Abstract

Using state and industry-level unemployment and trade protection data from India, we find no evidence of any unemployment increasing effect of trade reforms. In fact, our state-level analysis reveals that urban unemployment declines with liberalization in states with flexible labor markets and larger employment shares in net exporter industries. Moreover, our industry-level analysis indicates that workers in industries experiencing greater reductions in trade protection were less likely to become unemployed, especially in net export industries. Our results can be explained within a theoretical framework incorporating trade and search-generated unemployment and some institutional features of the Indian economy.

Key words: Search unemployment; protection; trade reforms; labor markets; India

JEL Classification Codes: F10, F14, F16, J6, O19, O53
1. Introduction

There now exists a small but growing literature on the relationship between trade and unemployment.\(^1\) Much of this literature is theoretical, with a few exceptions.\(^2\) A recent contribution based on cross-country analysis and which incorporates developing country experience is Dutt, Mitra and Ranjan (2009). Using cross-country data on trade policy, unemployment, and various controls, and controlling for endogeneity and measurement-error problems, they find that unemployment and trade openness are negatively related. Using panel data, they find an unemployment-increasing short-run impact of trade liberalization, followed by an unemployment-reducing effect leading to the new steady state. While that paper finds interesting empirical regularities that can be explained using plausible models of trade and search unemployment, the standard criticisms of cross-country regressions apply to that study as well. Countries differ from each other in very important ways that cannot always be controlled for by variables we use in such regressions.

The key empirical studies that analyze the links between trade policy and unemployment for individual developing countries are Attanasio, Goldberg, and Pavcnik (2004), Menezes-Filho and Muendler (2007), and Porto (2008). These studies focus on the experiences of Columbia, Brazil, and Argentina, respectively. Using labor force survey data spanning the period before and after Colombia's trade liberalization in the early 1990s, and relying on information on the one digit industry in which unemployed individuals either worked previously or were looking for employment, Attanasio, Goldberg, and Pavcnik (2004) find the following: while the overall probability of unemployment increased after liberalization, this increase was driven by nontraded sectors such as wholesale and retail trade rather than traded sectors such as manufacturing. On the other hand, based on a unique and very rich linked employer-employee data set which allows formally employed workers to be tracked over time and across production sectors, Menezes-Filho and Muendler (2007) find that Brazil's trade liberalization in the 1990s

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\(^1\) The most prominent contributors to this literature are Carl Davidson and Steve Matusz. See Davidson, Martin, and Matusz (1999) for a representative work and Davidson and Matusz (2004) for a survey. Also, see Moore and Ranjan (2005) and Mitra and Ranjan (2010) for recent contributions to this literature.

\(^2\) See, for example, Davidson and Matusz (2004; chapter 4) for some analysis of the correlation between job destruction and net exports across sectors within the US, with some further regressions in Davidson and Matusz (2005).
led to the displacement of formally employed workers from protected industries and that ‘comparative advantage’ industries or exporters did not absorb trade-displaced workers in full. Their complementary analysis of employment survey data reveals that many of these formally employed workers transitioned to informal work or self-employment. For others, trade liberalization was associated with transitions to unemployment.

Porto (2008) examines the links between trade liberalization and unemployment (and wages) in the case of Argentina. However, the focus of his study is a little different from the other two studies. More specifically, Porto investigates how world agricultural trade liberalization can be expected to affect unemployment (and wages) in Argentina using an empirical model of trade, unemployment, and labor supply. His estimates indicate that an increase in the price of Argentine agro-manufactured exports can be expected to lead to both a lower unemployment rate as well as an increase in labor market participation. Wages also increase given an increase in export prices.

In this paper, we contribute to the empirical trade and unemployment literature using labor force survey data from India, a developing country that has, in the last couple of decades, experienced major trade reforms and where a significant proportion of the population lives below the poverty line. This makes such a study useful for policy analysis.

We carry out our empirical analysis of trade and unemployment at two levels. In addition to an industry level analysis along the lines of Attanasio, Goldberg, and Pavcnik (2004) (and close in spirit to Menezes-Filho and Muendler, 2007), we also carry out analysis at the state level. Importantly, constitutional arrangements which give India’s states considerable regulatory power over economic matters and the large size of these states (larger than the vast majority of countries), with unique ethno-linguistic characteristics, make such an analysis meaningful. In particular, interstate variations in labor regulations (see Besley and Burgess, 2004) and low mobility across Indian states (see Dyson, Cassen, and Visaria, 2004 and Topalova, 2010) suggest that treating each state as an independent labor market is a reasonable approximation. Additionally, we adopt broadly the strategy of Topalova (2007) and Hasan, Mitra, and Ural (2007) and exploit variations in industrial composition across Indian states (districts in
the case of Topalova) around the time of the major trade liberalization of the early 1990s, and the variation in the degree of liberalization across industries over time to construct state-specific measures of protection. This allows us to determine whether states more exposed to reductions in protection experienced increases or decreases in unemployment rates.

We then complement our cross-state analysis of the relationship between unemployment and liberalization with a detailed analysis based purely on changes in industry-level variations in protection over time. More specifically, we examine whether workers in industries experiencing greater reductions in trade protection were more or less likely to become unemployed (relative to the average worker) using the two-stage approach used by Attanasio, Goldberg, and Pavcnik (2004).

In so far as our state-level analysis is concerned, we find that overall (rural plus urban) unemployment on average does not have any relationship with average protection (weighted average with 1993 sectoral employment as weights) over time and across states. However, there are some conditional relationships between the two variables in certain types of states. In states with more flexible labor markets, there is evidence that on average overall and urban unemployment are positively related to protection. We also find that reductions in protection reduce unemployment in the urban sectors of states with large employment shares in net exporter industries.

Turning to our analysis based purely on industry-level protection, we find hardly any evidence that workers in industries that experienced larger reductions in protection were more likely to be unemployed. In fact, there is some evidence that such workers were less likely to become unemployed, a result that is stronger in states with flexible labor regulations and net exporter industries. There is also some weak evidence that the immediate short-run effect of a tariff reduction may be an increase in unemployment prior to reduction to a lower steady-state unemployment rate.

We show how our empirical results are consistent with the impact of trade liberalization in a two sector model, with labor being the only factor of production and where unemployment arises due to search frictions. We discuss two extreme cases: (a) perfect labor mobility (the Ricardian case), where comparative advantage is exclusively productivity-driven and (b) no intersectoral labor mobility (where
labor becomes sector-specific), where comparative advantage, while still dependent on productivity, is also driven by relative sectoral labor force size. Our empirical results fall in between the two extremes, depending on the flexibility of labor markets.3

2. Trade and Unemployment: Theoretical Framework

Production Structure

Consider an economy that produces a single final good and two intermediate goods. The final good is non-tradable, while the intermediate goods are tradable. The final good denoted by \( Z \) is the numeraire and the two intermediate goods are denoted by \( X \) and \( Y \), their prices being \( p_x \) and \( p_y \), respectively. The production function for the final good is as follows:

\[
Z = \frac{AX^{1-\alpha}Y^{\alpha}}{\alpha^\alpha (1-\alpha)^{1-\alpha}}; 0 < \alpha < 1
\]  

(1)

Given the prices \( p_x \) and \( p_y \), of inputs, the unit cost for producing \( Z \) is given as follows.

\[
c(p_x, p_y) = \frac{(p_x)^{1-\alpha}(p_y)^{\alpha}}{A}
\]  

(2)

Since \( Z \) is chosen as the numeraire, \( c(p_x, p_y) = 1 \), or

\[
\frac{(p_x)^{1-\alpha}(p_y)^{\alpha}}{A} = 1
\]  

(3)

The production function for \( Z \) implies the following relative demand for the two intermediate goods.

\[
\frac{X^d}{Y^d} = \frac{(1-\alpha)p_y}{\alpha p_x}
\]  

(4)

Labor is the only factor of production. The total number of workers in the economy is \( L \), each supplying one unit of labor inelastically when employed. Our description of the labor market corresponds to a standard Pissarides (2000) style search model embedded in a two sector set up. A producing unit in

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3 It must be pointed out here that our empirical results can also be related to the predictions of some other theoretical models in the trade and unemployment literature. See for instance Felbermayr, Prat and Schmerer (2008). The opposite theoretical result is possible in Helpman and Itskhoki (2010). In Davidson, Martin, and Matusz (1999) and Moore and Ranjan (2005), the effect of trade on overall unemployment is ambiguous.
intermediate goods production is a job-worker match. New producing pairs are created at a rate determined by a matching function of two measures of labor market participation, namely vacancies and unemployment. Job destruction is a response to idiosyncratic shocks to the productivity of existing job-worker matches.

The production functions (in these one-worker firms) in the two intermediate goods sectors, once the matches are formed, are given by

\[ x = h_x l_x, \quad y = h_y l_y \]

If \( L_i \) is the total number of workers affiliated with (searching or employed in) sector-\( i \), \( u_i \) the unemployment rate in sector-\( i \), then the number of employed in sector-\( i \) is \((1- u_i) L_i\). The aggregate production in each sector is given by

\[ X = h_x (1 - u_x) L_x; \quad Y = h_y (1 - u_y) L_y; \quad L_x + L_y = L \]

The relative supply of the two intermediate goods is

\[ \frac{X^s}{Y^s} = \frac{h_x (1 - u_x) L_x}{h_y (1 - u_y) L_y} \]

Next let \( v_i \) be the vacancy rate (i.e., the number of vacancies divided by the labor force) in sector-\( i \). Define \( \theta_i = v_i / u_i \) as a measure of market tightness, and let \( m_i \) be a scale parameter in the matching function. Then, write the flow of matches in each sector per unit time as follows:

\[ M_i (v_i L_i, u_i L_i) = m_i (v_i)^\gamma (u_i)^{1-\gamma} L_i = m_i (\theta_i)^\gamma u_i L_i; \quad 0 < \gamma < 1 \]

where \( \gamma \) is a parameter capturing the vacancy intensity of this Cobb-Douglas matching function. Then, the exit rate (from unemployment) for an unemployed searcher in sector-\( i \) is \( \frac{M_i}{u_i L_i} = m_i \theta_i^{-1} \), and the rate at which vacant jobs are filled is \( \frac{M_i}{v_i L_i} = m_i \theta_i^{\gamma-1} \). The former is an increasing function of market tightness, and the latter a decreasing function of market tightness. Assume that the matches in sector-\( i \) are broken at an exogenous rate of \( \lambda_i \) per period. \( \lambda_i \) can be viewed as an arrival rate of a shock that leads to job
destruction. Given the above description of labor market, the net flow into unemployment per period of time is

\[ \dot{u}_i = \lambda_i (1 - u_i) - m_i \theta_i^r u_i \]  \hspace{1cm} (9)

In the steady-state the rate of unemployment is constant, thus given by

\[ u_i = \frac{\lambda_i}{\lambda_i + m_i \theta_i^r} \]  \hspace{1cm} (10)

Denote the recruitment cost in sector-\(i\) in terms of the final good by \(\delta_i\), the firing cost by \(F_i\), and the exogenous discount factor by \(\rho\). The asset value of a vacant job, \(V_i\) is characterized by the following Bellman equation

\[ \rho V_i = -\delta_i + m_i \theta_i^{r-1} (J_i - V_i) \]  \hspace{1cm} (11)

where \(J_i\) is the value of an occupied job. Free entry in job creation implies \(V_i = 0\), which we set from now on. Denoting the wage of workers in sector-\(i\) by \(w_i\) in terms of the numeraire, the asset value of an occupied job, \(J_i\) satisfies the following Bellman equation

\[ \rho J_i = p_i h_i - w_i - \lambda_i (J_i + F_i) \]  \hspace{1cm} (12)

Note that when the job is destroyed, the firm not only loses \(J_i\) but also has to pay the firing cost \(F_i\).

Free entry in job creation \((V_i = 0)\) implies the following from (11) above.

\[ J_i = \frac{\delta_i}{m_i \theta_i^{r-1}} \]  \hspace{1cm} (13)

Equations (12) and (13) imply

\[ p_i h_i - w_i - \lambda_i F_i = \frac{\delta_i (\rho + \lambda_i)}{m_i \theta_i^{r-1}} \]  \hspace{1cm} (14)

which is a zero profit condition: the value of a match equals wage plus expected hiring and firing costs.

\textit{Wage Determination}
Each unemployed worker receives a flow benefit of \( b \) (in units of the final good), which includes the value of leisure as well as unemployment insurance payments. Let \( W_i \) denote the present discounted value of employment in sector-\( i \) and \( U_i \) the present discounted value of unemployment. The Bellman equations governing \( W_i \) and \( U_i \) are given by:

\[
\rho W_i = w_i + \lambda_i (U_i - W_i) \tag{15}
\]

\[
\rho U_i = b + m_i \theta_i^r (W_i - U_i) \tag{16}
\]

Wage is determined through a process of Nash bargaining between the worker and the entrepreneur where the value of a job for an entrepreneur is given by \( J_i \) and the surplus of a worker from a job is \( W_i - U_i \).

Denoting the bargaining power of workers by \( \beta \), Nash bargaining implies:

\[
W_i - U_i = \frac{\beta}{1 - \beta} J_i \tag{17}
\]

Note from (16) and (17) that

\[
\rho U_i = b + \frac{\beta}{1 - \beta} m_i \theta_i^r J_i = b + \frac{\beta}{1 - \beta} \delta_i \theta_i \tag{18}
\]

where the last equality is obtained by using the expression for \( J_i \) in (13) above. By substituting out the expressions for \( J_i, W_i \), and \( U_i \) using (12), (15), and (18), respectively, in (17) we obtain

\[
w_i = (1 - \beta) b + \beta(p_i h_i + \delta_i \theta_i - \lambda_i F_i) \tag{19}
\]

A worker’s indifference between searching in either sector is given by a no-arbitrage condition:

\[
U_x = U_y \tag{20}
\]

which in turn implies from (18) that in equilibrium

\[
\delta_x \theta_x = \delta_y \theta_y \tag{21}
\]

That is, the market tightness in each sector is inversely proportional to the recruitment cost.

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4 In the presence of a firing cost, the initial wage for an open job may be different from the continuation wage for an occupied job. In particular, in the case of a continuing job, the job destruction not only causes a loss of surplus of \( J_i \) for the firm, but also a payment of firing cost \( F_i \). Therefore, the firm’s surplus from an occupied job is \( J_i + F_i \). This leads to a slightly different expression for the continuation wage from the one derived in our paper. See the discussion in Pissarides (2000), chapter 9, on this issue and the justification for using initial wage which is what is relevant for a firm calculating the returns from a new vacancy.
The model is solved as follows. For any $p_x/p_y$, the prices $p_x$ and $p_y$ are obtained from equation (3). For this pair of $p_x$ and $p_y$, equations (10), (14) and (19) determine $w_i$, $\theta_i$, and $u_i$. It is easy to verify that an increase in $p_x/p_y$ leads to an increase in $\theta_x/\theta_y$. Therefore, we get an upward sloping relationship between $p_x/p_y$ and $\theta_x/\theta_y$. Next, the no arbitrage condition (21) implies that $\theta_x/\theta_y$ must equal $\delta_x/\delta_y$. We can obtain the corresponding $p_x/p_y$ and the values of $w_i$, $\theta_i$, and $u_i$ as described above. Next, the relative supply in (7) and the relative demand in (4) together with the aggregate resource constraint, $L_x + L_y = L$, determine $L_i$.

**Impact of International Trade**

When the country opens up to trade, there is a change in relative price that depends on the country’s comparative advantage, determined in turn by $h_i$, $m_i$, $\delta_i$, $\lambda_i$, and $F_i$. Given the Ricardian nature of the model, if labor is completely mobile across sectors, the country will completely specialize in one good. To see the impact of trade on unemployment, gather the relevant equations (10), (14) and (19) below.

\[
p_i h_i - w_i - \lambda_i F_i = \frac{\delta_i (\rho + \lambda_i)}{m_i \theta_i^{r-1}} \tag{22}
\]

\[
w_i = (1 - \beta) b + \beta (p_i h_i + \delta_i \theta_i - \lambda_i F_i) \tag{23}
\]

\[
u_i = \frac{\lambda_i}{\lambda_i + m_i \theta_i^r} \tag{24}
\]

Eliminate $w_i$ from (22) and (23) to get

\[
p_i h_i = b + \lambda_i F_i + \frac{\beta}{1 - \beta} \delta_i \theta_i + \frac{\delta_i (\rho + \lambda_i)}{(1 - \beta) m_i \theta_i^{r-1}} \tag{25}
\]

From (25) obtain

\[
\frac{\partial \theta_i}{\partial p_i} = \frac{(1 - \beta) h_i}{\delta_i \left( \beta + \frac{(\rho + \lambda_i)(1 - \gamma) \theta_i^{-r}}{m_i} \right)} > 0 \tag{26}
\]

Next, note from (24) that
\[
\frac{\partial u_i}{\partial p_i} = -\frac{\lambda_i m_i \theta^{\gamma - 1}}{\left(\lambda_i + m_i \theta^\gamma\right)^2} \frac{\partial \theta_i}{\partial p_i} = -\gamma \mu_i (1 - u_i) \frac{1}{\theta_i} \frac{\partial \theta_i}{\partial p_i} < 0
\]  

where the last equality follows from (26). The intuition is very simple: an increase in the price of a product leads to an increase in the value of the marginal product of labor in the production of that good. This leads firms in that sector to increase vacancies posted relative to the number of workers searching.

Without loss of generality, suppose the country has a comparative advantage in good \( X \). Trade in this case will raise the relative price of \( X \), which implies an increase in \( p_x \) and a decrease in \( p_y \). Given the Ricardian nature of the model, the no-arbitrage condition cannot be satisfied anymore and all labor will move to sector \( X \). It is clear from (27) above that the post-trade unemployment in sector \( X \) is lower than before. The impact on the economy-wide unemployment depends on whether the \( X \) sector had higher or lower unemployment to begin with. If the \( Y \) sector had lower unemployment to begin with, then the impact of trade on economy-wide unemployment is ambiguous. Otherwise, trade reduces unemployment, including in the neutral case with symmetric search friction across sectors (\( \delta_x = \delta_y \)).

In the more likely case of costly labor mobility (which could be due to loss of skills in moving from one sector to another or some other idiosyncratic costs due to heterogeneity of preferences), \(^5\) the country may remain incompletely specialized even after opening to trade and the no-arbitrage condition is satisfied for the marginal worker. In this case, the unemployment rate decreases in sector \( X \) and increases in sector \( Y \). The net impact on economy-wide unemployment is going to be ambiguous.

Using the logic we have developed so far, it is easy to see that in a multisectoral model, a tariff reduction in an import competing sector, as long as that sector exists, will lead to an increase in the unemployment rate within that sector. The reason is that a tariff reduction leads to a reduction in the value of the marginal product of labor in that sector.

In our empirical analysis, sectoral employment-unemployment status is only available at the two-digit level. At this coarse level of disaggregation, it is difficult to differentiate between import tariffs on

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\(^5\) See Mitra and Ranjan (2010) for the impact of offshoring on unemployment in a search model with mobility cost.
output and inputs as a high fraction of the input into such a sector comes from itself. While we have not modeled the interaction between labor working in combination with a complementary input, a reduction in the tariff on such an imported input is analogous to an increase in labor productivity. In our model, it can be captured by an increase in $h_n$, which could also be brought about through a pro-competitive effect (again not modeled here) of imports (See Devarajan and Rodrik, 1991). From (25), we get

$$\frac{\partial \theta_i}{\partial h_i} = \frac{p_i}{\delta \left( \beta + (\rho + \lambda_i)(1-\gamma)\theta^{-\gamma} \right)} > 0 \text{ and } \frac{\partial u_i}{\partial h_i} = -\gamma u_i (1-u_i) \frac{1}{\theta} \frac{\partial \theta_i}{\partial h_i} < 0$$

That is, an increase in productivity increases market tightness and reduces unemployment.

In our online appendix, http://faculty.maxwell.syr.edu/dmitra/HMRA_WebAppendix.pdf, we show that the impact of labor market rigidity driven by firing costs and bargaining power of workers, has an ambiguous interaction effect with trade liberalization on overall unemployment. In addition, we discuss non-monotonic transitional and short-run effects of trade reforms on unemployment (an implication of equation (9): see our online appendix for details). An important reason is that there is net job creation in one sector and net job destruction in the other, coupled with the fact that job creation takes time while job destruction is instantaneous.

3. The Indian Policy and Institutional Framework

There are two features of the Indian policy and institutional landscape that have an important bearing on the strategy we adopt for estimating the impact of trade protection on unemployment rates. First, notwithstanding some earlier efforts, India undertook a dramatic liberalization of trade policies in 1991. Thus, for example, mean tariffs, which were 128 percent before July 1991, had fallen to roughly 35 percent by 1997-98 and the standard deviation of tariffs during this period went down from 41 percentage points to roughly 15. Significantly, the trade liberalization was unanticipated. It was the result of strong conditionality imposed by the International Monetary Fund (IMF) in return for IMF assistance for dealing with a balance of payments crisis. Given several earlier attempts to avoid IMF loans and the associated
conditionalities, the liberalization came as a surprise. Given its large and unanticipated nature, the trade liberalization of 1991 presents researchers an excellent opportunity to examine the effects of trade using data on trade protection and variables whose relationship with trade we are interested in examining spanning the years prior to 1991 and later.

Second, the impact of India's trade liberalization on unemployment can be expected to vary across Indian states. One reason is that the degree to which states are exposed to trade protection is unlikely to be a constant. In particular, the composition of employment across industries will typically vary across states thereby leading states to be differentially exposed to trade liberalization. Another reason has to do with the fact that the regulatory environment varies across India's states. To the extent that the effects of trade liberalization are influenced by the nature of the regulatory environment in which economic activity takes place, the impact of trade liberalization on unemployment can be expected to vary across India's states.

An element of regulation that is especially relevant for the analysis of this paper is labor market regulation. Under the Indian constitution, both the central (federal) government as well as individual state governments have the authority to legislate on labor related issues. In fact, the latter have the authority to amend central legislations or to introduce subsidiary legislations. A case in point is the Industrial Disputes Act (IDA) which lays down the conditions under which layoffs can take place and the procedures for settlement of labor related disputes among others. As we explain in more detail below, state level amendments to the Act have resulted in differences in labor regulation across states. In

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6 In addition to the reduction of tariff levels and their dispersion, trade liberalization involved the removal of most licensing and other non-tariff barriers on all imports of intermediate and capital goods, the broadening and simplification of export incentives, the removal of export restrictions, the elimination of the trade monopolies of the state trading agencies, and the simplification of the trade regime. Trade liberalization was also accompanied by full convertibility of the domestic currency for foreign exchange transactions. See Hasan, Mitra, and Ramaswamy (2007) and the sources cited therein for more details.

7 See also the discussion in Topalova (2007) and Khandelwal and Topalova (2010) on the extent to which India's trade liberalization was an endogenous outcome of political and economic processes. In particular, Topalova’s analysis indicates that at least until 1996, the variation in reductions in protection across industries was unlikely to be driven by economic and political factors that would give rise to concerns about trade policy variables being endogenous in our empirical analysis.

8 This is because India's constitution gives its states control over various areas of regulation. In these areas, states have the authority to enact their own laws and amend legislations passed by the Central (federal) government. Typically, states also have the authority to decide on the specific administrative rules and procedures for enforcing legislations passed by the center.

9 See Anant et al (2006) for a detailed discussion of India’s labor-market regulations.
addition, the enforcement of many labor regulations, even those enacted by the central government, lies with the state governments. Thus, the placement of labor issues in the Indian constitution suggests variation in labor regulations and/or their enforcement across India’s states. It is important to take into account this variation in assessing the impact of trade liberalization on unemployment.\footnote{A similar case could be made for other types of regulation -- for example, product market regulations. We discuss this possibility in more detail later.}

4. Empirical Strategy

4.1 State-Level Analysis

Our strategy for estimating the impact of trade protection on state unemployment is along the lines of Topalova (2007) and Hasan, Mitra, and Ural (2007), both of which examine the relationship between trade liberalization and poverty. In particular, we estimate variants of the following basic regression specification:

\[ \ln y_{it}^{j} = \alpha^{j} + \beta_{1}^{j} \text{protection}_{it-1}^{j} + \beta_{2}^{j} \text{protection}_{it-1}^{j} \cdot \text{regulation}_{i} + \delta_{i}^{j} + \mu_{i}^{j} + \epsilon_{it}^{j} \]  

where \( y_{it}^{j} \) is the natural logarithm of the unemployment rate in state \( i \) and sector \( j \) (i.e., for the state as a whole or a state's rural sector or its urban sector), \( \text{protection}_{it-1}^{j} \) refers to a measure of state-level trade protection (explained later) lagged once per state \( i \) and sector \( j \) in order to alleviate concerns about endogeneity and for allowing time for unemployment to respond to protection, and \( \text{regulation}_{i} \) is a time-invariant variable capturing the stance of regulations across states. \( \delta_{i}^{j} \) represents fixed state effects, \( \mu_{i}^{j} \) represents year dummies, and \( \epsilon_{it}^{j} \) represents an identically and independently distributed error term. The effect of trade liberalization on unemployment can be gauged by considering the marginal effect of protection on unemployment. This is the sum of two terms: \( \beta_{1}^{j} + \beta_{2}^{j} \cdot \text{regulation} \). The first term represents the direct effect of trade protection on unemployment, while the second term captures the differential effect of trade protection based on the regulatory characteristics of a state. Of course, the total effect of trade liberalization will depend on the sum of the two terms and vary across states.
It needs to be acknowledged that the validity of the above inferences would weaken in the face of interstate migration of workers. For example, unemployed individuals in states with flexible labor regulations and experiencing large declines in trade protection may move out of such states. A positively signed estimate of $\beta_{jt}$ may then be at least partly driven by such movements of workers.\textsuperscript{11} Fortunately for our analysis, India is a country with relatively low migration rates. As borne out by the detailed work of Dyson, Cassen, and Visaria (2004) using decennial population census data, the bulk of migration in India occurs among women on account of marriage; mobility for economic reasons is limited. Moreover, the migration that occurs, does so mostly within and across districts and very seldom across states. In fact, interstate migration has been declining in recent decades.\textsuperscript{12} These considerations strongly suggest that our results are unlikely to be driven by changes in the composition of the workforce at the state level.

4.2 Industry-Level Analysis

We next turn to our industry-level analysis. While the data available to us do not describe the industry in which unemployed workers are seeking employment, they do inform us about their most recent previous industry of employment (if any). This allows us to focus on the effect of trade protection on the probability that a worker with previous work experience in a given industry has become unemployed. To do so we employ the two-stage approach used by Attanasio, Goldberg, and Pavcnik (2004) and Goldberg and Pavcnik (2005). This approach is based on the industry wage premium methodology used in the labor literature.

In the first stage, we estimate the following equation separately for each round (each year $t$ for which data are available):

\textsuperscript{11} We are grateful to a referee for not only pointing this out, but also for directing us to some of the relevant literature.

\textsuperscript{12} Admittedly, the low estimates of migration reported in the decennial census may underestimate economic migration of shorter duration, as well as circulatory migration between rural and urban areas. Recent surveys by the NSSO have sought to capture some of these dimensions by applying a tighter definition than that allowed by census data. According to these surveys, the levels of migration are going up, but it is hard to discern an acceleration in migration in recent decades, especially across states (Anant et al, 2006). Low labor mobility across Indian states is also clearly pointed to in the work of Munshi and Rosenzweig (2009) and Topalova (2010).
\[ \text{unemployed}_{iskt} = \alpha_i + \beta_{st} X_{iskt} + \gamma_{st} + \gamma_{kt} + e_{iskt} \]  

(29)

where \( \text{unemployed}_{iskt} \) is an indicator variable for a worker \( i \) in state \( s \) with an industry affiliation \( k \) at time \( t \). This variable takes the value 1 for workers with previous experience who have become unemployed and 0 otherwise. Unemployed workers with no information on previous experience (or with no previous experience) are dropped from our analysis as there is no way of attaching any industry affiliation label to them. \( X_{iskt} \) captures individual characteristics such as age, age squared, dummies for male workers, rural workers, and indicator variables for educational status. \( \gamma_{st} \) are state effects (or the state dummy variable coefficients) while \( \gamma_{kt} \) are industry effects (or the industry dummy variable coefficients) for year \( t \). Finally \( e_{iskt} \) is an identically and independently distributed error term. As is the case in the previous literature (see Attanasio, Goldberg, and Pavcnik, 2004 and Goldberg and Pavcnik, 2005), we normalize our industry coefficients by converting them to a deviation from an employment-weighted average of the probability of unemployment across industries. The normalized industry coefficients thus represent the probability of becoming unemployed in an industry relative to that probability in an average industry.\(^\text{14}\)

The first-stage regressions are estimated separately for each year in our sample.

In the second stage, we estimate the following equation:

\[ \Delta \psi_{kt} = \alpha_2 + \beta_4 \Delta \text{protection}_{kt-1} + \lambda_t + \Delta \eta_{kt} \]  

(30)

where \( \Delta \psi_{kt} \) is the one-period change in the normalized industry unemployment probability for industry \( k \) at time \( t \). \( \Delta \text{protection}_{kt-1} \) is the one-period change in industry-level trade protection. \( \lambda_t \) are time effects that capture the role of macroeconomic factors that may be driving the changes in unemployment probabilities across time. Finally, \( \Delta \eta_{kt} \) is the one-period change in the identically and independently distributed error

\(\text{13}\) The industry dummy variable coefficients represent the part of the probability of unemployment that cannot be explained by individual characteristics and are instead due to a worker’s industry affiliation. Obtaining industry measures of the probability of unemployment in this manner is advantageous since the individual characteristics above control for composition differences (based on age, education etc) across industries. This ensures that the relationship between the probability of unemployment and trade protection in the second stage are not driven by such compositional differences.

\(\text{14}\) The normalized industry unemployment probabilities and their standard errors are calculated using the Haisken-DeNew and Schmidt (1997) approach.
term. We run (30) in one-period changes following the preferred specification of Attanasio, Goldberg, and Pavcnik (2004).\footnote{Note here that “period” refers to a round of the survey and the time difference between two such consecutive rounds is usually 6 years. Thus our estimation is effectively done in long differences and perhaps, given data constraints (the time duration between rounds), captures only steady-state effects. However, we also try long differences in four different time lags simultaneously in the hopes of capturing some of the transitional dynamics (short-run and long-run effects). Note also that time $t$ is measured in years and so $t-1$ refers to a one-year lag.}

A positively signed estimate of $\beta_4$ in (30) implies that reductions (increases) in protection are associated with reductions (increases) in the relative probability of becoming unemployed. While the overall relationship between trade protection and unemployment is ambiguous in theory, based on the discussion in Section 2, we expect that trade liberalization overall will lead to a decline in the relative probability of becoming unemployed in comparative advantage industries. To capture the role of the trade orientation of an industry, we interact $\Delta \text{protection}_{kt-1}$ with an indicator variable for net export industries (capturing revealed comparative advantage). We expect the coefficient of the interaction terms to be positive. Since the dependent variable in equation (30) is estimated we estimate the equation using weighted least squares (WLS) where the inverse of the variance of the industry unemployment probabilities estimated in the first stage will act as weights. We also correct for general forms of heteroskedasticity by computing Huber-White robust standard errors.

The industry-level measures of trade protection are particularly susceptible to endogeneity bias. This is because trade policy can be used to protect declining industries that are driving large increases in unemployment. To the extent that such political economy factors are time varying, they will not be removed by the first-differencing in equation (30). In addition, while the trade reforms of 1991 were conducted under external pressure and can thus be considered exogenous, the same cannot be said of the latter periods in our sample. Topalova (2010) argues that after 1996 the external pressure that led to the initial reforms had abated and thus trade policy was more likely to be driven by political economy factors.

To address such concerns for endogeneity we employ the approach used by Goldberg and Pavcnik (2005). This methodology involves instrumenting the differenced protection term in equation (30) using the following instruments: (a) two-period lagged protection data, and (b) protection data from
the initial year of the sample. This instrumental variable strategy rests on the assumption that while past protection levels determine current changes in protection they are less likely to be correlated with current changes in the error term. The endogeneity of protection is also relevant in the state-level analysis if there is systematic agglomeration across states. For example, if major parts of an industry are concentrated in a handful of states, then the political economy factors that create endogeneity concerns at the industry-level will also play a role at the state-level. Fortunately, we do not observe any systematic agglomeration in our data. In particular, we find that employment for each two-digit industry in our sample is fairly well spread out across the various states.

5. Data

5.1 State-Level Unemployment

State- and sector-specific unemployment rates – i.e., unemployment rates for the state as a whole as well as its rural and urban subcomponents – were computed using data from the "employment-unemployment" surveys carried out by India's National Sample Survey Organisation (NSSO). We utilize the four most recent quinquennial rounds of the surveys covering the years 1987-88, 1993-94, 1999-2000, and 2004-05 – years which enable our analysis to span a period that starts approximately three years prior to the trade liberalization of 1991 and ends fairly recently. These surveys cover over a hundred thousand households involving a multi-stage stratified sampling strategy over a full year. The employment-unemployment surveys collect information on demographic characteristics of all household members as well as information on their participation in economic activities. The latter can be used to infer labor force status of an individual; i.e., whether they are in the labor force or not, and in case they are, whether they are employed or unemployed.

We used the NSSO data to compute unemployment rates for 15 major states of India. In addition to considering unemployment rates at the state level as a whole, we also consider unemployment rates separately for the rural and urban sectors within states. A few of our unemployment numbers deviate marginally from those reported in the NSSO's official publications mainly on account of the fact that we
restrict at the outset attention to individuals aged between 15 and 65. There are only very few cases of such deviations. For further details on the NSSO data and the construction of the state unemployment rates see the online appendix.

5.2 Industry-Specific Unemployment

Beginning with the 1993-1994 round the NSSO surveys asked follow-up questions to individuals that were unemployed during the previous week. These follow-up questions asked unemployed workers whether they had worked previously and the industry of their previous employment. This information was used to construct the industry-specific unemployment variable used in the paper. In particular, unemployed workers who had worked previously were assigned a value of 1 and were considered “unemployed” while all other employed individuals were assigned a value of 0. Unemployed workers were then assigned the industry in which they were previously employed. Note that unemployed individuals who had never worked were excluded from this analysis as they could not be assigned to a particular industry.

One complication with the industry data in the various NSSO surveys is that the industrial classification changed starting with the 1999-2000 round. In particular, while the 1993-1994 round used the 1987 National Industrial Classification (NIC), the 1999-2000 and 2004-2005 rounds used the 1998 NIC. To ensure that the industry data in all three rounds were comparable, we converted all of the industry data to the two-digit 1987 NIC level. Finally, note that since the industry-level analysis starts with the 1993-1994 round, it does not cover the period prior to the trade reforms of 1991.

5.3 Protection

We use information on commodity-specific tariff rates and NTB coverage rate from Pandey (1999) and Das (2008) to construct industry-specific tariff rates and non-tariff coverage rates at the 2-digit
industry level for each year relevant to our analysis.\textsuperscript{16} There are 32 such industries spanning agriculture, mining, and manufacturing industries. We also use Non-Tariff Barriers (NTB) and a combined measure of tariffs and non-tariff barriers is calculated using principal component analysis (PCA) as alternate measures of trade protection.

As for state-level trade protection used in our state-level analysis, we follow Topalova (2007) and Hasan, Mitra, and Ural (2007) and construct state-specific measures of trade protection at three levels of aggregation -- i.e., the state as a whole, as well as for urban and rural sectors within states. In particular, we weight industry-level tariff rates and NTB coverage rates for the various agricultural, mining, and manufacturing industries by their respective employment shares in the “tradable” portion of the overall (and alternatively the urban or rural part of the) state economy to construct these state-specific protection measures (By the “tradable” portion, we mean more specifically the portion to which these individual industry-level tariffs and NTBs apply).

5.4 Labor-Market Flexibility

As noted in Section 3, India’s states can be expected to vary in terms of the flexibility of their labor markets. We use three approaches to partition states in terms of whether they have flexible labor markets or not. A first approach (FLEX1) is based on the Besley and Burgess’ (2004) coding of amendments to the Industrial Disputes Act (IDA) between 1958 and 1992 as pro-employee, pro-employer, or neutral, and extends it to 2004. An alternative partition of states (FLEX2) is based on Hasan, Mitra, and Ramaswamy (2007). The main difference between the two classifications is that the latter treats Maharashtra and Gujarat, two of India’s most industrialized states, as having flexible labor markets and classifies Kerala as having an inflexible labor market. See Hasan et al. (2007) for further details.

\textsuperscript{16} Pandey reports commodity-specific tariff rates and NTB coverage rate for various years over the period 1988 to 1998. Das (2008) updates these for various years up to 2003 using the methodology of Pandey. We use simple linear interpolation to account for the fact that there are some years between 1988 and 2003 for which we do not have information on trade protection. Additionally, as is explained below, our estimation strategy requires that we also have protection related data for 1986. We estimate these by assuming that tariff and NTB coverage rates grew at the same annual rate between 1986 and 1988 as they did between 1988 and 1989. The NTB coverage rates estimated for 1986 are bounded at 100%.
also consider a final alternative partition of states (FLEX3) that has recently been used by Gupta, Hasan, and Kumar (2009). This partition is based on combining information from Besley and Burgess (2004), Bhattacharjea (2008), and OECD (2007). Finally, we experiment with two other state-level characteristics. The first is the employment share of net exporter industries and of net importer industries. This is calculated using trade data for 1989-90 and state-specific employment shares for the urban sector for each of our years. The second measure relates to product market regulations across Indian states, which has been created by Gupta, Hasan, and Kumar (2009).

The upper two panels of Table 1 provide summary statistics for protection and unemployment rates for the 15 states and years our empirical analysis is based on. As can be seen quite clearly, India experienced a fairly remarkable reduction in tariffs and non-tariff barriers over the period covered in our paper. There has been some increase in tariffs between 1998 and 2003, however, driven largely by industries prevalent in rural employment (i.e., agricultural products). As for the reported unemployment rates, it may be noted from the reported variances that there is considerable variation in these across states and over time. The last panel of Table 1 describes the percentage of unemployed workers previously employed in an industry relative to all employed workers in the industry for different industry groups (i.e., first considering all industries together, and subsequently considering different points along the distribution of this industry-level percentage). This is done for each year for which the data is available.

6. Results

6.1 State Unemployment

In Table 2, we present results using the natural logarithm of the state unemployment rates as the dependent variable. In all our regressions presented in this table and all subsequent state-level ones, we use state-level fixed effects and year dummies. The primary state-level protection measure used is tariffs. The results in columns 1-5 in Table 2 indicate that there is no evidence of any effect of protection on

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17 See also Bhattacharjea (2006) for a critique of the Besley-Burgess coding.
unemployment for the overall sample. The coefficient of tariffs is mostly positive but insignificant. This is also true when we use NTB and the principal component combination of tariffs and NTB as our measure of protection.\textsuperscript{18} When an additional variable, namely an interaction of these protection measures with the state-level labor-market flexibility measure (either Flex1 or Flex2 or Flex3) or product market regulation (PMR), is introduced, we find that this variable is positive but in most cases only mildly statistically insignificant. The protection variable, by itself, still remains positive and insignificant. However, taking into account the overall effects of protection on unemployment -- i.e., incorporating not only the own protection terms but also the interactions terms -- we find that in states with more flexible labor markets as measured through either Flex2 or Flex3, unemployment is positively and significantly related to protection. In other words, we find evidence that trade liberalization can reduce unemployment in states with flexible labor markets. Consider the estimates reported in column 3 of Table 2. In states with flexible labor markets, a one percentage point increase in the employment-weighted tariff rate leads to a 0.75 percent increase in the unemployment rate (0.00388+0.00361).\textsuperscript{19} A Wald test reveals this effect to be statistically significant at the 10% level. Since tariff rates declined by an average of 21% in states with flexible labor markets between 1987 and 1993, this reduction in protection translates into a decline in the unemployment rate of approximately 16%. The average unemployment rate in states with flexible labor markets was 4.75% in 1987. A 16% decline would mean an unemployment rate of 3.99% by 1993. Given that the actual unemployment rate in 1993 was 2.94% in these states our estimates suggest that trade liberalization had an economically significant impact on reducing unemployment rates in these states. Qualitatively similar results are obtained when using the principal-components combination of the employment-weighted tariffs and NTBs.

In columns 6-10 in Table 2 we repeat the above analysis on rural workers. The results are somewhat similar to what we found for overall unemployment. However, the significance of the

\textsuperscript{18} The results with NTBs and the principal components measure for overall and rural state-level unemployment are not presented here but are available upon request.

\textsuperscript{19} Note here that the dependent variable is the logarithm of unemployment rate and employment-weighted protection is obtained by computing the employment-weighted average of protection measured in percentage points.
interaction terms involving protection and the Flex variables is particularly weak. This suggests that a positive relationship between protection and unemployment may be stronger in urban areas. This is indeed what we find in columns 11-15 in Table 2. Here, the various estimates provide strong evidence across all protection and labor market flexibility measures that in the states with flexible labor markets, protection and unemployment are positively related. For example, in states with flexible labor markets the estimates reported in column 13 indicate that a one percentage point increase in the employment-weighted tariff rate leads to a 1.1 percent increase in the unemployment rate (0.00788+0.00321). Since average employment-weighted tariff rates in the urban sectors of states with flexible labor markets declined from 131% to 93.6% (i.e., a decline of approximately 37 percentage points) between 1987 and 1993, the estimates of column 13 suggest a 41.5% decline in the urban unemployment rate in such states. With an average urban unemployment rate of 6.62% in the states in 1987, the tariff reductions would imply unemployment rates to fall to 3.87% in 1993. The actual average unemployment rate in 1993 was 4.72%.

While these results are consistent with the notion that the benefits of trade liberalization will outweigh its costs in environments characterized by a high degree of factor mobility (labor mobility in this case), alternative interpretations of these results are possible. Perhaps the most relevant one is the possibility that the positive interaction involving protection and flexible labor regulations we find is capturing the beneficial effects of the latter on state’s economic growth. As found by Besley and Burgess using data from 1957 to 1992, pro-employer amendments are associated with faster state-level economic growth and therefore suggests that FLEX states have grown faster. Regressions of the log of gross state domestic product (GSDP) per capita on a time trend and an interaction between the time trend and our FLEX dummies are broadly supportive of this. In particular, while the interaction terms involving FLEX1 and FLEX2 are positive and statistically significant, that pertaining to FLEX3 is

20 Another alternative possibility is that our results are being driven by trends in unemployment that depend on the importance of traded industries in state employment. However, introducing the 1993 employment shares for nontradables in interaction with protection terms as an additional regressor in the models estimated in Table 2 do not change the results too dramatically. In particular, all interactions between protection and FLEX2 remain positive and statistically significant. And while those involving FLEX1 and FLEX3 do not, several of the direct protection terms remain positive and statistically significant (namely tariff rates in the regressions involving both FLEX1 as well as FLEX3, and the first principal component in the regression involving FLEX3).
positive but insignificant. Thus, it is not surprising that when we introduce the log of GSDP per capita as an additional regressor in the models estimated in Table 2, all of our protection terms, including those involving interactions with the flexibility measures, become statistically insignificant. However, they remain positively signed. As for the GSDP terms, the coefficients on these are negative and statistically significant coefficients so that states which grow faster experience negative and significant reductions in unemployment. Of course, given that economic growth is probably the single most important correlate of unemployment rates, these results should not be too surprising. They do, however, suggest some caution in interpreting the results of Table 2.

In addition, recall that the endogeneity of protection is also relevant in the state-level analysis if there is systematic agglomeration across states. For example, if major parts of an industry are concentrated in a handful of states, then the political economy factors that create endogeneity concerns at the industry-level will also play a role at the state-level. Fortunately, we do not observe any systematic agglomeration in our data. This holds true at the overall, urban, and rural-only subsamples separately.

In Table 3, we consider another control, namely the employment share of net exporter industries denoted by ENX (or of the net importer industries denoted by ENM) interacted with protection, in addition to labor-market flexibility. There is fairly strong evidence across all three measures of state-level protection from columns 1, 4 and 7 that in states with labor laws that make for a more flexible labor market, urban unemployment is positively related to employment-weighted protection and trade liberalization in such states reduces unemployment. There is also fairly strong evidence from columns 2, 5 and 8 that in states with a high employment share of net exporter industries, urban unemployment is positively related to employment-weighted protection and trade liberalization in such states reduces unemployment.

Our discussion is based on the Flex2 measure of labor market flexibility. Using Flex3 does not change our key results.

We have not found any evidence though that such effects conditional on the employment share of net exporter industries additionally vary between rigid and flexible labor market states. This is explained by the fact that ENX and ENM for urban areas are highly correlated with labor market flexibility. In fact, looking at the data we find that ENX on average is about 18 percent higher for the more flexible labor market states (as measured by our Flex2 variable) than the remaining states. While ENM is also higher for the flexible states, the differential is much smaller (only 8 percent). Therefore, once we control for the ENX or ENM interactions, there is nothing remaining to be explained by labor market flexibility.
6.2 Industry-Specific Unemployment

We next move to the impact of trade protection on the relative probability of becoming unemployed in a particular industry. Table 4 presents the estimation results for equation (29), using more than a hundred thousand observations for each survey year, which were used to calculate the industry unemployment probabilities.23 The results suggest that the probability of becoming unemployed is higher among younger, urban, and less educated workers. In the interest of space we do not report the actual industry coefficients. These results are available upon request.

Table 5 presents the results with the relative probability of becoming unemployed in a particular industry as the dependent variable. All regressions are in first differences and include year dummies. In addition, because the dependent variable is estimated we use weighted least squares (WLS) where the inverse of the variance of the industry unemployment probabilities estimated in the first stage will act as weights. Finally, due to the data limitations discussed in Section 5.2, the industry-level analysis starts with the 1993-1994 round and does not cover the period prior to the trade reforms of 1991. The results in columns 1-3 do not suggest that trade protection has a statistically significant effect on the probability of becoming unemployed. In fact, the positive coefficient on all three protection measures suggest that lower trade protection is associated with lower probabilities of becoming unemployed. A one percentage point reduction in tariff in a two-digit industry leads to a 0.008 percentage point reduction in that industry’s rate of unemployment (or the probability of unemployment in that industry) relative to probability of unemployment faced by an average worker. With a hundred percentage point reduction in tariff in a particular industry (which was roughly the case in many industries during this period), this relative unemployment rate or unemployment probability went down by 0.8 percentage points, which was slightly less than a fourth of the overall unemployment rate in 2003.

The industry-level protection measures used in columns 1-3 are more susceptible to endogeneity bias than our state-level protection measures used in Tables 3 and 4. This is because trade policy can be

23 Survey weights have been taken into account in our estimation.
used to protect declining industries that are driving large increases in unemployment. To address such endogeneity concerns we follow the strategy used by Goldberg and Pavcnik (2005) and instrument the differenced protection term in the baseline specification using the following instruments: (a) two-period lagged protection data, and (b) protection data from the initial year of the sample. Columns 4-6 in Table 5 present the IV results. The coefficients for the one-period change in output tariffs and the principal component between tariffs and NTB’s suggest that lower protection leads to lower probabilities of becoming unemployed. These results are significant at the 5% level. However, when we use output NTB’s to capture protection we find no evidence of an effect of protection on the probability of becoming unemployed. The instruments themselves comfortably pass the over-identification test, while the first-stage F-statistic suggests that the instruments have adequate strength. Nonetheless, given the small sample sizes and the fact that the IV coefficients are larger than their OLS counterparts, the reader should interpret the IV results with caution.

We next turn to the question of whether the flexibility of labor markets in a state affects the industry-level relationship between trade protection and unemployment. Based on the results in Table 2 we expect the unemployment reducing effects of trade liberalization to be stronger for individuals in states with flexible labor markets – a result that is driven mainly by the urban sectors of states. To examine this question we conduct the procedure described in Section 4.2 first for individuals in the urban sectors of flexible labor law states and then for individuals in the urban sectors of rigid labor law states. Thus, for each industry we obtain two unemployment probabilities. Columns 1-3 in Table 6 list the results with the unemployment probabilities for individuals in flexible labor law states as the dependent variable. The coefficients suggest that lower trade protection is associated with lower unemployment, with the relationship being statistically significant in the case of the principal component between tariffs and NTB’s. Columns 4-6 repeat this analysis with the unemployment probabilities for individuals in rigid labor law states as the dependent variable. In this case the coefficients suggest that lower trade protection

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24 It is important to note here that for the overall sample (i.e., rural and urban) we did not find the effect of protection on industry-level unemployment for the flexible labor market states to be significantly different from that in the rigid labor market states. Therefore, for the flexible-rigid comparisons in Table 6, we restrict ourselves to the urban subsample.
has weaker unemployment reducing effects compared to states with flexible labor laws. Thus, the results in columns 1-6 of Table 6 confirm the previous finding that the unemployment reducing effects of trade liberalization are stronger for individuals in the urban sectors of states with flexible labor markets.

Our analysis in Section 2 suggested that industry characteristics may have an important role in the relationship between trade protection and the probability of becoming unemployed. In particular, we expect that lower trade protection should reduce unemployment probabilities in comparative advantage sectors, which are expected to expand after trade liberalization. We examine this in columns 7-9 in Table 6 by interacting our protection measures in the baseline specification with an indicator for net export industries. The coefficient for the interaction term in column 7 suggests that lower protection leads to a statistically significant decrease in the probability of becoming unemployed in net export industries. The result is qualitatively unchanged when we use alternate measures of protection.25

Finally, we introduce additional lags of the protection measures in Table 7 in the hopes of separating the short-run effects of trade liberalization from its long-run effects. We do so by first adding the lags separately and then jointly in one regression. As mentioned before, the long time interval between any two consecutive rounds of the data poses a serious challenge in this regard. When the various lags of protection are introduced separately, as in columns 1 through 4, we find that they are all positive. Except for the first lag, the others are also highly significant. It is important to note that the various lags of protection are highly correlated with each other. Thus, a simple interpretation of these results is that trade liberalization reduces industry-specific unemployment but with a lag. Regardless of the lag we introduce, we find that a one percentage point reduction in tariff in a two-digit industry leads to a 0.01 percentage point reduction in that industry’s rate of unemployment (or the probability of unemployment in that industry) relative to probability of unemployment faced by an average worker. With a hundred percentage point reduction in tariff in a particular industry (which was roughly the case in many industries during this

25 In the period examined in this paper, India undertook several other reforms aimed at liberalizing the economy. Such reforms included the removal of strict licensing requirements that, among other things, dictated the size of firms as well as the removal of restrictions on foreign-direct investment (FDI). In results not reported here, we find that even after controlling for de-licensing and FDI liberalization, the relationship between trade protection and industry unemployment probabilities remains unchanged.
period), this relative unemployment rate or unemployment probability went down by one percentage point, which was more than a fourth of the overall unemployment rate in 2003. In column 5 when all the lags are simultaneously introduced, we find that while the first lag is negative and significant at the 10 percent level, the second and third lags are positive, with second lag being significant at the 10 percent level. Also, the combined magnitude of the second and third lags is greater than the first lag, indicating that the long-run effect of trade liberalization is unemployment reducing even though the immediate impact can be unemployment increasing. As explained in the last paragraph of section 2, the above result can arise from the fact that job destruction is instantaneous, while job creation takes time. Therefore, unemployment may increase immediately in the import competing sector followed by a gradual decrease in unemployment in the export sector.

7. Concluding Remarks

In this paper, we have empirically examined the relationship between trade protection and unemployment using labor force survey data from India. We find that trade liberalization has an unemployment reducing effect in states with flexible labor markets, and in states with a high employment share in the net export sectors. In addition to the state-level findings, we also find that workers in industries experiencing greater trade liberalization were less likely to become unemployed, especially in states with flexible labor regulations and net export industries. There is some evidence that this effect works with a small lag and that in the short-run there is the possibility of an unemployment increasing effect of trade liberalization in the case of industry-specific unemployment.

These results can be explained using a theoretical framework incorporating trade and search-generated unemployment and institutional features of the Indian economy such as limited or no intersectoral mobility and labor-market rigidities. In conducting our analysis, we follow some of the recent literature on cross-regional analysis of the impact of trade liberalization on poverty, child labor, human capital, etc., to construct state-level protection measures as the employment weighted-averages of
industry-level protection measures such as tariffs or alternatively NTBs.\textsuperscript{26} Finally, we complement this analysis with industry-level analysis, which involves the generation of industry-level unemployment measures from unemployment premium regressions that involve more than a hundred thousand observations for each year (with survey weights taken into account), capturing individuals surveyed in each survey round. Changes in industry-level unemployment are regressed on lagged changes in industry-level protection.

In conclusion, the empirical results in this paper provide support for trade liberalization along with complementary reforms in domestic policy, i.e., the full benefits of trade reforms cannot be reaped without domestic labor market reforms. We also see that states with a bigger share of the urban population in net-export sectors are ones where trade reforms are more effective in reducing urban unemployment. While this is certainly a function of comparative advantage, certain export-promotion strategies also might be useful. Exporting also has to do with search for and matching with buyers abroad.\textsuperscript{27} This is an area where the government may have a role to play.

\section*{References}


\textsuperscript{26} See for instance Edmonds, Pavcnik and Topalova (2008) and Topalova (2010).

\textsuperscript{27} See for instance Freund and Pierola (2009)


### TABLE 1. Summary Statistics

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Notes:
* Trade protection measures are introduced in our regression equations with a one-year lag.
** The average is taken over the 15 major states.
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<td>L. Tariffs</td>
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<td>0.003</td>
<td>0.003***</td>
</tr>
<tr>
<td>L. Tariffs*FLEX1</td>
<td>0.002</td>
<td>0.002</td>
<td>0.003**</td>
</tr>
<tr>
<td>L. Tariffs*FLEX2</td>
<td>0.003</td>
<td>0.003</td>
<td>0.003***</td>
</tr>
<tr>
<td>L. Tariffs*FLEX3</td>
<td>0.003</td>
<td>0.004</td>
<td>0.003**</td>
</tr>
<tr>
<td>L. Tariffs*PMR</td>
<td>0.002</td>
<td>0.002</td>
<td>0.001</td>
</tr>
<tr>
<td>Observations</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Number of states</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.22</td>
<td>0.27</td>
<td>0.26</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the log of state unemployment rate. State fixed-effects regressions. Absolute value of robust t statistics in brackets. Also included among the independent variables but not reported are the year dummy variables (1987 is the reference year).

* significant at 10%; ** significant at 5%; *** significant at 1%
<table>
<thead>
<tr>
<th>Variables</th>
<th>Tariff</th>
<th>NTB</th>
<th>First principal component</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.730</td>
<td>1.568*</td>
<td>0.383</td>
</tr>
<tr>
<td></td>
<td>[1.00]</td>
<td>[1.80]</td>
<td>[0.46]</td>
</tr>
<tr>
<td>L. Protection</td>
<td>0.008</td>
<td>-0.001</td>
<td>0.010*</td>
</tr>
<tr>
<td></td>
<td>[1.43]</td>
<td>[0.14]</td>
<td>[1.70]</td>
</tr>
<tr>
<td>L. Protection*FLEX2</td>
<td>0.003***</td>
<td>0.004***</td>
<td>0.090***</td>
</tr>
<tr>
<td></td>
<td>[3.00]</td>
<td>[2.76]</td>
<td>[2.94]</td>
</tr>
<tr>
<td>L. Protection*ENX</td>
<td>0.0002**</td>
<td>0.0003**</td>
<td>0.009*</td>
</tr>
<tr>
<td></td>
<td>[2.14]</td>
<td>[2.61]</td>
<td>[2.00]</td>
</tr>
<tr>
<td>L. Protection*ENM</td>
<td>0.0001</td>
<td>0.00002</td>
<td>-0.0005</td>
</tr>
<tr>
<td></td>
<td>[0.89]</td>
<td>[0.13]</td>
<td>[0.08]</td>
</tr>
<tr>
<td>Observations</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Number of states</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.31</td>
<td>0.25</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the log of state unemployment rate. State fixed–effects regressions. Absolute value of robust t statistics in brackets. Also included among the independent variables but not reported are the year dummy variables (1987 is the reference year).

* significant at 10%; ** significant at 5%; *** significant at 1%
<table>
<thead>
<tr>
<th>Variables</th>
<th>1993</th>
<th>1999</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.032***</td>
<td>0.061***</td>
<td>0.078***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.009)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Age</td>
<td>-0.000***</td>
<td>-0.002***</td>
<td>-0.001***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Age Squared</td>
<td>0.000</td>
<td>0.000***</td>
<td>0.000***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Male</td>
<td>0.001</td>
<td>-0.000</td>
<td>-0.003**</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Rural</td>
<td>-0.004***</td>
<td>-0.006***</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Primary Education or Below</td>
<td>-0.004***</td>
<td>-0.009**</td>
<td>-0.003*</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.004)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Middle School Education</td>
<td>-0.004***</td>
<td>-0.012***</td>
<td>-0.008***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Secondary Education</td>
<td>-0.003**</td>
<td>-0.015***</td>
<td>-0.007***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Upper Secondary or Graduate Education</td>
<td>-0.004**</td>
<td>-0.005</td>
<td>-0.005**</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Post Graduate Education</td>
<td>-0.003</td>
<td>-0.006</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.004)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Observations</td>
<td>119802</td>
<td>120219</td>
<td>114904</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.006</td>
<td>0.024</td>
<td>0.024</td>
</tr>
</tbody>
</table>

Notes: The dependent variable takes the value of 1 for unemployed individuals that have worked previously and is 0 for employed individuals. Standard errors in parentheses. Also included among the independent variables but not reported are the industry and state dummy variables.

* significant at 10%; ** significant at 5%; *** significant at 1%
## TABLE 5. Trade Liberalization and Industry Unemployment

<table>
<thead>
<tr>
<th>Variables</th>
<th>FD</th>
<th>2SLS - FD</th>
<th>2SLS - FD</th>
<th>2SLS - FD</th>
<th>2SLS - FD</th>
<th>2SLS - FD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.001</td>
<td>0.000</td>
<td>0.001</td>
<td>-0.001</td>
<td>-0.005</td>
<td>0.015**</td>
</tr>
<tr>
<td></td>
<td>[0.903]</td>
<td>[0.066]</td>
<td>[0.401]</td>
<td>[0.641]</td>
<td>[1.113]</td>
<td>[2.071]</td>
</tr>
<tr>
<td>Δ[L. Tariffs]</td>
<td>0.008</td>
<td>0.044**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1.220]</td>
<td>[2.267]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ[L. NTB]</td>
<td>0.001</td>
<td></td>
<td>-0.009</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.207]</td>
<td></td>
<td>[0.977]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ[L. First Principal Component]</td>
<td>0.144</td>
<td></td>
<td>1.425**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.622]</td>
<td></td>
<td>[1.988]</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Observations</td>
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<td>64</td>
<td>64</td>
<td>64</td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td>Number of Industries</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>F-stat. for instrument strength</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>7.45</td>
<td>7.15</td>
<td>6.23</td>
</tr>
<tr>
<td>OID test p-value</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.69</td>
<td>0.94</td>
<td>0.75</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.018</td>
<td>0.001</td>
<td>0.006</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the one-period change in the probability of becoming unemployed in an industry relative to that probability in an average industry. Protection measures have been lagged by one year and divided by 100. 2SLS-FD refers to first-difference regressions where the first-differenced protection measures have been instrumented using two-period lagged protection data and the protection data from the initial year of the sample. Note that first differencing here refers to differencing between two successive survey rounds that are generally six years apart and “period” here refers to a survey round. Absolute value of robust t statistics in brackets. Also included among the independent variables but not reported are the year dummy variables (1999 is the reference year).

* significant at 10%; ** significant at 5%; *** significant at 1%
### TABLE 6. State and Industry Characteristics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Flexible Labor Law States</th>
<th>Rigid Labor Law States</th>
<th>Net Export Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Constant</td>
<td>0.004</td>
<td>0.004*</td>
<td>0.008**</td>
</tr>
<tr>
<td></td>
<td>[0.697]</td>
<td>[1.767]</td>
<td>[2.079]</td>
</tr>
<tr>
<td>Δ[L. Tariffs]</td>
<td>0.004</td>
<td>-0.010</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.457]</td>
<td></td>
<td>[0.965]</td>
</tr>
<tr>
<td>Δ[L. NTB]</td>
<td>0.011</td>
<td>0.005</td>
<td>0.010</td>
</tr>
<tr>
<td></td>
<td>[1.467]</td>
<td>[0.740]</td>
<td>[1.487]</td>
</tr>
<tr>
<td>Δ[L. First Principal Component]</td>
<td>0.480*</td>
<td></td>
<td>0.039</td>
</tr>
<tr>
<td></td>
<td>[1.697]</td>
<td>[0.740]</td>
<td>[1.487]</td>
</tr>
<tr>
<td>Δ[L. Tariffs*Net Export]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ[L. NTB*Net Export]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ[L. First Principal Component*Net Export]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>59</td>
<td>59</td>
<td>59</td>
</tr>
<tr>
<td>Number of Industries</td>
<td>28</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.158</td>
<td>0.171</td>
<td>0.173</td>
</tr>
</tbody>
</table>

Notes: All regressions are in first differences. The dependent variable is the one-period change in the probability of becoming unemployed in an industry relative to that probability in an average industry. Protection measures have been lagged by one year and divided by 100. Note that first differencing here refers to differencing between two successive survey rounds that are generally six years apart and “period” here refers to a survey round. Absolute value of robust t statistics in brackets. Also included among the independent variables but not reported are the year dummy variables [1999 is the reference year]. As explained in the text, the results on the flexible-rigid comparison presented in this table are for the urban sample.

* significant at 10%; ** significant at 5%; *** significant at 1%
TABLE 7. Dynamics and Additional Time Lags

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.001</td>
<td>-0.002**</td>
<td>-0.002**</td>
<td>-0.002*</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>[0.903]</td>
<td>[2.108]</td>
<td>[2.101]</td>
<td>[1.875]</td>
<td>[1.575]</td>
</tr>
<tr>
<td>Δ[L. Tariffs]</td>
<td>0.008</td>
<td></td>
<td>-0.016*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1.220]</td>
<td></td>
<td>[1.684]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ[L2. Tariffs]</td>
<td>0.010***</td>
<td></td>
<td>0.040*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[2.831]</td>
<td></td>
<td>[1.786]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ[L3. Tariffs]</td>
<td></td>
<td>0.009***</td>
<td></td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>[2.747]</td>
<td></td>
<td>[0.044]</td>
<td></td>
</tr>
<tr>
<td>Δ[L4. Tariffs]</td>
<td></td>
<td></td>
<td></td>
<td>0.010***</td>
<td>-0.025</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[2.721]</td>
<td>[1.286]</td>
</tr>
<tr>
<td>Observations</td>
<td>64</td>
<td>64</td>
<td>64</td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td>Number of Industries</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.018</td>
<td>0.085</td>
<td>0.074</td>
<td>0.069</td>
<td>0.122</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the one-period change in the probability of becoming unemployed in an industry relative to that probability in an average industry. Protection measures have been lagged and divided by 100. Note that first differencing here refers to differencing between two successive survey rounds that are generally six years apart and “period” here refers to a survey round. Absolute value of robust t statistics in brackets. Also included among the independent variables but not reported are the year dummy variables (1999 is the reference year).

* significant at 10%; ** significant at 5%; *** significant at 1%