	0.03417	0.02917	0.37672	0.12452
Wearing apparel	0.18158	0.12812	0.25996	0.02171	0.05120	0.00865	0.00000	0.01640	0.00030	0.00000	0.01467	0.05026	0.00873	0.19767	0.00939	0.25968	0.00863

Continued

Industry	Delhi	Punjab	Haryana	Rajasthan	Uttarprades	Madhyaprades	Bihar	Westbengal	Assam	Orissa	Gujarat	Maharashtra	Andraprades	Karnataka	Kerala	Tamilnado	Rest of India
Leather products	0.03027	0.01512	0.04712	0.00856	0.06342	0.01260	0.00187	0.04810	0.00000	0.00000	0.00066	0.00693	0.00303	0.00635	0.01056	0.09182	0.00968
Wood products	0.00009	0.00496	0.03220	0.01932	0.00540	0.00203	0.00214	0.02953	0.01142	0.00407	0.01694	0.00622	0.00598	0.00922	0.03353	0.01186	0.00889
Paper products, publishing	0.00159	0.01001	0.00449	0.00349	0.00630	0.00275	0.00040	0.00143	0.00724	0.00699	0.00964	0.00543	0.00683	0.00744	0.00348	0.00864	0.00556
Petroleum, coal products	0.00001	0.00001	0.00005	0.00037	0.00877	0.00036	0.01702	0.00768	0.03251	0.00129	0.02987	0.01921	0.00068	0.01678	0.01747	0.01094	0.00605
Chemical,rubber,plastic prods	0.01277	0.04182	0.04439	0.07097	0.05559	0.02956	0.00050	0.07954	0.02750	0.10601	0.27632	0.14419	0.07386	0.04956	0.04059	0.04555	0.06916
Mineral products nec	0.00015	0.00710	0.00535	0.04514	0.00597	0.02418	0.00216	0.00626	0.00511	0.01458	0.01823	0.00994	0.02523	0.01415	0.00373	0.01647	0.01017
Ferrous metals	0.00408	0.04498	0.03127	0.02509	0.02227	0.01747	0.00420	0.06080	0.00648	0.13034	0.04610	0.05678	0.03085	0.04677	0.01791	0.02102	0.08787
Metals nec	0.00123	0.01358	0.00944	0.00758	0.00673	0.00528	0.00127	0.01836	0.00196	0.03936	0.01392	0.01715	0.00932	0.01413	0.00541	0.00635	0.02654
Metal products	0.01035	0.03676	0.03318	0.02025	0.02204	0.00928	0.00076	0.01333	0.00096	0.00641	0.05590	0.06665	0.02460	0.01955	0.00151	0.06263	0.01761
Motor vehicles and parts	0.00233	0.01332	0.18553	0.00845	0.02293	0.01219	0.00000	0.00066	0.00008	0.00003	0.00538	0.05627	0.00262	0.03271	0.00006	0.10387	0.01206
Transport equipment nec	0.00134	0.03929	0.11986	0.00200	0.00387	0.00150	0.00013	0.01034	0.00000	0.00000	0.01057	0.03034	0.00465	0.01460	0.00937	0.01424	0.00646
Electronic equipment	0.00311	0.00139	0.00189	0.01308	0.01852	0.00099	0.00000	0.00198	0.00002	0.00000	0.00304	0.01125	0.00501	0.00931	0.00309	0.01052	0.01424
Machinery and equipment nec	0.00491	0.02762	0.06139	0.00793	0.02403	0.01506	0.00087	0.00851	0.00044	0.00108	0.04125	0.09786	0.01200	0.07248	0.00399	0.05905	0.05142
Manufactures nec	0.02392	0.02906	0.04825	0.06835	0.06709	0.00179	0.00068	0.00939	0.00000	0.00000	0.29574	0.52269	0.03294	0.54703	0.00851	0.17756	0.04304
Electricity	0.11025	0.06233	0.07803	0.07062	0.05390	0.04543	0.00354	0.08429	0.02898	0.08469	0.08612	0.02443	0.08730	0.14896	0.09399	0.14062	0.18933
Gas manufacture, distribution	0.00035	0.00018	0.00029	0.00014	0.00008	0.00008	-0.00009	0.00014	0.00000	0.00010	0.00028	0.00004	0.00014	0.00047	0.00025	0.00050	0.00041
Water	0.00387	0.00288	0.00424	0.00174	0.00113	0.00099	-0.00026	0.00218	0.00043	0.00199	0.00398	0.00069	0.00476	0.00456	0.00287	0.00559	0.00515
Construction	0.01833	0.01928	0.04143	-0.00452	-0.01686	-0.01363	-0.09070	-0.00130	-0.03781	-0.00424	0.03305	0.01745	0.00263	0.07239	-0.00038	0.07835	0.01315
Trade	0.44788	0.19535	0.44826	0.18448	0.12207	0.11254	-0.09481	0.19678	0.03641	0.13021	0.38883	0.06891	0.20628	0.43216	0.33226	0.59732	0.54440
Transport nec	0.14132	0.11538	0.13282	0.09406	0.07416	0.06331	-0.00013	0.09446	0.03379	0.07800	0.12468	0.02780	0.09744	0.18495	0.10763	0.21038	0.21651
Sea transport	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.06875	0.00000	0.09125	0.05244	0.02547	0.06105	0.06335	0.07212	0.08302	0.00000
Air transport	0.05001	0.00031	0.00000	0.00143	0.00046	0.00127	-0.00020	0.00526	0.00155	0.00078	0.00290	0.01468	0.00438	0.01645	0.00285	0.01402	0.00033
Communication	0.02278	0.01435	0.01352	0.01265	0.01094	0.00597	-0.00037	0.01468	0.00178	0.00840	0.02649	0.00065	0.01412	0.02849	0.01450	0.03857	0.02313
Financial services nec	0.47382	0.16283	0.12309	0.08248	0.03137	0.05462	-0.02154	0.08206	0.03183	0.08435	0.08157	0.11583	0.06052	0.19374	0.12301	0.16689	0.04161
Insurance	0.00028	0.01853	0.01751	0.01053	0.00620	0.00638	-0.00593	0.01013	-0.01162	0.00858	0.01216	0.01704	0.00721	0.02409	0.00959	0.02288	0.00683
Business services nec	0.24956	0.05065	0.12058	0.06652	0.02954	0.05317	0.01841	0.03942	0.03834	0.05476	0.02717	0.03776	0.05558	0.12606	0.11924	0.09506	0.02269
Recreation and other services	0.05150	0.03577	0.02148	0.03052	0.02631	0.02002	-0.00258	0.03461	0.01386	0.01760	0.02526	0.13095	0.02416	0.04622	0.03324	0.05134	0.05615
PubAdmin/Defence/Health/Educat	0.09142	0.04801	0.03512	0.03996	0.03322	0.02578	-0.00770	0.04670	0.01549	0.02426	0.04235	0.16162	0.06049	0.07833	0.05317	0.08526	0.08503
Dwellings	0.08069	0.03235	0.08615	-0.00471	-0.03494	-0.02587	-0.11009	-0.00706	-0.08317	-0.02151	0.10006	0.00426	-0.00014	0.15376	0.03185	0.17399	0.06666