Journal of Development Economics 99 (2012) 265–281

Contents lists available at SciVerse ScienceDirect

Journal of Development Economics

journal homepage: www.elsevier.com/locate/devec

Tariff pass-through and the distributional effects of trade liberalization ☆

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ARTICLE INFO

Article history:
Received 8 April 2010
Received in revised form 6 February 2012
Accepted 7 February 2012

JEL classification:
D31
F14
O12
O15

Keywords:
Trade liberalization
Pass-through
Wages
India
Welfare distribution

ABSTRACT

This paper estimates the distribution of welfare gains due to the trade reforms in India by simultaneously considering the effect on prices of tradable goods and wages. The cost of consumption for each household is affected by the domestic price changes, while wage incomes adjust to these price changes in equilibrium. Three rounds of the Indian Employment and Consumption Surveys are used for the analysis. The price transmission mechanisms are estimated for both rural and urban areas to understand the extent to which the trade reforms are able to affect the domestic prices. In order to assess the distributional effects, a series of nonparametric local linear regressions are estimated. The findings show that households at all per capita expenditure levels had experienced gains as a result of the trade liberalization, while the average effect was generally pro-poor and varied significantly across the per capita expenditure spectrum.

1. Introduction

Over the past two decades, many developing countries have used trade liberalization as an integral part of their development strategy. Although it is generally accepted that trade liberalization increases the aggregate welfare of a country, how these welfare gains are distributed among its population remains an important policy question. Recent debate on the effects of globalization on poverty has shown the importance of identifying the real winners and losers within an economy. However, the outcome of the empirical research that studies the link between trade liberalization and poverty is far from conclusive. Goldberg and Pavcnik (2005b) and Topalova (2007, 2010) studied the trade liberalization episodes in Colombia and India, respectively, and found that the effects of these reforms were either insignificant or poverty enhancing. This would mean that these reforms may have actually increased the percentage of people below the poverty line within these countries. On the other hand, Hasan et al. (2007b) found significant evidence that the reduction in the tariff rates and non-tariff barriers leads to a reduction in poverty in India.

In order to understand the impacts of a trade reform on poverty, it is important to trace through the different potential channels through which households may be affected, as there is not much known about how these mechanisms work. As Winters et al. (2004) state in their detailed survey, "there is little empirical evidence about the effects of trade liberalization and poverty dynamics at the household level … and about the manner in which border price changes are transmitted to local levels and how this may differ between the poor and non-poor." Many of the papers in the existing literature use aggregate poverty data and assume a perfect pass-through of border prices to consumers. Therefore, they do not address the gap in the literature that Winters et al. (2004) point out. Another important gap in the literature is due to the limitation of poverty estimates. Some aspects of the distributional effects of trade reforms may not be captured by these estimates, as they generally move with the well-being of the marginal poor. Trade liberalization can increase inequality while reducing poverty at the same time, and both of these results can be driven by the same distributional impact. For this reason, it is important to see how these welfare effects differ across the entire distribution.

This paper contributes to the literature on the effects of trade liberalization on poverty in India by estimating two main components of the underlying distribution of trade-induced welfare changes and by providing micro-level empirical evidence to identify the relative

☆ I am grateful to Devashish Mitra, Mary Lovely, William Horrace, and Rana Hasan for their guidance and helpful discussions throughout this project. I thank the editor and two anonymous referees for valuable comments and suggestions. In addition, I am grateful to the participants of the Midwest International Trade Meetings at the University of Minnesota, Twin Cities, the Western Economic Association International Meetings at Kyoto, and the various departmental seminars for comments provided on an earlier version of this paper. The standard disclaimer applies.

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doi:10.1016/j.jdeveco.2012.02.004

importance of each component.[1] More specifically, the paper accomplishes these tasks by using pre-reform and post-reform Indian household surveys to investigate the distributional effects of this country's substantial trade liberalization, while simultaneously considering the changes in the prices of tradable goods and wages. Instead of focusing directly upon poverty rates, this paper estimates the distributional impacts across all households. This allows for the distinguishing of households in terms of their expenditure patterns, factor endowments, productivity-related characteristics, locations, and cultural attributes. In addition, the paper adds to the previous literature by differentiating between geographical areas in terms of their ability to transmit the tariff reductions to consumers. It is especially important to make this distinction between rural and urban markets for the distributional analysis, as most of the population in India lives in rural areas, and the mechanisms of commodity markets differ considerably between these two area types. Significant differences between rural and urban India have also previously been documented in the literature, in terms of poverty rates, inequality, and domestic price levels (Datt and Ravallion, 2011; Deaton and Dreze, 2002; Deaton, 2003; Hasan et al., 2007b).

India presents a particularly important setting to analyze the distributional effects of globalization. First, it has more poor people than any other country in the world. According to the World Bank's estimates, one third of the world's poor lives in India. Although the poverty rate has declined within the last two decades, the number of poor individuals actually increased during this time due to high population growth (World Bank, 2011). Second, India began a comprehensive and externally imposed trade reform in 1991. Fig. 1 presents the trends in the average tariff rates that followed this reform for the industries of manufacturing, agriculture, and mining. After the trade liberalization, there was a steady and substantial decline in the tariff rates across all of these broadly-defined industries. Between 1988 and 2000, the average tariffs were reduced by 119.5 percentage points in manufacturing, 91.9 percentage points in agriculture, and 72.4 percentage points in mining. Third, India has rich, nationally representative, household-level and individual-level surveys that allow for the identification of the welfare effects across the per capita expenditure distribution, in order to answer the question of whether or not it is the poor who gains from trade reforms.

The empirical approach in this paper generally builds upon the methodology of Porto (2006) and Nicita (2009). The extent to which household consumption is affected by price changes depends on the expenditure shares of each traded commodity and the tariff reduction for that commodity. This paper utilizes the Indian expenditure data at the much disaggregated level, in order to assess the impact of tariff reductions on household expenditure. It is important to recognize that the spatial distribution of price effects may not be uniform, as the pass-through rates of tariffs are expected to be different across states and across the rural and urban areas of each state. This is incorporated by allowing the tariff pass-through to differ across these geographical regions. The effect on labor income, on the other hand, is allowed to vary by the skill level and industry affiliation of individuals. The distributional effects of tariff reduction through these two channels are analyzed using a series of nonparametric regressions across the entire spectrum of per capita expenditure.

The results show that there is a wide variation in the effects of trade liberalization on households at different points along the per capita expenditure distribution, and the effects demonstrate a pro-poor bias. The average effects from the consumption of traded goods and labor incomes were positive for all households with different expenditure levels. In addition, the results indicate that changes

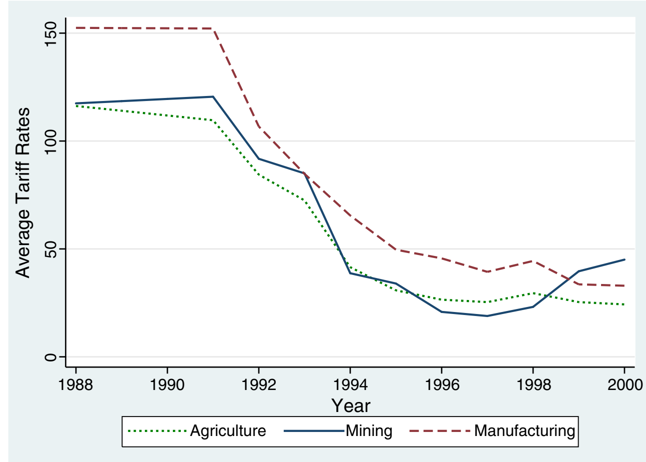

Fig. 1. Average tariff rates by major industry groups. Notes: The tariff rates presented in this figure are averages across 1-digit NIC 1987 industries. In the analysis, 2-digit NIC 1987 classification for income effects two digit Indian Input-Output categorization for consumption effects are used.

in trade policy were not perfectly transmitted to the consumer, as market imperfections and trade costs partially isolate households from their effects. The results also indicate a regional variation in the pass-through elasticities, with urban markets transmitting trade policy changes onto domestic prices with a significantly higher elasticity relative to rural markets. Therefore, the perfect pass-through assumption leads to an overestimation of the consumption effects in both rural and urban areas and an underestimation of the differential effect between these areas. The lower rural pass-through rates reported in this paper show that rural households are relatively more isolated from the effects of tariff reductions. The estimated total gain through the cost of consumption and wage incomes for the 12-year period was between 13 to 26% of the initial expenditure level in rural areas and 18 to 40% of the initial expenditure level in urban areas.

The paper is organized as follows. Section 2 provides a brief review of the relevant literature. Section 3 presents the theoretical framework, in order to characterize the various channels through which trade reforms can affect households. Section 4 discusses the data used in the empirical analysis. Section 5 discusses the empirical strategy that is used to identify and estimate the effects through consumption and labor income due to the tariff reductions. This section also presents these results. Section 6 concludes the paper.

2. Background

Following the seminal paper of Deaton (1989), there has been great interest on the distribution of the welfare effects of policy-induced price changes. Deaton used a form of the Hicksian negative compensating variation measure that was derived from a money metric indirect utility function.[2] This approach allows for different components of a household's consumption and income to be incorporated into welfare measures based on the nature of the policy change. The estimated effect on household welfare then indicates the negative of the amount a household would need in order to maintain its previous level of welfare.[3]

There are a few recent studies in the trade and development literature that build upon Deaton's framework, in order to study the impact of trade liberalization which affects the prices of many goods within

[1] See Deaton (2005) and Hasan et al. (2007b) for a detailed discussion of the measurement issues and the impact of trade reform on the incidence of poverty in India. Harrison (2006) summarizes the empirical results in her extensive and insightful work on the effects of trade reform on poverty using various partial equilibrium studies for several developing countries.

[2] See Winters et al. (2004) for an extensive literature review.

[3] If labor markets are imperfect, then labor supply choices are dependent on the labor demand of the household farm, so the production and consumption decisions cannot be treated as separable. For an example, see Seshan (2005).

the country. These types of policy changes have an economy-wide impact on the labor and commodity markets, beyond the agricultural household production and consumption decisions, as they induce a significant reallocation of the factors of production across industries and influence the returns to labor across the entire economy.

Porto (2006) extended Deaton's framework to analyze the effects of the Mercosur's free-trade zone on Argentinean households, examining both the labor market effects and the consumption effects. He estimated the direct response of the prices of traded goods and wages to tariff changes, as well as the endogenous response of non-traded goods, all as separate components of household welfare. As in Deaton (1989), Porto performed the welfare analysis across the entire income distribution to assess the distributional effects of this policy change. His results suggest that Mercosur had a pro-poor effect through the labor income channel and an insignificant effect through the consumption channel. While Argentina experienced a substantial increase in income inequality during the 1990s, these findings indicate that trade was not responsible for this phenomenon.

A drawback of Porto's approach is the assumption of the complete pass-through of trade reforms to domestic price levels. This assumption might be misleading, as very little is known about how domestic prices respond to tariff changes (Harrison, 2006). Market imperfections, transportation costs, and factor market rigidities are all potentially important factors that influence how trade policy can affect households. In addition to the domestic market conditions, imperfect pass-through may stem from imperfect competition in the foreign export market (Feenstra, 1995). Under perfect competition, imperfect pass-through of a tariff is possible when the country is large, because a tariff improves a country's terms of trade. Under imperfect competition, foreign exporters generally will not allow consumer prices to rise by the full amount of the tariff. They will absorb some of the price effect, and the pass-through elasticity will be less than unity. Either of these scenarios results in imperfect pass-through of a tariff reduction on to domestic prices.

Nicita (2009) extended Porto's approach by adding a link from trade policy to domestic prices. He studied the impact of Mexico's trade liberalization across different regions by looking at the between-state average differences in the effects on household welfare. Although he did not estimate the nonparametric distribution across households with different income levels, he showed that Mexican states along the U.S. border experienced higher welfare gains and that Mexico's trade liberalization has generally been welfare improving for households.

This paper complements and extends the previous work, by studying the effect of trade liberalization in India using rich, nationally representative, household expenditure and employment surveys. It distinguishes the imperfect price transmission mechanism between urban and rural areas and shows that rural households are relatively more isolated from changes in trade policy regardless of the importance of traded goods in their budget. Although the effect of trade on poverty in India is a controversial topic, there are no papers in the literature thus far that study the country using this methodology. The current paper provides a micro-level distributional analysis for India by studying the wage and consumption components within a unified framework and documents that trade liberalization had pro-poor effects through these two channels.

3. Theoretical framework

The theoretical framework for this study follows the approach of Porto (2006) and allows for the identification of three channels through which trade policy influences household welfare: labor income, the consumption of traded goods, and the consumption of non-traded goods. The indirect utility function of the household is defined as:

$$u_h = v_h(y_h, p_T, p_{NT}) \tag{3.1}$$

where household welfare is a function of household income, y_h, the prices of traded goods, p_T, and the prices of non-traded goods, p_{NT}. There are H households, T traded goods, and NT non-traded goods in the economy. The total differentiation of Eq. (3.1) and the application of Roy's identity yields:

$$du_h = \left(dy_h - \sum_T c_T^h dp_T - \sum_{NT} c_{NT}^h dp_{NT}\right)\frac{\partial u_h}{\partial y_h} \tag{3.2}$$

where c_T^h is the consumption share of traded good T and c_{NT}^h is the consumption share of non-traded good NT by household h. Household income is given by $y = w_h l_h$, where w_h is the wage income and l_h is the labor supply. We can totally differentiate household income and then substitute it into the above equation. Assuming that the marginal utility of income is unity, dividing this whole expression by y_h yields:

$$\frac{du_h}{y_h} = \theta_w^h \frac{dw_h}{w_h} - \sum_T \theta_T^h \frac{dp_T}{p_T} - \sum_{NT} \theta_{NT}^h \frac{dp_{NT}}{p_{NT}} \tag{3.3}$$

where $\theta_w^h = w_h\, l_h/y_h$ is the share of wage income for household h, $\theta_T^h = p_T\, c_T^h/y_h$ is the share spent on traded goods, and $\theta_{NT}^h = p_{NT}\, c_{NT}^h/y_h$ is the share spent on non-traded goods. The first term represents the income effect, and the last two terms represent the consumption effects of traded and non-traded goods, respectively. Every household is affected by the change in the price of a good proportional to the net exposure of that good on their budget. This measure defines the percentage change in the money metric utility, which is the negative compensating variation as a fraction of the initial household income level.

The measure in the above equation provides the total effect of the wage income and the consumption channels, but there may be other income effects through remittances, rents, or profits from the household farm. In this case, the effect on welfare may be overestimated or underestimated depending on the direction of these components. In addition, trade could affect unemployment and labor market participation, and these effects would not be captured by Eq. (3.3). For these reasons, it is important to note that this notion of household welfare refers to the total effects from consumption and wages and possibly leaves out other factors.

Households are assumed to be price takers and prices are determined at the aggregate level. Relaxing the assumption of the perfect pass-through of tariffs allows for market imperfections to affect the extent to which reforms are reflected in domestic prices. In a small open economy, the prices of traded goods are a function of world prices, tariffs, exchange rates, and trade costs. A foreign firm will receive less than the domestic firm for imported goods. Specifically, it will receive $p_T/(1+\tau_T)$, where p_T is the domestic price of the product. This yields the following expression for traded goods:

$$p_T = e p_T^*(1+\tau_T)TC \tag{3.4}$$

where e is the exchange rate, $p_T{}^*$ is the world price, τ_T is the tariff rate, and TC is the trade cost at time t.

Suppose there are traded and non-traded final goods in the economy, both of which use factors of production and traded intermediate goods in their production. Suppose TI denotes the traded intermediate goods, NTI denotes the non-traded intermediate goods, and ω denotes the factors of production in the economy. Assuming constant returns to scale in each industry and competitive markets, price is equal to the unit production costs. Then, the prices of non-traded goods and factor prices at time t are determined by the following system:

$$\begin{bmatrix} ep_T^*(1+\tau_T)TC \\ p_{NT} \\ p_{NTI} \end{bmatrix} = \begin{bmatrix} f(\omega, ep_{TI}^*(1+\tau_{TI})TC, p_{NTI}) \\ f(\omega, ep_{TI}^*(1+\tau_{TI})TC, p_{NTI}) \\ h(\omega) \end{bmatrix}. \tag{3.5}$$

If the total number of final and intermediate traded goods is equal to the number of factors, this system of equations will fully determine the prices of factors as a function of the vector of traded good prices. Given the prices of traded goods and factor endowments, the vector of equilibrium prices of non-traded goods are determined by:

$$p_{NT} = p_{NT}\left(ep_T^*(1+\tau_T)TC, ep_{TI}^*(1+\tau_{TI})TC\right). \tag{3.6}$$

The exogenous prices of traded goods uniquely determine the factor prices in Eq. (3.5). This will determine the prices of non-traded goods in those sectors. In this model, trade policy affects household welfare in two steps. First, trade policy affects the domestic prices of traded goods. Because households are consumers of these goods, their welfare is affected by these price changes. Next, wages are endogenously determined by Eq. (3.5) and the prices of non-traded goods are determined by Eq. (3.6).

4. Data

This study uses data from two different surveys conducted by the Indian National Sample Survey Organization (NSSO): the Employment and Unemployment Survey, and the Household Consumer Expenditure Survey. Three “thick” rounds of these surveys are used: 1987–1988, 1993–1994, and 1999–2000.[4] The Employment Survey provides detailed information on wages, other sources of income, industry affiliation, occupation, education, and other various individual and household level characteristics. The Household Consumer Expenditure provides detailed information about the consumption patterns of households.

The tariff data is available by the Indian input–output categories. There are a total of 98 traded categories in the tariff data, and these categories are hand-matched to the NSS Expenditure categories, in order to disaggregate the products to the extent that is possible. When an expenditure category matches to more than one input–output category, an import-weighted average of the tariffs is used. For example, household sugar consumption is matched to sugarcane, sugar, and sugar products (e.g. khandsari, boora). Then, an import-weighted average of the tariff rates of these three categories is matched to the corresponding household expenditure category. All of the traded goods in the NSS data are matched to the tariff rates in this fashion, so that only non-traded goods and services, such as education, medicine, and entertainment, do not have corresponding tariff rates. These concordances between the input–output categories, the NSS expenditure categories, and the world prices are available in the Appendix.

The NSS Employment Survey reports each individual's industry affiliation by the Indian National Industry Classification (NIC) categories. The tariff rates, by the 2-digit 1987 version of the NIC categories, are from Hasan et al. (2007a). They are computed using the tariffs of both inputs and outputs for each industry and are aggregated using the imports as weights. The concordances between the input–output and NIC categories are also presented in the Appendix. These tariff rates are then merged by the NIC categories in the NSS Employment Survey, in order to estimate the wage regressions. Because the 43th round uses the NIC-1970, the 50th round uses the NIC-1987, and the 55th round uses the NIC-1998, the concordance tables are used to make the industry classifications consistent across rounds.

Following Hasan et al. (2007b) and Mitra and Ural (2008), the following states are considered in this paper: Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal. These are major states that were formed before 1987, and together they constitute approximately 91% of the total population in India.

Domestic consumer prices were calculated using the unit values from the household survey. In the NSS Consumption Survey, respondents were asked to provide information about their expenditures and quantities of over 500 commodities. The ratio of their expenditure to quantity provides a measure of unit price for each household and each commodity.[5] State-level weighted averages for each round, for both rural and urban areas, are provided in Table 1, where the weights are common across states and years and are computed as the expenditure share of each commodity and year for rural and urban areas. There is a considerable amount of variation in the unit prices and they are relatively higher in urban areas than in rural areas for all of the states. Between-state variation in domestic prices may reflect varying input costs, product market regulations, the relative endowments of states, and finally, individual preferences. The reason for using the unit values is due to the unavailability of price data by commodity and by state across years.[6] We need to keep in mind that these unit values reflect quality choice as well as quantity choice. Each household faces a trade-off between quality and quantity given their budget, and the unit values reflect the outcome of this tradeoff. However, it is not possible to identify the extent to which a household may be substituting between the quality and quantity of a product given the available information.

The world prices are obtained from various sources. The WTO Trade Statistics Handbook publishes the export prices of primary commodities (wheat, maize, rice, vegetables, meat, sugar, and energy). These prices are used in the analysis as the world prices for primary traded goods. The world prices for coffee, tea, and tobacco were calculated by the Indian Department of Commerce and are adjusted to the same base year as the WTO Export Prices. The Cotton Outlook World Price Index is used to account for the world prices of cotton. Most of these prices are available after 1993, and therefore, the pass-through regressions are estimated for the post-reform period. The final list of products includes eleven categories that are merged with the tariff rates by industry categories, as well as the unit values of the corresponding products obtained from the household survey.

The NSSO collects the data as repeated cross-sections in each round (i.e., the survey does not follow the same individuals or households over time). For the parametric estimation of the wage responses, I construct a pseudo-panel of individuals as suggested by Deaton (1997) and Baltagi (2005), in order to introduce these panel dynamics into the data. This methodology involves tracking age cohorts and estimating the economic relationships based on cohort means rather than on individual observations. For example, one cohort represents the average characteristics of 30-year-olds in the 1987–1988 survey, 36-year-olds in the 1993–1994 survey, and 42-year-olds in the 1999–2000 survey. Deaton (1997) points out that this methodology allows us to disentangle the age-related life-cycle components of income and consumption from the generational components. Another advantage of the cohort method is that it allows the combination of data from different surveys, so the questionnaire need not be administered to the same individuals or households.

If the cohort in the first round of the data is very old, then the members of this cohort would be out of the labor force in the last round of the data, and the attrition levels would be very significant. If the cohort in the last round is very young, then they would be under the working age in the first round. To avoid these problems, 39 age cohorts are defined for which the youngest is 15-years-old in the first round, and the oldest is 65-years-old in the last round. The average worker characteristics and wages are then calculated within each cell, as defined by age cohort, skill level, 2-digit Indian National Industry Classification (NIC), and year, in order to define a panel that follows cohorts of workers with the same skills and industry affiliation across the three rounds. A skilled worker is defined as an individual with at least a secondary education.

[4] NSSO also implements “thin” rounds more often and on a smaller scale. However, the sample design is not comparable to the “thick” rounds.

[5] See Deaton (1997) for a detailed discussion about the calculation of household level unit prices using the Indian NSS consumption survey.

[6] The Ministry of Statistics of India provides commodity-level and state-level price indexes. However, commodity-level price indexes for each state are not available.

Table 1
Domestic prices by year and state (logs).

	Rural			Urban		
	1988	1994	2000	1988	1994	2000
Andhra Pradesh	5.459	6.518	6.802	5.570	6.564	7.081
	(0.503)	(0.531)	(0.536)	(0.564)	(0.604)	(0.551)
Assam	5.379	6.834	6.676	5.707	6.790	7.207
	(0.379)	(0.462)	(0.466)	(0.458)	(0.515)	(0.541)
Bihar	5.592	6.593	6.956	5.651	6.632	7.124
	(0.389)	(0.442)	(0.453)	(0.429)	(0.494)	(0.495)
Gujarat	5.475	6.618	6.937	5.627	6.669	7.208
	(0.467)	(0.474)	(0.454)	(0.545)	(0.533)	(0.477)
Haryana	5.342	6.597	6.582	5.205	6.641	7.109
	(0.363)	(0.502)	(0.270)	(0.350)	(0.562)	(0.453)
Jammu and Kashmir	5.438	6.364	6.920	5.638	6.378	7.040
	(0.386)	(0.448)	(0.477)	(0.437)	(0.509)	(0.522)
Karnataka	5.377	6.568	6.953	5.515	6.634	7.201
	(0.505)	(0.543)	(0.521)	(0.566)	(0.615)	(0.520)
Kerala	5.482	6.470	7.045	5.456	6.476	7.155
	(0.471)	(0.574)	(0.534)	(0.522)	(0.630)	(0.564)
Madhya Pradesh	5.605	6.311	6.600	5.504	6.337	6.840
	(0.436)	(0.450)	(0.477)	(0.427)	(0.502)	(0.500)
Maharashtra	5.456	6.668	6.989	5.622	6.705	7.247
	(0.457)	(0.492)	(0.499)	(0.505)	(0.556)	(0.502)
Orissa	5.597	6.627	6.732	5.697	6.689	6.954
	(0.429)	(0.513)	(0.538)	(0.465)	(0.578)	(0.577)
Punjab	5.190	6.568	6.898	5.366	6.581	7.072
	(0.331)	(0.459)	(0.442)	(0.419)	(0.514)	(0.485)
Rajasthan	5.518	6.501	6.731	5.595	6.543	7.062
	(0.464)	(0.457)	(0.455)	(0.507)	(0.515)	(0.479)
Tamil Nadu	5.471	6.612	7.035	5.482	6.667	7.208
	(0.499)	(0.544)	(0.525)	(0.557)	(0.620)	(0.556)
Uttar Pradesh	5.494	6.184	6.447	5.517	6.205	6.654
	(0.401)	(0.358)	(0.383)	(0.414)	(0.403)	(0.412)
West Bengal	5.472	6.567	7.071	5.536	6.587	7.345
	(0.408)	(0.442)	(0.448)	(0.449)	(0.491)	(0.500)

Notes: The domestic prices are the unit values that are computed from the NSS Consumption Surveys for each of the following expenditure categories: wheat, maize, rice, meat, sugar, vegetables, coffee, tea, tobacco, textile and energy. The table presents the weighted state averages where weights are the expenditure shares that are common across states and years. The sampling weights are used in computation of unit values. Standard deviations are presented in parentheses.

Wage earnings are defined for each individual as wages (in cash or in kind) from the following activities: worked in a household enterprise, worked as a regular wage employee, worked as a casual wage labor in public works, or worked as a casual wage labor in other works.[7] An activity is reflected in wage incomes if the individual engaged in that activity and received wages. The activity categories are consistent across rounds and across rural and urban surveys.[8] The share of wage income in the household budget is computed at the household level and reflects the total wage income earned by each member of the household with respect to the total household expenditure.

5. Empirical strategy and results

5.1. Price transmissions

An important part of investigating the relationship between trade costs and the cost of household consumption is to examine how price changes are transmitted from the border to the consumer. Trade reforms must operate through markets that are able to transmit the effects of trade policy in order to affect household welfare. Most reduced-form models assume perfect pass-through, where any change in the tariff rate is perfectly transmitted to domestic prices and therefore to the consumer. However, there may be various market imperfections and trade costs that affect this transmission mechanism.

I first estimate the extent to which changes in the border prices of traded goods are passed-through to domestic prices using a model similar to those of Feenstra (1995) and Nicita (2009)[9]:

$$ln\, p_{ist} = \beta_0 + \beta_1 \ln p^*_{it} + \beta_2 \ln(1+\tau_{it}) + \beta_3 \ln e_t + \beta_4 \xi_{it} + \mu_s + \eta_t + \varepsilon_{ist} \tag{5.1}$$

where p_{ist} is the domestic price of good i in state s at time t, $p_{it}{}^*$ is the world price, e_t is the exchange rate in domestic currency, τ_{it} is the ad-valorem tariff rate, ξ_{jt} represents the industry-specific trends, μ_s represents the state fixed effects, η_t represents the time fixed effects, and ε_{ist} is an *i.i.d.* error term. The year fixed effects control for the time-varying factors that are common to all states, and the industry-specific trends control for the movements in producer costs that are associated with changes in production technology or input costs. The state fixed effects in this specification take regional price differences into account, while in a second specification, the pass-though coefficients are allowed to vary by state. This regression is estimated for rural and urban areas separately using different combinations of year fixed effects, state fixed effects, industry-specific trends, state–year interactions, and state–industry interactions. These results are presented in Table 2 for rural and urban areas.

In rural areas, the pass-though coefficient is estimated to be between 33 and 49%. The exclusion of any time trends or year fixed effects leads to lower pass-through estimates in rural areas, indicating that rural prices tend to decrease more slowly. This specification without time controls also yields slightly lower estimates for urban areas, however, the difference is not as high as it was for rural areas. The estimates are quite robust to the inclusion of state–year interactions, state–industry interactions, and industry-specific trends. It is only when state–year interactions and state–industry interactions are included together (columns 7 and 8), that the estimates increase by approximately 4 percentage points. This can be observed when state-specific regulations vary over time and by industry, such as agricultural policies that often vary by state and are implemented at different times. Consumers in urban areas are affected by tariff reductions more than rural consumers, with a pass-through elasticity between 64 and 68%. These estimates increase by about 4 percentage points when time effects are incorporated, but they are also robust to the inclusion of various controls across different specifications. The exchange rate pass-through turned out to be very close to the tariff pass-through in rural areas, but it is insignificant in urban areas. The empirical approach here uses the tariff variation across products to estimate the tariff pass-through. However, the exchange rates are the same for all products, and they vary only by year. Although it is imperative to control for the exchange rates, or year fixed effects, in order to identify the tariff pass-through, the lack of variation in exchange rates may be behind the insignificant coefficient.

There are two important messages to discern from these analyses. First, any change in trade policy is not perfectly transmitted to the consumer. Market imperfections may partially isolate household from tariff changes in both rural and urban areas. Second, the estimates confirm the statement of Winters et al. (2004) regarding the likely pattern of the price transmission mechanism, that is, the pass-

[7] Other activities defined in the NSS survey are: involuntarily unemployed; attending educational institutions; attending to domestic duties; free collection of goods; rent, pension or remittance recipients; not able to work due to disability; beggars and others. Of course, these activities also influence the welfare of a family. However, these welfare impacts are beyond the scope of the current study, as the focus is on the wage and consumption channels only.

[8] Round 43 does not differentiate whether or not the individual is a worker or an employer in the household enterprise, which was done for rounds 50 and 55. This difference between the rounds does not, however, affect the total wages.

[9] Goldberg and Knetter (1997) provide an excellent survey of the exchange rate and tariff pass-through literature.

Table 2
Pass-through of tariff rates to domestic prices.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: log (rural prices)								
log (1 + tariff)	0.331**	0.457***	0.458***	0.457***	0.452***	0.448***	0.495***	0.491***
	(0.136)	(0.123)	(0.123)	(0.132)	(0.133)	(0.137)	(0.130)	(0.134)
log (world price)	0.386***	0.392***	0.392***	0.398***	0.393***	0.395***	0.371***	0.373***
	(0.097)	(0.100)	(0.100)	(0.105)	(0.104)	(0.108)	(0.107)	(0.110)
log (exchange rate)	0.336**				0.306**			
	(0.128)				(0.137)			
R-squared	0.119	0.120	0.120	0.162	0.165	0.181	0.165	0.181
Number of observations	332	332	332	332	332	332	332	332
Dependent variable: log (urban prices)								
log (1 + tariff)	0.635***	0.677***	0.677***	0.668***	0.670***	0.668***	0.664***	0.661***
	(0.129)	(0.127)	(0.127)	(0.134)	(0.134)	(0.136)	(0.142)	(0.146)
log (world price)	0.502***	0.504***	0.504***	0.506***	0.501***	0.505***	0.504***	0.508***
	(0.074)	(0.075)	(0.075)	(0.079)	(0.079)	(0.081)	(0.084)	(0.087)
log (exchange rate)	0.056				0.044			
	(0.084)				(0.090)			
R-squared	0.075	0.081	0.081	0.140	0.145	0.163	0.147	0.166
Number of observations	331	331	331	331	331	331	331	331
Year indicators	No	No	Yes	No	No	No	No	No
Industry specific trends	No	Yes	Yes	Yes	No	No	Yes	Yes
State * year interactions	No	No	No	Yes	No	Yes	No	Yes
State * industry interactions	No	No	No	No	Yes	Yes	Yes	Yes
Number of states	16	16	16	16	16	16	16	16

Notes: Domestic prices are computed using the value and quantity of consumption reported by households, and they vary by commodity, state and year. The following commodities are included: wheat, maize, rice, meat, sugar, vegetables, coffee, tea, tobacco, textile and energy. The results are based on data from 1994 and 2000. The 'industry' indicator takes the value of one if the commodity is an agricultural product and zero if it is a manufacturing product. Exchange rate variable is dropped in specifications that include state–year interactions and industry specific trends due to perfect multicollinearity. All regressions include a constant. All standard errors are robust for heteroscedasticity and clustered at state-industry pairs.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

through estimates are significantly lower in rural areas. Winters et al. further stated that in some rural areas, producers and consumers may be completely isolated from the rest of the economy, so the price changes at the border would have no effect on the local price levels. This will be reflected in the results of this paper, as the presented estimates are interpreted as the average pass-through. If the percentage of isolated households in rural areas is higher than it is in urban areas, the estimated coefficients will be smaller.

Policy changes in a large, open country may influence world prices. This could be potentially important if the Indian tariff reductions had a significant impact on world prices, which could then be transmitted to domestic prices. Hausman tests on endogeneity of world prices reveal that instrumentation is not required for both rural and urban areas.[10] The limited time variation provided by the NSS surveys may be behind this insignificant effect. This may also be because India's share of world trade was still relatively small for the period studied in this paper: only 0.59% of world trade in 1993 and only 0.67% in 2000. It was not until after 2002, that India's share of world trade began to grow rapidly.[11]

The difference between rural and urban areas can be tested by replacing the dependent variable with the difference between the logarithms of urban and rural prices. The results presented in Table 3 indicate that the difference in the pass-through coefficient was significant, and that urban areas were able to transmit the changes in tariff rates with an approximately 23 percentage point higher elasticity than rural areas. However, the results suggest that the pass-through elasticities of world prices were not significantly different between rural and urban areas. The transmission of world prices is almost uniform across India, not only between the two area types, but also across states. In results that are not presented, I interact world prices with the state indicators and find that the state-specific transmission of world prices is around 40% in rural areas and 50% in urban areas, with little variation across states.

The relatively uniform transmission of world prices may be due to the fact that this mechanism is highly controlled by the central government, especially for major crops that are crucial for households, such as rice and wheat. This was clearly observed during the world food price crisis around 2008.[12] Such an intervention mechanism may not be present for tariff pass-through, as the tariff effect on prices has been downward, not upward like it is for the world prices. Therefore, government intervention on this transmission mechanism may not have been considered necessary for consumer welfare.

On the other hand, the transmission of the tariff rates on domestic consumer prices varies considerably across states. Table 4 presents the state specific elasticities that are obtained by interacting the tariff rates with the state indicators from specification (2) in Table 2. Half of the states presented in this table are coastal states with major trade ports: Andhra Pradesh, Gujarat, Karnataka, Kerala, Maharashtra, Orissa, Tamil Nadu, and West Bengal. All of these coastal states have significant pass-through elasticities in both rural and urban areas, with the exception of rural Kerala. This indicates that households near a port of entry benefit significantly from the tariff reductions. In rural areas, only three of the eight inner states have significant pass-through: Assam,

[10] U.S. exports or U.S. total trade is considered as potential instruments for world prices.
[11] Government of India Economic Surveys, 1994–2009; Srinivasan (2006).

[12] During the food price crisis in 2008, the world price of rice increased by 41% within a year, while the domestic price in India increased by only 14%. The Indian government implemented a series of aggressive policies to prevent these price shocks from being transmitted to domestic prices. The short term policy responses to the world food price crisis included releasing government held stocks and raising the minimum support prices, just to mention a couple. While such a crisis did not happen during the period studied in this paper, this aggressive response shows that Indian authorities are watching world prices very closely and are protecting the domestic consumers from these adverse effects to the extent that is possible.

Table 3
Differential pass-through elasticities between urban and rural areas.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: log (urban prices) − log (rural prices)								
log (1 + tariff)	0.270**	0.231**	0.232**	0.225**	0.221**	0.219**	0.227**	0.195**
	(0.129)	(0.094)	(0.094)	(0.097)	(0.094)	(0.095)	(0.096)	(0.092)
log (world price)	0.121	0.133	0.133	0.135	0.133	0.134	0.134	0.124
	(0.130)	(0.114)	(0.114)	(0.122)	(0.121)	(0.126)	(0.117)	(0.129)
log (exchange rate)	−0.337**				−0.350**			
	(0.144)				(0.144)			
Year indicators	No	No	Yes	No	No	No	No	No
State * year interactions	No	Yes	Yes	Yes	No	No	Yes	Yes
State * industry interactions	No	No	No	Yes	No	Yes	No	Yes
Industry-specific trends	No	No	No	No	Yes	Yes	Yes	Yes
R-squared	0.024	0.025	0.025	0.142	0.186	0.215	0.115	0.219
Number of observations	328	328	328	328	328	328	328	328
Number of states	16	16	16	16	16	16	16	16

Notes: Domestic prices are computed using the value and quantity of consumption reported by households, and they vary by commodity, state and year. The following commodities are included: wheat, maize, rice, meat, sugar, vegetables, coffee, tea, tobacco, textile and energy. The results are based on data from 1994 and 2000. The 'industry' indicator takes the value of one if the commodity is an agricultural product and zero if it is a manufacturing product. Exchange rate variable is dropped in specifications that include state–year interactions and industry specific trends due to perfect multicollinearity. All regressions include a constant. All standard errors are robust for heteroscedasticity and clustered at state–industry pairs.

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

Table 4
Pass-through elasticities and average consumption effects by state.

					Average consumption effects			
	Pass-through elasticities		Average expenditure shares		Full pass-through		Imperfect pass-through	
State	(1) Rural	(2) Urban	(3) Rural	(4) Urban	(5) Rural	(6) Urban	(7) Rural	(8) Urban
Andhra Pradesh	0.563***	0.618***	0.662	0.630	0.374	0.362	0.211	0.224
	(0.182)	(0.165)	(0.007)	(0.005)	(0.003)	(0.003)	(0.002)	(0.002)
Assam	0.938***	1.205***	0.670	0.752	0.391	0.452	0.367	0.545
	(0.207)	(0.197)	(0.011)	(0.016)	(0.008)	(0.012)	(0.007)	(0.015)
Bihar	0.493***	0.605**	0.705	0.712	0.393	0.405	0.194	0.245
	(0.136)	(0.267)	(0.006)	(0.007)	(0.003)	(0.004)	(0.001)	(0.002)
Gujarat	0.633***	0.521**	0.668	0.734	0.371	0.394	0.235	0.205
	(0.191)	(0.204)	(0.007)	(0.005)	(0.003)	(0.003)	(0.002)	(0.001)
Haryana	0.287	1.522***	0.682	0.680	0.425	0.422	0.000	0.642
	(0.571)	(0.147)	(0.014)	(0.012)	(0.009)	(0.007)	(0.000)	(0.011)
Jammu and Kashmir	1.444	0.614**	0.629	0.635	0.423	0.411	0.000	0.252
	(0.786)	(0.296)	(0.010)	(0.008)	(0.007)	(0.005)	(0.000)	(0.003)
Karnataka	0.490***	0.537***	0.653	0.639	0.381	0.404	0.187	0.217
	(0.160)	(0.116)	(0.008)	(0.008)	(0.004)	(0.005)	(0.002)	(0.003)
Kerala	0.402	0.475*	0.600	0.690	0.370	0.407	0.000	0.193
	(0.254)	(0.274)	(0.008)	(0.005)	(0.004)	(0.004)	(0.000)	(0.002)
Madhya Pradesh	−0.364	0.519	0.607	0.636	0.368	0.384	0.000	0.000
	(0.314)	(0.398)	(0.014)	(0.005)	(0.008)	(0.003)	(0.000)	(0.000)
Maharashtra	0.354**	0.573**	0.637	0.643	0.378	0.394	0.134	0.225
	(0.154)	(0.278)	(0.006)	(0.010)	(0.003)	(0.007)	(0.001)	(0.004)
Orissa	0.592***	1.054***	0.703	0.670	0.400	0.395	0.237	0.417
	(0.140)	(0.189)	(0.007)	(0.007)	(0.003)	(0.004)	(0.002)	(0.005)
Punjab	0.908*	0.633	0.680	0.679	0.435	0.412	0.395	0.000
	(0.491)	(0.415)	(0.010)	(0.006)	(0.006)	(0.004)	(0.006)	(0.000)
Rajasthan	0.085	0.154	0.577	0.676	0.386	0.406	0.000	0.000
	(0.145)	(0.160)	(0.008)	(0.008)	(0.008)	(0.006)	(0.000)	(0.000)
Tamil Nadu	0.359**	0.650***	0.627	0.656	0.421	0.423	0.151	0.275
	(0.133)	(0.108)	(0.007)	(0.005)	(0.004)	(0.003)	(0.002)	(0.002)
Uttar Pradesh	−0.201	0.055	0.688	0.660	0.396	0.408	0.000	0.000
	(0.121)	(0.122)	(0.011)	(0.015)	(0.005)	(0.010)	(0.000)	(0.000)
West Bengal	0.400**	1.095***	0.664	0.653	0.403	0.398	0.161	0.436
	(0.147)	(0.203)	(0.007)	(0.004)	(0.004)	(0.003)	(0.001)	(0.003)

Notes: The state specific price transmission elasticities are obtained by interacting the log tariffs with state indicator variables in specification (2) of Table 3. Standard errors are presented in parentheses and are clustered within state–industry pairs. Standard deviations of expenditure shares and consumption effects are also reported in parentheses. The estimates presented in this table are based on the 55th round of NSS Consumer Expenditure Survey and incorporate the sampling weights. All expenditure shares are based on 30-day expenditure of the traded goods that are not home-produced or free-collected, and are matched to the corresponding tariff rates (see Appendix). Consumption effects are computed for each household given their expenditure shares and tariff reductions of each commodity. This table reports state-level averages of consumption effects.

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

Bihar, and Punjab. Although these states are not on the coast, they all share international borders with at least one of the neighboring countries. On the other hand, states that are entirely surrounded by other Indian states, such as Madhya Pradesh that has no major sea port or international border, have insignificant transmission in both rural and urban areas.

In general, the transmission elasticities are higher in urban areas, with the exception of Gujarat.[13] These higher elasticities in urban areas may be explained by better access to imported goods, due to the quality of transportation infrastructures and road quality. The urban markets are also expected to be more integrated with the world markets, due to their higher demand for imported goods and, therefore, their higher market share of foreign firms relative to rural areas. This would lead to a higher pass-through, as explained by Feenstra (1995). Urban markets may also be more competitive relative to rural markets, leading to more responsive domestic prices allowing their tariff reductions to be reflected in consumer prices to a higher extent. In addition, as Winters et al. (2004) state, the share of self-sufficient, isolated households is expected to be lower in urban areas, leading to higher pass-through elasticities. Finally, the spatial variation of the pass-through elasticities may also be due to geographical characteristics, such as the topography or distance to major ports. In Mexico, Nicita (2009) shows that the pass-through rates of tariffs increase as one moves closer to the U.S. border. Determining the causes of geographical variation is beyond the scope of this paper, and more detailed data are required to understand which of these factors are driving the results and how they interact. However, this geographical variation in the transmission elasticities is crucial to understand the effects of tariff changes on households, and the current paper incorporates this variation in the distributional analysis.

5.2. Effect on the cost of consumption

The price effect of traded goods is estimated using the expenditure share of every good in a household's basket. Following the definition in Eq. (3.3) and Nicita (2009), the consumption effect of traded goods for each household h in state s is computed as follows:

$$CE_h = -\sum_i \theta_i^h dp_i \tag{5.2}$$

where $i=1,\ldots,n$ represents traded goods in the household expenditure bundle. The commodity-level data set records the expenditure on every commodity for each of the 71,385 households in rural areas and 48,924 households in urban areas. There are approximately 6 million observations for rural areas and 4.8 million observations for urban areas. This data is then merged to the tariff data, so that every commodity has a corresponding tariff rate. The expenditure share, θ_i^h, of every commodity for each household is calculated using the value of consumption. The change in prices, dp_i, is given by the tariff reduction of that product multiplied by the pass-through elasticity. These effects are computed for every traded commodity i, and then aggregated for each household h, in order to arrive at the consumption effect for that household.

The expenditure shares vary by household and commodity, the price transmission coefficients vary by state and rural/urban designation, and the tariff reductions vary by commodity. The distributional effects on the consumption side are generated by the fact that: households have different expenditure shares for each good, each good experienced a different tariff reduction, and households experienced the effect of these tariff reductions to a different extent depending on their geographical location.

In India, food constitutes a substantial part of the traded good expenditure of households. According to the 1999–2000 survey, for example, the share of food expenditure was 59.4% in rural India and 48.1% in urban India. These numbers are presented in Table 5. We can compare these consumption patterns with those of a developed country, such as United States. In 1999, according to the Consumer Expenditure Survey, U.S. households spent 13.6% of their overall expenditure on food. This consumption pattern of Indian households is important in analyzing the distributional effects of trade policy. The households at the very low end of the per capita expenditure distribution tend to spend almost all of their income on food, whereas households at the high end of the per capita expenditure distribution spend a higher share of their total income on non-tradable services and less on food. This is expected to generate a distributional effect, because the price levels in this consumption group are directly and significantly affected by trade policy.

These straightforward predictions about the distributional effect are complicated, however, by the inclusion of other traded goods, such as textile, furniture, and other manufacturing items, that are consumed more in urban areas and by high income households. Further, the food consumption items that are reported to be self-produced or collected are not included, because the subsistence portion of expenditure is generally assumed to be unaffected by the price shocks. Because this component is higher for rural households, it will lower the gap in the average expenditure share of traded goods between rural and urban areas.

Each household's expenditure share of traded goods is given by $\sum_i \theta_i^h$. Table 4 presents the state-level averages of these shares for rural and urban areas in the third and fourth columns, respectively. There is no systematic relationship across rural–urban areas or across states. The shares are higher in rural areas in only seven of the states. A relatively poor state, like Uttar Pradesh, and a relatively rich state, like Tamil Nadu, have similar shares. However, these averages do not imply similar expenditure patterns at the disaggregated level, as households are consuming different shares of different items within the traded category. In the micro-level analysis, there is substantial variation within states and between poorer and richer households. This is discussed in further detail later in this section.

The consumption effects with full pass-through, where the pass-through elasticities are set to unity, and with imperfect pass-through, where pass-through elasticities are allowed to vary across states and across rural and urban areas, are presented in columns 5 through 8 of Table 4. With the full pass-through assumption, there is little difference between rural areas and urban areas on average, as the cost of consumption for traded goods was reduced by roughly 40% in both cases. Relaxing this assumption introduces a significant

Table 5
Consumption shares of major commodity groups.

Commodity	Rural			Urban		
	1988	1994	2000	1988	1994	2000
Tradable goods	84.6	81.8	74.0	75.9	71.5	68.7
Food	64.0	63.2	59.4	56.4	54.7	48.1
Other tradable goods	20.6	18.6	14.6	19.5	16.8	20.6
Nontradable goods and services	15.4	18.2	26.0	24.1	28.5	31.3

Notes: NSS India Report No. 454 and author's calculations. All consumption shares are based on 30-day expenditure. The estimates presented in this table are based on broad expenditure categories. Nontraded goods include transportation, communication, health, education and other services. Non-food tradable goods include clothing, footwear, durables, tobacco, intoxicants, and fuel and light. Note that the NSS report does not report electricity consumption separately; therefore in this table it is included under the broad category of fuel and light as a tradable good. In welfare estimations, electricity is treated as a non-tradable good.

[13] In this state, the major sea port is not located near the largest and fastest growing cities, such as Ahmedabad, which may partially explain this result. In Maharashtra, for example, the two major sea ports are very close to Mumbai, and similarly in West Bengal, the major port is very close to Kolkata, and both are very large cities. The information on major ports is compiled from the information provided by the Port Authority of India, and it is available from the author upon request.

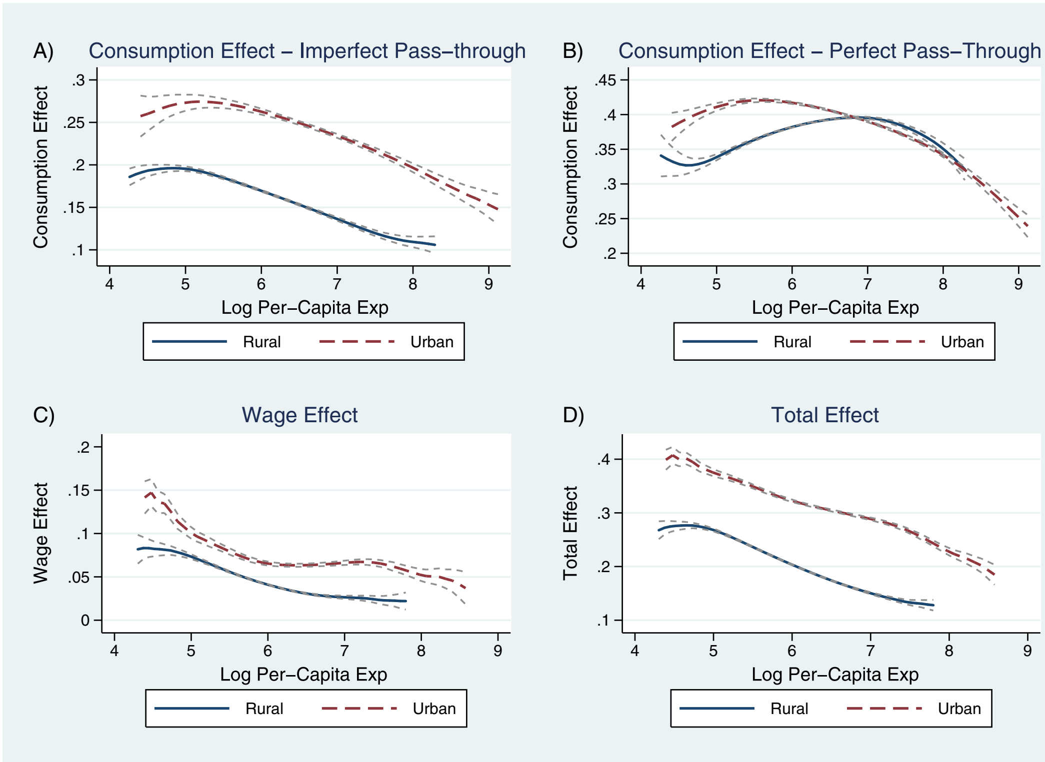

Fig. 2. Total effects in rural and urban areas. Notes: The results of nonparametric estimations and their 95 percent confidence intervals are presented for consumption effects, wage effects and total effects for rural and urban areas. Commodity-specific tariff rates are used for consumption effects. Results with imperfect pass-through are based on the state-specific pass-through elasticities.

difference between the two area types and reduces the consumption effect to an average of 14% in rural areas and 24% in urban areas.

In the theoretical model, the welfare effect is approximated in the first order and therefore does not allow for the substitution between different traded consumption goods. I assume the bundle of consumption goods in each household is fixed, and I measure the cost of purchasing that fixed bundle of goods. The heterogeneity across households comes from their consumption baskets. However, the substitution from low to high quality rice would not affect the results of this paper. In essence, the paper estimates how households with different consumption baskets are affected by price changes, instead of estimating the response of the households to these price changes. The behavioral response would require the estimation of the second order welfare effects with own-price and cross-price elasticities, which are not available by the level of disaggregation used in this paper. If these elasticities are a function of income, then there would be additional second-order distributional effects.

A second limitation due to data availability is the non-traded goods. The price data for these goods are not readily available, and therefore, they are excluded from the welfare estimations. Because they adjust to tariff changes in equilibrium, there are no theoretical predictions in terms of the direction of the effect (Porto, 2006). Empirically, however, these effects are likely to be relatively small for India. The largest groups of non-traded services, education and health, are highly regulated, and they are not likely to be very responsive to other price changes in the economy. In addition, the traded goods category covers a very large portion of a household's expenditure. In any case, it is not possible to speculate on the direction and magnitude of the consumption effects of non-traded goods, and this is a limitation of the current paper.

In order to assess the distributional effects through the consumption of traded goods, a series of nonparametric local linear regressions of the consumption effect on the log per capita expenditure is estimated by state and by rural/urban areas. At each point of the per capita expenditure distribution, this method obtains a consistent estimator of the average consumption effect by using the information in the neighborhood around that point, which is defined as a range by the specified bandwidth. The Epanechnikov kernel function specifies the weights that are assigned to each observation within the bandwidth (Li and Racine, 2007; Pagan and Ullah, 1999). As the shape of the nonparametric distribution is very sensitive to outliers, the observations outside of four standard deviations from the mean are not used.[14]

The results are presented in panels A and B of Fig. 2. The cost of consumption was reduced for all households, as implied by the positive consumption effect. The distributional effect through the consumption channel was generally pro-poor and decreases as we move up the per capita expenditure spectrum. Urban households benefited relatively more than rural households, particularly due to the higher pass-through elasticities in urban areas. This can be seen more clearly from panel B, where perfect pass-through is assumed, and the elasticities are set to unity. While the urban households appear to have higher welfare gains in the lower half of the expenditure distribution, the differential effect disappears in the upper half, implying that tariff reductions weighted by the expenditure shares are similar between better-off households, regardless of the urban/rural area type.

The results of the nonparametric regressions for each state and for rural and urban areas are presented in Fig. 3. These results reflect the different pass-through elasticities across states, as well as the distribution of expenditure shares of traded goods and their corresponding tariff reductions at each point in the per capita expenditure distribution within states. In urban areas, only the states of Assam and Bihar show a pro-rich effect, while the other states experienced a pro-poor or relatively

[14] This is a common treatment in the nonparametric estimation of consumption shares. The number of excluded households is very small compared to the size of the survey: 48 in rural areas and 32 in urban areas. These outlier households are excluded only for the nonparametric estimation of the distributions.

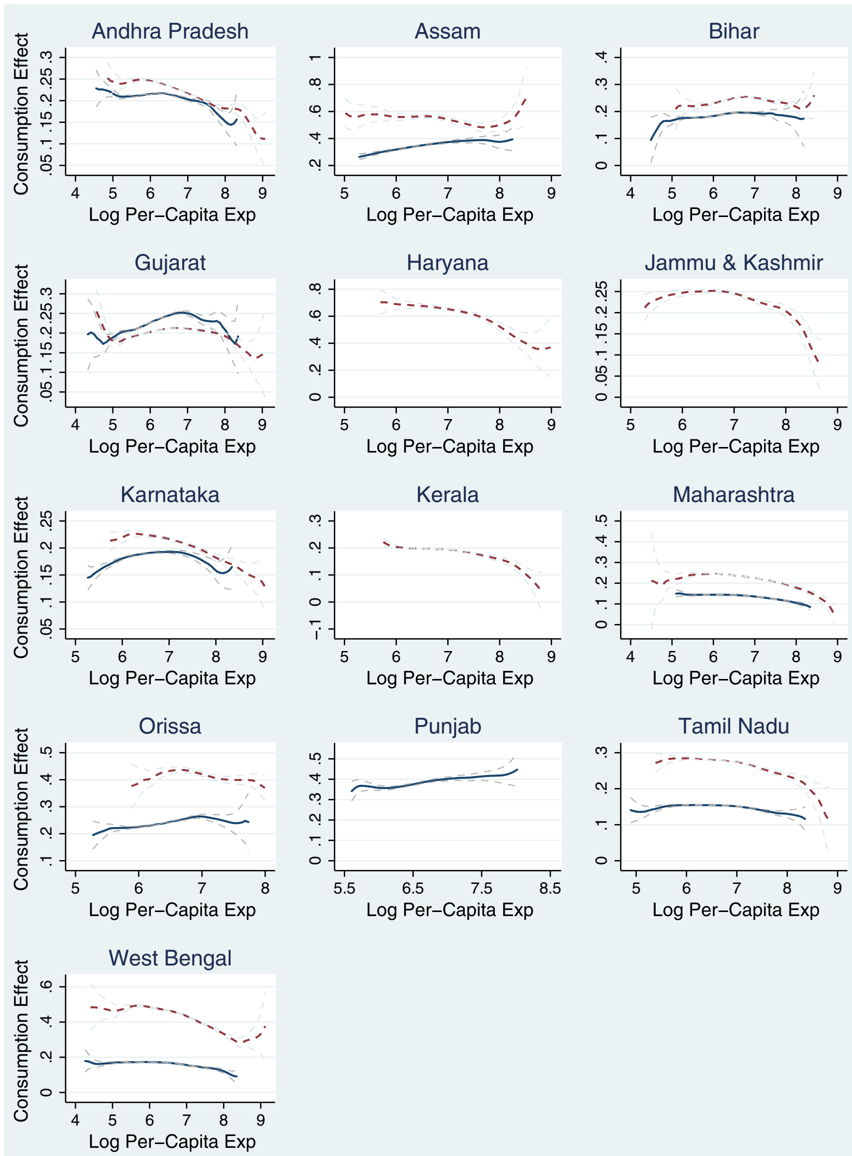

Fig. 3. Distribution of consumption effect by state. Notes: The state-specific nonparametric distribution of consumption effects are presented with 95 percent confidence intervals. Madhya Pradesh, Rajasthan and Uttar Pradesh are omitted due to insignificant pass-through elasticities in both rural and urban areas (solid line indicates rural areas and dashed line indicates urban areas). Rural areas of Haryana, Jammu & Kashmir, Kerala and urban Punjab are omitted due to insignificant pass-through elasticities.

neutral distributional effect. In rural areas, the states of Assam, Orissa and Punjab show a pro-rich effect, while the other states experienced either a pro-poor or neutral effect. In addition, households in states with high pass-through elasticities, such as Andhra Pradesh, Assam, and Gujarat, benefited the most from the consumption channel. This can also be seen in the last two columns of Table 4, where the average consumption effects for each state are provided. The consumption effect was reduced by 22% in urban Andhra Pradesh and by 64% in urban Haryana, while the effect was only 13% in rural Maharashtra. The size of the consumption effect can be relatively low if the households allocate a smaller percentage of their budget on traded goods, if the commodities that are more important for households had experienced lower reductions in tariffs, or if the households live in an area that partially isolates them from the effects of trade policy.

5.3. Labor income effects

It is well known that when domestic prices change, the returns to factors of production adjust. In a poor, unskilled, and labor-abundant country, standard trade theory suggests that the returns to labor, especially to unskilled labor, should increase as a result of trade liberalization. This theory requires perfect intersectoral factor mobility, which can only hold in the long run. In the short run, there will be significant adjustment costs and intersectoral factor mobility will be imperfect. Goldberg and Pavcnik (2005a) estimate this relationship for the Colombian trade reforms and conclude that industry affiliation plays an important role as to how much the wage incomes respond to changes in trade policy. Besley and Burgess (2002) and Hasan et al. (2007b) identify labor regulations as a source of imperfect labor mobility and argue that the flexibility of labor markets varies across Indian states. Kumar and Mishra (2008) showed that unskilled workers in the manufacturing sectors in India benefited from trade liberalization relatively more than their skilled counterparts. This is an important component of the distributional analysis, as the share of unskilled workers is higher at the lower end of the per capita expenditure distribution.

These considerations suggest a method that permits industry variation and skill variation in the response of wages to changes in trade policy. The estimation of the effect on wage incomes is based on a

Table 6
Wages in rural and urban areas.

	Rural (1)	Urban (2)	All India (3)	Rural (4)	Urban (5)	All India (6)
Tariffs	−0.0054**	−0.0050***	−0.0063***	−0.0058**	−0.0050***	−0.0064***
	(0.0026)	(0.0017)	(0.0020)	(0.0026)	(0.0013)	(0.0017)
Tariffs * skilled	0.0020***	0.0040***	0.0037***	0.0025***	0.0043***	0.0039***
	(0.0007)	(0.0004)	(0.0004)	(0.0006)	(0.0004)	(0.0003)
Tariffs * rural			0.0026***			0.0022***
			(0.0007)			(0.0006)
Rural			−0.5915***			−0.5737***
			(0.0785)			(0.0667)
Age	0.4068***	0.1111***	0.1319***	0.0726	0.0816***	0.0765***
	(0.1439)	(0.0327)	(0.0302)	(0.0500)	(0.0166)	(0.0194)
Age-squared/100	−0.4550***	−0.1325***	−0.1522***	−0.0292	−0.0915***	−0.0872***
	(0.1399)	(0.0437)	(0.0388)	(0.0591)	(0.0196)	(0.0220)
Male	0.7777***	0.9542***	0.8441***	0.6432***	0.8470***	0.7546***
	(0.1808)	(0.1122)	(0.1136)	(0.1449)	(0.0894)	(0.1020)
Married	0.1130	0.0606	0.1097*	0.1518*	0.1212*	0.1733***
	(0.1036)	(0.0753)	(0.0621)	(0.0833)	(0.0634)	(0.0553)
Age cohort * year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Age cohort * industry fixed effects	Yes	Yes	Yes	No	No	No
Industry fixed effects	No	No	No	Yes	Yes	Yes
Observations	2561	3683	6244	2561	3683	6244
R-squared	0.9354	0.9361	0.9254	0.9142	0.9230	0.9152

Notes: The dependent variable is logarithm of wage income from the following activities: Worked in household enterprise, worked as a regular wage employee, as a casual wage labor in public works or in other types of works. The data is constructed as a panel that follows the same age cohorts within each 2-digit industry over time by skilled and unskilled workers. A skilled worker is defined as a worker with at least secondary education. Additional controls are religion, land ownership and state effects, where state effects are defined as the number of observations within each industry–year–cohort–skill cell by state. Standard errors are clustered to account for within-industry correlation and presented in parentheses.

* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

pseudo-panel that follows age cohorts over years by skill level and by industry affiliation. This allows us to control for the changing behavior of cohorts over time, as well as across industries. The following Mincerian equation is estimated in both rural and urban areas:

$$ln\, w_{smjt} = \lambda_0 + \lambda_1 \tau_{jt} + \lambda_2 \left(\tau_{jt} * \text{Skilled}_{smjt}\right) + \lambda_3 \varphi_{smjt} + \eta_{mt} + \mu_{mj} + \varepsilon_{smjt} \quad (5.3)$$

where w_{smjt} is the average wage income, τ_{jt} is the tariff rate for industry j at time t, and φ_{smjt} represents the labor market productivity characteristics for skill level s, age cohort m, and industry j at time t, such as the age, gender, marital status, religion, and state variables. Skilled_{smjt} is an indicator variable that takes the value of one for skilled cohorts in the particular industry and year. Because the time period covered in this regression is quite long, the changing behavior of cohorts may be an important factor. This is controlled with the cohort–time fixed effect interactions, η_{mt}. Unobservable differences of cohorts across industries may be correlated with wages and lead to biased coefficients on the tariff rates. This effect is isolated using the age cohort fixed effects interacted with the industry fixed effects, μ_{mj}. In an alternative specification, the industry fixed effects are added to the system, in order to separately control for the unobservable industry characteristics. The error term is *i.i.d.* and is represented by ε_{smjt}.[15]

The values of φ_{smjt} in each cell are calculated as follows. When each unit of observation in the data set is an individual, these indicator variables consist of binary values. The mean values within each cell, by age cohort, industry, skill level, and year, are computed for worker characteristics, and the indicator variables then represent the share of people with a given attribute within that cell (for example, the percentage of male). Similarly, the state variables are defined as the percentage of individuals in a state within each cell, as defined by age cohort, industry, skill level, and year. This allows us to control for state effects without increasing the dimension of the panel. The state effects in this framework account for the state-specific differences in productivity levels, as well as the variation in the pass-through elasticities of the rural and urban areas. The above equation can then be considered as a reduced-form regression of wages on prices, where prices are defined as a function of the tariff rates. In this case, however, a more relevant price to consider would be the producer price, not the unit value of the household.

Table 6 presents these estimation results for rural and urban areas. The coefficients on the tariff rates are negative and significant in both rural and urban areas, and the effect for skilled individuals was relatively smaller. This result is consistent with the study of Kumar and Mishra (2008), which also uses the weekly wage earnings from the NSS data rather than the wage rates from the industry surveys. These results can be explained in a specific factors framework. If labor mobility is limited, then the price changes due to trade liberalization will induce capital reallocation across industries, leading to industry-specific changes in the return to labor. Average wage effects may be positive if capital has moved towards labor-intensive industries, increasing the marginal product of labor in those industries. Das (2008) documents that trade policy is associated with increased employment and wages, especially in the labor-oriented manufacturing sector. In the contracting sectors, the effect of tariff reductions on wages may be positive if low-wage workers are more likely to be displaced.[16] In addition to the factor reallocation, trade is known to increase productivity by inducing the Melitz-type entry and exit of firms and/or by stimulating technology diffusion, which can also increase the marginal productivity of labor (Krishna and Mitra, 1998).

In the literature, there is some evidence from the Indian Annual Survey of Industries (ASI), which suggests that trade liberalization induced a skill-biased technological change which increased the demand for skilled labor (Berman et al., 2005). There are several

[15] In order to test the linearity assumption, the tariff-squared and tariff-cubed variables are added to the regression. Both variables turn out to be insignificant, implying that the effect of tariffs on wages is best specified within a linear framework.

[16] Estimation of this model at the individual level provides similar results. In addition, a selection model where selection is considered as a function of marital status, religion, and household size, yields similar results.

major differences between the ASI survey and the NSS Employment survey. First, the NSS Employment Survey records multiple activities for each individual, allowing them to earn income from each activity. Wages are then defined as the total earnings from all activities, while the industry surveys record a wage rate per worker. Second, the employment survey covers wages from self-employment activities, as well as informal or unregistered activities, which are not likely to be reported in the industry surveys. Third, the papers based on the ASI survey, as well as the aforementioned papers that are more similar to the current paper, focus only on the manufacturing industry, while the current paper covers all of the traded sectors, including agriculture, which by itself employs about 60% of the population in India. While the evidence provided by these papers is crucial to understanding the skill upgrading and productivity improvements within the manufacturing sector, their distributional implications are limited to the individuals that work in the manufacturing sector and are proportional to the importance of wage income from that sector in the household's budget.

In these regressions, tariffs are defined in levels and range between approximately 11 and 212%. Results suggest that a one percentage point reduction in the tariff rates increases the wage incomes of unskilled workers by between 0.54 and 0.58% in rural areas and by 0.50% in urban areas. The wages of skilled workers increase by 0.33% in rural areas and only between 0.07 and 0.10% in urban areas. These results are quite robust to the separate inclusion of industry fixed effects or year fixed effects, as well as their interactions with age cohort fixed effects. For brevity, the results with separate year fixed effects and separate age cohort fixed effects are not reported. The rural and urban sample is combined in columns (3) and (6) to reveal that the percentage increase in rural areas is smaller than in urban areas, once we control for the lower level of wage earnings in rural areas by including the rural indicator itself. Note that the compensating variation is defined as the percentage of the initial values, so the same level of increase may translate to a higher percentage gain in rural areas. The preferred specification is therefore given in the first two columns of Table 6.

These are evaluated for each individual through the use of their skill level and industry affiliation. The actual tariff reduction in the affiliated industry is used to find the effect on wage earnings. These effects are then multiplied by the share of wage earnings in the household expenditure for each individual wage earner and aggregated to arrive at the household-level welfare effect through wage incomes. The distributional effect through wages comes from the differences in the industry affiliations of individuals along the per capita expenditure spectrum, as well as the differences in their skill levels and the importance of their wage incomes in the household budget. Because there are relatively more unskilled workers among the poorer households, and because their wage earnings increased by relatively more, the wage channel also shows a pro-poor effect from trade liberalization.

The average log wage incomes and average wage effects are provided by state in Table 7. The tariff reductions contributed positively to wage incomes in all states, although the effect varied significantly across states. The average wage effect in rural Andhra Pradesh was 4.5%, implying that consumers would need to give up 4.5% of their initial expenditure in order to have the same utility as they had prior to the policy change. The results suggest that differences in industry structures across states and across rural and urban areas lead to a considerable amount of variation in the welfare gains through wage incomes. Because the wage effects vary by industry, the relative sizes of industries in different states are an important factor for the between-state variation of the wage effects.

Panel C in Fig. 2 shows the conditional distribution of wage effects in rural and urban areas, respectively. In urban areas, the wage effect turned out to be higher due to a greater reliance on wages as a source of income. This can also be seen in columns 3 and 4 of Table 7, where the shares of wage income are reported. On average, this share is 22% in rural areas and 50% in urban areas, with the highest, visible rural–urban gaps shown in Bihar, Maharashtra, and West Bengal. The distributional analysis reveals that, at the very low end of the per capita expenditure distribution, households gained approximately 14% of their initial expenditures, while this number monotonically decreases to 4% as we move towards households that are relatively better off. The effect in rural areas was also pro-poor, as the households in those areas benefited by gaining between 2 and 8% of their initial level of expenditure.

5.4. Total effects

The analytical framework in this paper looks at the effect of tariff reduction on households by focusing on the price changes of traded goods and wage incomes. State-specific average total effects from these two channels are reported in columns (7) and (8) of Table 7, and the results of the nonparametric regressions are presented in panel D of Fig. 2. The average total effect is relatively higher for states that are able to transmit the effects of tariff reductions to the consumer, and for states in which the share of wage incomes is relatively higher. In both rural and urban areas, the total gain was mostly driven by the consumption channel, because of the relatively high magnitude of this effect. The results reveal the pro-poor effect of the tariff reductions in both rural areas and urban areas, particularly through the consumption channel, due to the higher tariff reductions of commodities that are more important for poorer households, and through the wage income channel, due to the higher share of unskilled labor among poorer households. Because the consumption effect and the labor income effect are both pro-poor, the total effect is also decreasing with per capita expenditure.

Moving from the per-capita expenditure variation to rural/urban differences, the total effect turns out to be significantly higher in urban areas. The higher pass-through elasticities of the tariff rates in urban areas allowed for higher levels of price reductions at the border to be transmitted to the household budget. In addition, the greater reliance on wage incomes in urban areas resulted in a higher gain from this channel. Over the 12-year period studied in this paper, the estimated total compensating variation from these two channels is 27% of the initial expenditure in rural areas at the very low end of the expenditure distribution, and it decreases almost monotonically to 13% as we move up on the per capita expenditure distribution. In urban areas, the effect is 40% among the households with very low expenditure levels, and it decreases monotonically to 18% among households with the highest level of per capita expenditure.

One implication of these estimates is that trade liberalization helped to reduce poverty in India by improving wage earnings and reducing the cost of consumption for households. This result is consistent with the findings of Hasan et al. (2007b), but it is contradictory to Topalova (2007, 2011). These papers make important contributions to the literature and are each important in identifying the mechanisms through which trade can affect poverty using sophisticated techniques. While the empirical framework followed in the current paper is very different, which make the comparisons difficult, there may be several potential reasons behind these differences in the general predictions.

First, the tariff definition varies across these studies. The current paper uses tariff data at the industry level and does not compute the aggregated protection rates by geographical regions. Topalova's papers exploit the differences between regions and use the employment-weighted tariff rates by setting the tariff rate in the non-traded sector to zero. This may be important if the share of employment in the non-traded sector is decreasing over time at different rates in different regions, as the weighted tariffs are negatively correlated with the share of employment in the non-traded sector. Hasan et al. (2007b), among other differences, construct the employment-

Table 7
Average wage effects and total effects by state.

State	Average log wage incomes		Share of wage income		Average wage effects		Average total effects	
	(1) Rural	(2) Urban	(3) Rural	(4) Urban	(5) Rural	(6) Urban	(7) Rural	(8) Urban
Andhra Pradesh	5.248	6.420	0.234	0.445	0.045	0.070	0.259	0.297
	(0.773)	(0.972)	(0.344)	(0.596)	(0.077)	(0.112)	(0.043)	(0.056)
Assam	5.874	6.907	0.235	0.415	0.077	0.031	0.418	0.579
	(0.788)	(0.752)	(0.502)	(0.737)	(0.138)	(0.054)	(0.097)	(0.116)
Bihar	5.376	6.694	0.245	0.825	0.042	0.088	0.227	0.332
	(0.768)	(1.000)	(0.428)	(1.322)	(0.078)	(0.133)	(0.039)	(0.049)
Gujarat	5.485	6.508	0.192	0.502	0.037	0.069	0.262	0.275
	(0.864)	(0.858)	(0.304)	(0.649)	(0.070)	(0.116)	(0.051)	(0.040)
Haryana	6.337	6.797	0.180	0.571	0.038	0.057	0.038	0.697
	(0.790)	(0.918)	(0.531)	(0.997)	(0.094)	(0.094)	(0.024)	(0.125)
Jammu and Kashmir	6.686	6.977	0.109	0.232	0.024	0.032	0.024	0.276
	(0.747)	(0.658)	(0.320)	(0.578)	(0.078)	(0.099)	(0.008)	(0.051)
Karnataka	5.188	5.986	0.206	0.507	0.041	0.062	0.229	0.273
	(0.603)	(0.919)	(0.340)	(0.720)	(0.077)	(0.097)	(0.036)	(0.049)
Kerala	5.407	6.428	0.414	0.451	0.091	0.040	0.092	0.233
	(0.794)	(0.787)	(0.551)	(0.602)	(0.130)	(0.060)	(0.023)	(0.034)
Madhya Pradesh	5.205	6.399	0.157	0.402	0.029	0.060	0.028	0.060
	(0.779)	(0.954)	(0.305)	(0.776)	(0.058)	(0.122)	(0.013)	(0.014)
Maharashtra	5.341	6.600	0.211	0.652	0.039	0.071	0.178	0.297
	(0.922)	(0.868)	(0.334)	(0.867)	(0.072)	(0.102)	(0.032)	(0.048)
Orissa	5.192	6.521	0.242	0.595	0.044	0.071	0.281	0.493
	(0.934)	(1.003)	(0.363)	(0.783)	(0.074)	(0.109)	(0.032)	(0.089)
Punjab	6.324	6.714	0.245	0.629	0.046	0.083	0.425	0.083
	(0.711)	(0.766)	(0.509)	(0.824)	(0.097)	(0.137)	(0.068)	(0.034)
Rajasthan	6.087	6.835	0.069	0.312	0.018	0.045	0.018	0.045
	(0.791)	(0.798)	(0.244)	(0.630)	(0.074)	(0.108)	(0.007)	(0.015)
Tamil Nadu	5.479	6.308	0.352	0.554	0.069	0.063	0.222	0.338
	(0.846)	(0.929)	(0.471)	(3.520)	(0.105)	(0.107)	(0.028)	(0.049)
Uttar Pradesh	5.689	6.546	0.108	0.288	0.023	0.052	0.023	0.052
	(0.977)	(0.913)	(0.317)	(0.570)	(0.070)	(0.118)	(0.007)	(0.015)
West Bengal	5.668	6.654	0.275	0.734	0.060	0.083	0.229	0.530
	(0.854)	(0.900)	(0.425)	(1.025)	(0.105)	(0.129)	(0.039)	(0.098)

Notes: The data are presented for round 55. Wage incomes include the following activities: worked in household enterprise, worked as a regular wage employee, as a casual wage labor in public works or in other types of works. Columns (3) and (4) present the share of total wage income by all household members in household expenditure. Standard deviations of wage incomes are clustered to account for within-industry correlation. The standard deviations of log wage incomes and wage effects are presented in parentheses.

weighted tariffs by focusing only on the employment structure within the traded sectors and by states instead of districts. Their results suggest that trade liberalization had reduced poverty in India, especially in urban areas and in states with flexible labor markets. The current paper also finds that the tariff reductions had positive welfare effect through wage earnings of individuals in traded sectors, and by more in urban areas. It must be noted that Hasan et al. (2007b) state that they do not believe that the computations of the tariff rates are deriving the different results.

Another major difference in the analytical framework is that this paper considers the combined effect of the cost of the consumption of traded goods and wage incomes, while both Topalova (2007, 2010) and Hasan et al. (2007b) use the poverty estimate as the outcome variable. The results in this paper suggest that the gains were higher among the very poor households, but the headcount poverty rate will only decrease with average gains among the marginal poor, which are relatively modest compared to the effect at the left side of the distribution. Further, the poverty lines are adjusted over time, with state-level price changes absorbing the price effect of traded goods on consumers. Finally, the current paper uses the data at the micro-level and estimates the household gains with respect to their initial expenditure, rather than the differential effects across geographical regions which are identified after taking into account the economy-wide changes due to the tariff reductions.

6. Conclusion

This paper investigates the effect of trade liberalization on households through the cost of the consumption of traded goods and their wage incomes. Three rounds of both the NSS Consumption Survey and the NSS Expenditure Survey, spanning from 1988 to 2000, are used for the analysis. The coverage of the household-level data and the nature of the substantial Indian trade liberalization allow for the identification of the effects of the trade reform at the household and individual level. The cost of the consumption of each traded good and the wage incomes of each member of the household are affected by the tariff reductions, and the total effect on households was proportional to the relative importance of these channels in the household budget.

The price transmission mechanisms in rural and urban India are estimated separately to understand the extent to which trade reforms are able to affect domestic prices. The findings suggest that changes in trade policy are not perfectly transmitted to consumers. Market imperfections and trade costs partially isolate households from the effects of trade policies. In general, urban markets are able to transmit prices with a higher elasticity relative to the rural markets. This translates to higher welfare gains through this channel for urban areas at all levels of per capita expenditure. The gain was higher for poorer households in both rural and urban areas due to their high expenditure share of traded commodities.

The effects on wage incomes are analyzed using a Mincerian framework that distinguishes between skilled and unskilled workers. The results suggest a negative relationship between the tariffs and wage incomes, and this effect was higher for unskilled workers, leading to a pro-poor distribution in both rural and urban areas. The relative magnitude of this channel was, however, considerably smaller than the direct effect on the cost of consumption, and therefore, the distribution of the total gain across per capita expenditure spectrum was largely driven by the consumption channel. The results show that the total effect of the tariff reductions through the consumption of traded goods and wages is pro-poor in both rural and urban areas, and the effect on urban households is unambiguously higher at every level of per capita expenditure.

Overall, there are significant differences across states due to their ability to transmit the effects of tariff reductions, the relative importance of wage earnings, and the relative importance of traded goods in their budget. The empirical approach followed in this paper has some clear appeal as it incorporates different dimensions of heterogeneity at each step of the analysis. It utilizes detailed micro-level information in the expenditure survey that allows for the estimation of the consumption effects at a much disaggregated level. It considers the heterogeneity in the relative importance of different consumption goods in the household budget, as well as the spatial variation in the impact of the tariffs. Industry affiliations, skill levels, and the importance of wages in the household budget are all incorporated as sources of heterogeneity across households. The overall predictions of this paper are consistent with Hasan et al. (2007b) with regards to the pro-poor effects of trade liberalization and the relatively more significant effects in the urban areas. The current paper adds to the literature through its identification of the two main channels, the wage effects and the price effects of traded goods, which sets it apart from the previous work on the subject.

The detailed micro-level analysis is relatively data intensive and different income sources of households can be modeled to the extent that the data is available. There are other potential channels on the income side, apart from wages, that may be affected by the reduction of tariffs which are not incorporated in the current study. For example, the effect on the profits from household farms may be an important factor and can be incorporated as a third component, if the data on these production activities are available. Unfortunately, the NSS does not record this data. Other potential sources, such as remittances and rents, may also be important. Finally, the effects of non-traded goods are not explicitly modeled in this paper, as the prices of non-traded goods are not readily available. Given a set of prices in the non-traded sectors, over time and by geographical region, future research can study the impact on individuals in the non-traded sectors by considering the general equilibrium effects in the country through the re-allocation of resources.

Appendix. Matching between I/O, NSS, NIC and world prices

Input–output categories		NSS 55th round		World prices		NIC 1987 2-digit categories	
Code (1)	Description (2)	Code (3)	Description (4)	Description (5)	Source (6)	Code (7)	Description (8)
1	Paddy	101/106	Rice	Rice	WTO	0	Agricultural prod.
2	Wheat	107/114	Wheat	Wheat	WTO	0	Agricultural prod.
3	Jowar	115	Jowar			0	Agricultural prod.
4	Bajra	116	Bajra			0	Agricultural prod.
5	Maize	117	Maize	Maize	WTO	0	Agricultural prod.
6	Gram	141, 142, 151	Gram and gram products			0	Agricultural prod.
7	Pulses	140, 143/150, 152, 153	Pulses			0	Agricultural prod.
8	Sugarcane	269	Sugar and sugar products (I/O 8 + 33 + 34 combined)	Sugar	WTO	0	Agricultural prod.
9	Groundnut	251	Groundnut			0	Agricultural prod.
10	Jute	379, 389	Clothing and bedding (I/O 10 + 11 + 41/46 + 48/49 combined)			0	Agricultural prod.
11	Cotton	379, 389	Clothing and bedding (I/O 10 + 11 + 41/46 + 48/49 combined)			0	Agricultural prod.
12	Tea	291	Tea	Tea (NSS 290 + 291)	Indian Dept. of Commerce	1	Plantations
13	Coffee	293	Coffee	Coffee (NSS 292 + 293)	Indian Dept. of Commerce	1	Plantations
14	Rubber					1	Plantations
15	Coconut	250	Coconut			1	Plantations
16	Tobacco	329	Cigarettes, leaves. etc. (I/O 16 + 40 combined)	Tobacco (NSS 329)	Indian Dept. of Commerce	1	Plantations
17	Other crops	118/122, 139, 229, 249, 253/257, 279, 289, 319	Other crops and vegetables	Fruits, vegetables (NSS 229 + 249)	WTO	1	Plantations
18	Milk and milk products	169	Milk and milk products			2	Milk and milk products, livestock
19	Animal services (agricultural)					2	Milk and milk products, livestock
20	Other livestock products	189	Eggs, fish and meat (I/O 20 + 22 combined)	Meat (NSS 181 + 182)	WTO	2	Milk and milk products, livestock
21	Forestry and logging					5	Forestry and logging
22	Fishing	189	Eggs, fish and meat (I/O 20 + 22 combined)			6	Fishing
23	Coal and lignite	340, 341, 343/353, 508, 510	Coal, LPG, charcoal, other gas and fuel, petrol, diesel (I/O 23 + 24 combined)	Energy	WTO	10	Mining of coal and lignite
24	Crude petroleum, natural gas	340, 341, 343/353, 508, 510	Coal, LPG, charcoal, other gas and fuel, petrol, diesel (I/O 23 + 24 combined)	Energy	WTO	11	Mining of petroleum
25	Iron ore					12	Mining of iron ore
26	Manganese ore					13	Mining of manganese ore
27	Bauxite					13	Mining of manganese ore
28	Copper ore					13	Mining of manganese ore

Appendix (*continued*)

Input–output categories		NSS 55th round		World prices		NIC 1987 2-digit categories	
Code (1)	Description (2)	Code (3)	Description (4)	Description (5)	Source (6)	Code (7)	Description (8)
29	Other metallic minerals					13	Mining of manganese ore
30	Lime stone					19	Other mining
31	Mica					19	Other mining
32	Other non metallic minerals					19	Other mining
33	Sugar	269	Sugar and sugar products (I/O 8+33+34 combined)	Sugar	WTO	20	Food products
34	Khandsari, boora	269	Sugar and sugar products (I/O 8+33+34 combined)	Sugar	WTO	20	Food products
35	Hydrogenated oil (vanaspati)	170	Vanaspati			21	Food products
36	Edible oils other than vanaspati	171/174	Mustard oil, groundnut oil, coconut oil, other edible oil			21	Food products
37	Tea and coffee processing	290, 292	Processed tea and coffee	Tea, coffee	Indian Dept. of Commerce	21	Food products
38	Miscellaneous food products	300/308	Biscuits, salted refreshments, prepared sweets, cooked meals, cake, pastry, pickles, sauce, jam, jelly, other processed food			21	Food products
39	Beverages	294/297, 339	Beverages except tea and coffee, alcohol			22	Beverages, tobacco and related products
40	Tobacco products	329	Cigarettes, leaves. etc. (I/O 16+40 combined)			22	Beverages, tobacco and related products
41	Khadi, cotton textiles	379, 389	Clothing and bedding (I/O 10+11+41/46+48/49 combined)	Cotton (NSS 379+389)	Cotton outlook	23	Cotton textiles
42	Cotton textiles	379, 389	Clothing and bedding (I/O 10+11+41/46+48/49 combined)	Cotton (NSS 379+389)	Cotton outlook	23	Cotton textiles
43	Woolen textiles	379, 389	Clothing and bedding (I/O 10+11+41/46+48/49 combined)	Cotton (NSS 379+389)	Cotton outlook	24	Wool, silk and fiber textiles
44	Silk textiles	379, 389	Clothing and bedding (I/O 10+11+41/46+48/49 combined)	Cotton (NSS 379+389)	Cotton outlook	24	Wool, silk and fiber textiles
45	Art silk, synthetic fiber textiles	379, 389	Clothing and bedding (I/O 10+11+41/46+48/49 combined)	Cotton (NSS 379+389)	Cotton outlook	24	Wool, silk and fiber textiles
46	Jute, hemp, mesta textiles	379, 389	Clothing and bedding (I/O 10+11+41/46+48/49 combined)	Cotton (NSS 379+389)	Cotton outlook	25	Jute and other fiber textiles
47	Carpet weaving					26	Textile products
48	Readymade garments	379, 389	Clothing and bedding (I/O 10+11+41/46+48/49 combined)	Cotton (NSS 379+389)	Cotton outlook	26	Textile products
49	Miscellaneous textile products	379, 389	Clothing and bedding (I/O 10+11+41/46+48/49 combined)	Cotton (NSS 379+389)	Cotton outlook	26	Textile products
50	Furniture and fixtures—wooden	559	Furniture and fixtures			27	Wood and wood products; furniture and fixtures
51	Wood and wood products					27	Wood and wood products; furniture and fixtures
52	Paper, paper prods. and newsprint					28	Paper and paper products
53	Printing and publishing					28	Paper and paper products
54	Leather footwear	399	Footwear			29	Leather and leather products
55	Leather and leather products					29	Leather and leather products
56	Rubber products					31	Rubber, plastic, petroleum and coal products
57	Plastic products					31	Rubber, plastic, petroleum and coal products
58	Petroleum products					31	Rubber, plastic, petroleum and coal products
59	Coal tar products					31	Rubber, plastic, petroleum and coal products
60	Inorganic heavy chemicals					30	Basic chemical and chemical products
61	Organic heavy chemicals					30	Basic chemical and chemical products
62	Fertilizers					30	Basic chemical and chemical products
63	Pesticides					30	Basic chemical and chemical products
64	Paints, varnishes and lacquers					30	Basic chemical and chemical products

Appendix (*continued*)

Input–output categories		NSS 55th round		World prices		NIC 1987 2-digit categories	
Code (1)	Description (2)	Code (3)	Description (4)	Description (5)	Source (6)	Code (7)	Description (8)
65	Drugs and medicines					30	Basic chemical and chemical products
66	Soaps, cosmetics and glycerin	459	Toilet articles, soap, shampoo, etc.			30	Basic chemical and chemical products
67	Synthetic fibers, resin					30	Basic chemical and chemical products
68	Other chemicals					30	Basic chemical and chemical products
69	Structural clay products					32	Non-metallic mineral products
70	Cement					32	Non-metallic mineral products
71	Other non-metallic mineral prods.					32	Non-metallic mineral products
72	Iron, steel and ferro alloys					33	Basic metal and alloy industries
73	Iron and steel casting and forging					33	Basic metal and alloy industries
74	Iron and steel foundries					33	Basic metal and alloy industries
75	Non-ferrous basic metals					33	Basic metal and alloy industries
76	Hand tools, hardware					34	Metal products and parts
77	Miscellaneous metal products					34	Metal products and parts
78	Tractors and agri. implements					35	Machinery and equipment
79	Industrial machinery (F&T)					35	Machinery and equipment
80	Industrial machinery (others)					35	Machinery and equipment
81	Machine tools					35	Machinery and equipment
82	Office computing machines					35	Machinery and equipment
83	Other non-electrical machinery					35	Machinery and equipment
84	Electrical industrial machinery					36	Machinery and equipment
85	Electrical wires and cables					36	Machinery and equipment
86	Batteries					36	Machinery and equipment
87	Electrical appliances	609, 631, 632	Cooking and household appliances, other machines			36	Machinery and equipment
88	Communication equipments					36	Machinery and equipment
89	Other electrical machinery					36	Machinery and equipment
90	Electronic equipments (incl.TV)	569	Radio, television. gramophone and record player, VCR, etc.			36	Machinery and equipment
91	Ships and boats					37	Transport equipment
92	Rail equipments					37	Transport equipment
93	Motor vehicles	612	Motor car			37	Transport equipment
94	Motor cycles and scooters	611	Motorcycle, scooter			37	Transport equipment
95	Bicycles, cycle-rickshaw	610	Bicycle			37	Transport equipment
96	Other transport equipments	613, 614	Other transport equipment			37	Transport equipment
97	Watches and clocks	630	Clock, watch			38	Other manufacturing industries
98	Miscellaneous manufacturing	449, 479, 579, 589, 629	Goods for personal care and effects, sundry articles, jewelry and ornaments, crockery and utensil, therapeutic appliances			38	Other manufacturing industries
Non-traded categories (not used)							
99	Construction	649	Residential building				
100	Electricity	342	Electricity				
101	Gas						
102	Water supply	540	Water charges				
103	Railway transport serv.	500/507, 511/513	Conveyance (except petrol and diesel)				
104	Other transport services	500/507, 511/513	Conveyance (except petrol and diesel)				

Appendix (*continued*)

Input–output categories		NSS 55th round		World prices		NIC 1987 2-digit categories	
Code (1)	Description (2)	Code (3)	Description (4)	Description (5)	Source (6)	Code (7)	Description (8)
105	Storage and warehousing						
106	Communication	487, 488	Telephone, postage and telegram				
107	Trade						
108	Hotels and restaurants	439	Entertainment				
109	Banking						
110	Insurance						
111	Ownership of dwellings	529, 539	Rent				
112	Education and research	409	Education				
113	Medical and health	419, 429	Medicine				
114	Other services	480/486, 490/494	Other consumer services				
115	Public administration						

Notes: Tariff rates by input/output categories in columns 1 and 2 and by NIC categories in columns 7 and 8 are from Hasan et al. (2007a). Consumption effects: all expenditure categories in the NSS Consumer Expenditure Survey are matched to the input–output categories by the author. 3-digit NSS categories with last digit '9' represent subtotals. When an expenditure category matches more than one input/output category (e.g. sugar), an import-weighted average of tariffs are used. These are indicated in parentheses in column 4. Price transmissions: world prices are matched to the tariff rates by I/O categories. Unit values of these goods are computed from the NSS Expenditure Survey using the corresponding NSS categories. In column (5), deviations from column (3) are indicated in parentheses. For example, NSS code 229 (vegetables) and 249 (fruits) are used for unit prices, and the tariff rate is matched to I/O category 17 (other crops, including vegetables and fruits). Wage effects: tariff rates by 2-digit NIC87 are computed using tariffs of inputs and outputs for each industry and aggregated using imports. These tariff rates are merged to NIC87 categories in the NSS Employment Survey to estimate the wage regressions. Concordance tables are used to make the industry classifications consistent across the three rounds of NSS Employment Surveys.

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