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TRADE IN UNEMPLOYMENT

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RESEARCH STUDY SERIES No. 64

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TRADE IN UNEMPLOYMENT

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Abstract

Insights from a novel Trade-and-Employment theoretical framework are used to assess the relationship between openness to trade and unemployment. The impact of trade on unemployment depends on the covariance between comparative advantage and sector level labour market frictions. If the covariance is positive then trade liberalization may lead to an increase in unemployment, whereas if the correlation is negative then unemployment falls as the economy opens up to international trade. This prediction is empirically confirmed in a panel of 97 countries during the period 1995-2009.

Keywords: Trade, Search unemployment

JEL Classification: F10, F13, F16

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Any mistakes or errors remain the authors' own.

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1. INTRODUCTION

Does international trade create or destroy jobs? We develop a model that introduces labour market frictions in a trade model with a continuum of sectors to address this question. Comparative advantage and trade frictions drive the patterns of trade, whereas labour market frictions generate equilibrium unemployment. In our model, labour market frictions are sector-specific and the aggregate unemployment rate can be thought of as the weighted average of sector-specific unemployment rates, where the weights are given by employment shares. As a result, the patterns of trade and sector-specific labour market frictions interact in shaping the aggregate unemployment rate. If a country has a comparative advantage in sectors that have high labour market frictions, then trade liberalization reallocates resources towards sectors with stronger labour market frictions, and therefore increase unemployment. Conversely, if comparative advantage and sector-specific labour market frictions are negatively correlated, then this country will see unemployment fall after trade liberalization. We find strong empirical support for this theoretical prediction in a panel of 97 countries that account for more than 90 per cent of world trade over the period 1995-2009. We also revisit existing seemingly conflicting results on this topic under the new light provided by the model, and show that our framework provides an explanation.

Integrating labour market frictions in trade models is important for at least four reasons. First, such a setting allows trade to destroy or create jobs, rather than assume away the impact of trade on unemployment. Until fairly recently, most economists would agree with Krugman (1992) that "it should be possible to emphasize to students that the level of employment is a macroeconomic issue...with microeconomic policies like tariffs having little net effect." Most – if not all – international economics textbooks have no chapter on the impact of trade on unemployment. We aim at filling this gap in the wake of Helpman and Itskhoki (2010). Second, the impact of trade on unemployment is likely to be complex and ambiguous as illustrated by our model. It is therefore important to understand when to expect the adverse effects to dominate. Third, in our setting welfare and unemployment are negative correlated, but not perfectly: freer trade may destroy more jobs than it creates *and* yet increase welfare. Fourth, this is an important political issue, and policymakers are convinced that there is a link, although they disagree on the sign of the impact of trade on unemployment. Our model and empirical evidence suggests that potentially the sign can be either positive or negative.

Our empirical strategy comprises three steps. First, bringing our theoretical prediction to the data requires a measure of comparative advantage, which is straightforward, and measures of labour market frictions at the sector level, which is more challenging. We measure the former using Balassa-type Revealed Comparative Advantage (RCA) indices. To construct the latter we build on an idea developped by Hausmann, Hwang and Rodrik (2007) to measure the product sophistication in a certain sector. More concretely, we define the unemployment rate of a sector as the RCA-weigthed average of the unemployment rate in each country. The idea is that countries with high rates of unemployment tend to have their production bundle tilted towards sectors with stronger labour market frictions. This novel measure of sector specific labour market frictions is positively correlated with existing proxies of labour market frictions such as labour union coverage and membership.

In a second step, we compute the country-specific covariance between measures of comparative advantage and labour market frictions. The country with the strongest covariance in our sample is Italy at 0.31. This positive covariance implies that it has a comparative advantage in sectors that are relatively intensive in labour market frictions. The country with lowest covariance is Iceland with a value of -0.31, which therefore has a comparative advantage in sectors with low labour market frictions.

Our third and final step involves testing whether trade liberalization increases unemployment in countries where the covariance between RCA and sector labour market frictions is high. The empirical results confirm this theoretical prediction. The country specific estimates of the correlation between comparative advantage and labour market frictions also help explain the heterogeneity of results in existing country specific studies of the impact of trade liberalization on unemployment. For example, if we rank countries in terms of this covariance, Brazil, Mexico, and the United States are in the top 33 per cent, and the value of their covariances is well above the estimate threshold for which trade liberalization is associated with a fall in unemployment. These are countries for which important case-studies find a negative impact of trade liberalization on jobs. Similarly, Ethiopia, Madagascar and Zambia are in the bottom 33 per cent, and these are countries for which existing studies suggest that trade liberalization had a positive impact on employment.

Ours is not the first paper to study the impact of trade reforms on unemployment. Brecher (1974) is an early example. He develops a 2x2 Hecskscher-Ohlin model of a small open economy with a minimum wage to show that the impact of trade liberalization on welfare and unemployment depends on relative factor endowments: labour-abundant countries experience a fall in unemployment as they open up to trade, whereas capital-abundant countries see unemployment increase. Davis (1998), building on Brecher's setup and allowing for terms-of-trade effects in a world with two identical economies except for their labour market rigidities, shows that openness reduces welfare and increases unemployment in the economy with more rigid labour markets. Davidson, Martin and Matusz (1999) find that the impact of trade liberalization on unemployment depends on relative capital-labour endowments across different countries as in Brecher (1974). More importantly, they are the first to recognize that sectoral labour market frictions can be a source of comparative advantage. Helpman and Itskhoki (2010) build a Diamond-Mortensen-Pisarides model of labour market friction in an open economy and and show that a country with relatively low labour frictions in the differentiated-good sector will be a net exporter of that good. Intuitively, lower frictions imply lower labour costs and therefore a comparative advantage in the differentiated sector. The impact of trade on unemployment is ambiguous, with unemployment raising or falling in both or one country being possible depending on the extent of labour frictions in the differentiated and homogenous-good sectors.[1]

Thus, while this growing theoretical literature recognizes an impact of trade on unemployment, there does not seem to be a consensus regarding on the sign of this impact. As put by Hoekman and Winters (2005):"These are complex models with complex and ambiguous results, but at least they admit the possibility that trade reform could have long-run consequences for employment."

When theory provides contradicting answers, the natural next step is to look for empirical patterns in the data. However, the rapidly growing empirical work has not found an unanimous answer either. Several important papers suggest that trade liberalization or import growth have led to an increase in unemployment. Revenga (1997) provides evidence for Mexico, Menezes-Filho and Mundler (2011) and Mesquita and Najberg (2000) for Brazil, and Autor, Dorn and Hanson (2013), Ebeinstein et al. (2009) and Pierce and Schott (2013) for the United States.[2] There are also several important papers suggesting that trade has no impact on unemployment. Goldberg and Pavnick (2005) provide evidence (or rather its absence) for Colombia, Hasan et al. (2012) for India, and Currie and Harrison, (1997) for Morocco. Finally, there is also evidence suggesting that trade has led to reductions in unemployment. Dutt et al (2010) do so in a cross-section of countries, Kpodar (2007) for Algeria, Nicita (2008) for Madagascar, and Balat, Brambilla and Porto (2007) for Zambia.

[1] Helpman, Itshkhoki and Redding (2010) introduce heterogenous workers with match-specific ability and costly worker screening for hiring firms. In such a setup trade tends to increase unemployment because it reduces the hiring rate, as trade reallocates resources towards more productive firms that have stronger incentives to screen. Another important strand of this recent literature looks at the impact of trade on unemployment caused by "efficient" or "fair-wages", as in Davis and Harrigan (2011) or Egger and Kreickemeier (2009).

[2] Autor, Dorn and Hanson (2013) and Pierce and Schott (2013) focuses on the rapid increase of United States manufacturing imports from China.

2. COMPARATIVE ADVANTAGE AND LABOUR MARKET FRICTIONS: THEORETICAL INSIGHTS

Our empirical strategy is guided by insights from a model that has two building blocks: a trade model based on comparative advantage and a model of equilibrium unemployment based on search and matching frictions. We present here only a reduced-form model in order to fix ideas. Details of the theory may be found in Carrère and al. (2013).

Consider an open economy that produces and exports goods from n_X distinct sectors, imports and consumes goods from n_M sectors, and produces purely for domestic consumption in the remaining $n_D = 1 - n_X - n_M$ sectors (there is an exogenous unit measure of sectors). Let Λ and l be the (average) number of workers seeking a job in each exporting sector and in each purely domestic sector, respectively. L is the inelastically supplied total number of workers in the economy. The 'full-participation' of all workers requires

$$L = n_X \Lambda + n_D l \tag{1}$$

The unemployment rate at the country level is the weighted sum of the unemployment rates at the sectoral level, namely,

$$u = \bar{u}_X \frac{n_X \Lambda}{L} + \bar{u}_D \frac{n_D l}{L} \tag{2}$$

where $\bar{u}_X$ and $\bar{u}_D$ are the average unemployment rates that prevail in the domestic sectors, exporting and purely respectively. In the model we develop below, unemployment arises as the result of DMP-like labour market frictions. The patterns of trade are driven by comparative advantage.[3] When trade barriers fall, the number of exporting and importing sectors increase and the number of purely domestic sectors falls, i.e. $dn_X > 0$ and, $dn_D < 0$. This implies a reallocation of workers across sectors. The number of people seeking a job in each exporting sector usually rises because the domestic country now also serves a larger fraction of world demand, i.e. $d\Lambda > 0$, while the effect on the number of job seekers in purely domestic sectors is ambiguous in general (it depends on the elasticity of income for the goods produced by these sectors). Differentiating the full-participation condition (1) yields

$$0 = (\Lambda \mathrm{d}n_X + l dn_D) + (n_X d\Lambda + n_D dl) \tag{3}$$

that is, the sum of the extensive margins and the intensive margins of adjustment are equal to zero because the supply of L is fixed.

In order to evaluate the effect of trade opening on the overall unemployment rate in the economy, totally differentiate (2) using (3) to substitute for $l dn_D + n_D dl$.

This yields

$$L du = (\bar{u}_X - \bar{u}_D) n_X d\Lambda + (\bar{u}_X - \bar{u}_D) \Lambda \mathrm{d}n_X - \beta dToT \tag{4}$$

some $\beta > 0$. In words, the total effect on the employment level is the outcome of the reallocation of workers from import-competing to newly and existing export sectors, as well as of a terms-of-trade

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[3] The source of comparative advantage is Ricardian in our model below but this assumption is immaterial.

effects. The number of job seekers in each exporting sector rises by $d\Lambda$ and each of these job seekers faces a probability of being unemployed of $\bar{u}_X$ instead of $\bar{u}_D$; the difference between the two gives the net contribution of the *intensive margin* adjustment to unemployment. The number of exporting sectors increases by dn_X and each of these sectors is composed by Λ job seekers. Thus Λdn_X of job seekers who exit the marginal import-competing sectors, where there probability of unemployment rate is $\bar{u}_D$, find a job in the export sectors, where the probability of unemployment is $\bar{u}_X$; the difference between the two is the net contribution of the extensive margin to the unemployment adjustment. Finally, an improvement in the terms of trade, $dToT > 0$, makes job creation more profitable, encouraging job creation in all active sectors so that $\bar{u}_X$ and $\bar{u}_D$ in particular fall. This has an independent, negative impact on unemployment. The sensitivity of the aggregate unemployment rate u to the terms-of-trade, β, depends on the specific micro-foundations of the model.

Put simply, a country will see its unemployment rate go up following a trade liberalization episode if it has a comparative advantage in 'unemployment-intensive' sectors; conversely, unemployment falls if trade shifts resources towards sectors with relatively low labour market frictions.

3. EMPIRICAL STRATEGY

To test the theoretical prediction of equation (4) we put forward the following empirical model:

$$ln(U_{ct}) = \beta_c + \beta_t + \beta_1\rho_{ct} + \beta_2\tau_{ct} + \beta_3(\tau_{ct} \times \rho_{ct}) + \beta_4 ln(H_{ct}) + \beta_5 ln(w_{ct}) + \mu_{ct} \qquad (5)$$

where U_{ct} is aggregate unemployment in country c at time t, ρ_{ct} is the covariance between the revealed comparative advantage and the measure of sector level labour market frictions, τ_{ct} is a measure of the trade restrictiveness (we use simple average tariffs or the share of collected duties in total imports), H_{ct} is total employment, w_{ct} is real wages which is proxied with GDP per capita to also control for business cycles, and μ_{ct} is an i.i.d error term. The β_c and β_t are country time-specific fixed effects. The former control for any time-invariant determinant of unemployment, such as differences in institutional setups at the aggregate level, and the latter for aggregate shocks that may affect unemployment in all countries in a given year, such as global technological shocks. The other βs are the estimated coefficients for the right-hand-side variables discussed above. Our model predicts a negative coefficient on the interaction between import barriers and the covariance between labour market frictions and comparative advantage ($\beta_3 < 0$). And the marginal impact on unemployment of a reduction in trade barriers is given by $\partial ln(U)/\partial\tau = \beta_2 + \beta_3 \times \rho_{ct}$, which is country and year specific and can be positive or negative depending on the value of the two β parameters and ρ_{ct}.

From (4) or (34), we also expect to find $\beta_1 > 0$ (having a comparative advantage in friction-intensive sectors is associated with a higher equilibrium unemployment rate, ceteris paribus) and $\beta_5 < 0$ (a larger income per capita is associated with a higher level of employment). On the other hand the model does not provide clear predictions for β_2 or β_4 which are the coefficients in front of τ and H respectively.[4]

To implement the empirical model we need a measure of the covariance between comparative advantage and labour market frictions for each country and year. Measures of sector level labour market frictions are not readily available. To proxy them, we follow an idea developed by Hausmann, Hwang and Rodrik (2005) to measure product sophistication at the sector level. The idea is very simple. Countries with high rates of unemployment will tend to be specialized in sectors with strong labour market frictions. Thus,

[4] We need τ because it is part of the interaction which is our variable of interest. We introduce H to control for size as one may expect the search costs to be larger in smaller and therefore thinner markets, everything else equal. This is not captured by our model, and we will therefore discuss estimates without using H as a control.

we can proxy the degree of labour market frictions in each sector by exploring the extent of unemployment in countries which are specialized in each sector. In other words, labour market frictions in sector s (i.e., the discrete version of z) is captured by the weighted average of unemployment rates, where the weights are given by a measure of the comparative advantage of each country in sector s. As in Hausmann, Hwang and Rodrik (2005), we use Proudman and Redding's (2000) comparative advantage indicator, which allows for comparisons not only across countries within a sector, which is important for our measure of labour market friction at the sector level to make sense, but also across sectors, which is important if we want to compare our measure of labour market friction across sectors.[5] More formally, the measure of sector level labour market frictions is given by:

$$\upsilon_s = \sum_c \theta_{cs} U_c, \text{ where } \theta_{cs} = \frac{1}{C} RCA_{cs}^x \tag{6}$$

C is the total number of countries, U_c is a measure of aggregate unemployment, and

RCA_{cs}^x is Proudman and Redding's measure of comparative advantage which is given by:

$$RCA_{cs}^x = \frac{x_{cs} / \sum_s x_{cs}}{\frac{1}{C} \sum_c \left(x_{cs} / \sum_s x_{cs} \right)}$$

where x_{cs} are country c exports of sector s.[6] Note that by construction the means across sectors of RCA_{cs}^x is equal to 1 in all sectors, and therefore the sum of RCA_{cs}^x is equal to C. To make the interpretation of υ_s more straightforward, we set the weights on the right-hand-side of (6) to sum up to 1 by dividing RCA_{cs}^x by C. Then, υ_s can be interpreted as the weighted-average in each sector of aggregate unemployment rates.

We construct υ_s using data at the beginning of the sample (1995-1997) to avoid potential endogeneity concerns when estimating (5), so that υ_s does not vary by year. The implicit assumption is that sector level labour market frictions do not rapidly change across time. It does not vary by country either as we use the variation in aggregate unemployment across countries to construct υ_s. The assumption here is that sector level labour market frictions are highly correlated across countries (note that we do not need to assume that they are the same, but only that they are highly correlated, as what we are after is not υ_s per se, but rather its correlation with a measure of comparative advantage). In the robustness section we will try using measures of υ_s that vary between developed and developing countries, and also the rank of υ_s rather than its value.

The weights, θ_{cs} in (6) are constructed using export data at the six-digit of the Harmonized System (HS), allowing us to construct υ_s for 4975 sectors. In the robustness section we also provide results using data at the four and two-digit level of the HS (1240 and 96 sectors, respectively). The advantage of using highly disaggregated data is that most labour reallocation associated with trade liberalization tends to occur within large broad sectors, and therefore if one were to use more aggregated data, we will not be capturing the impact that this within broad sector reallocation of labour has on aggregate unemployment. The disadvantage of using highly disaggregated data is that we are implicitly making the assumption that labour market frictions are specific to a very narrow sector. However, this is a numerical question, and a

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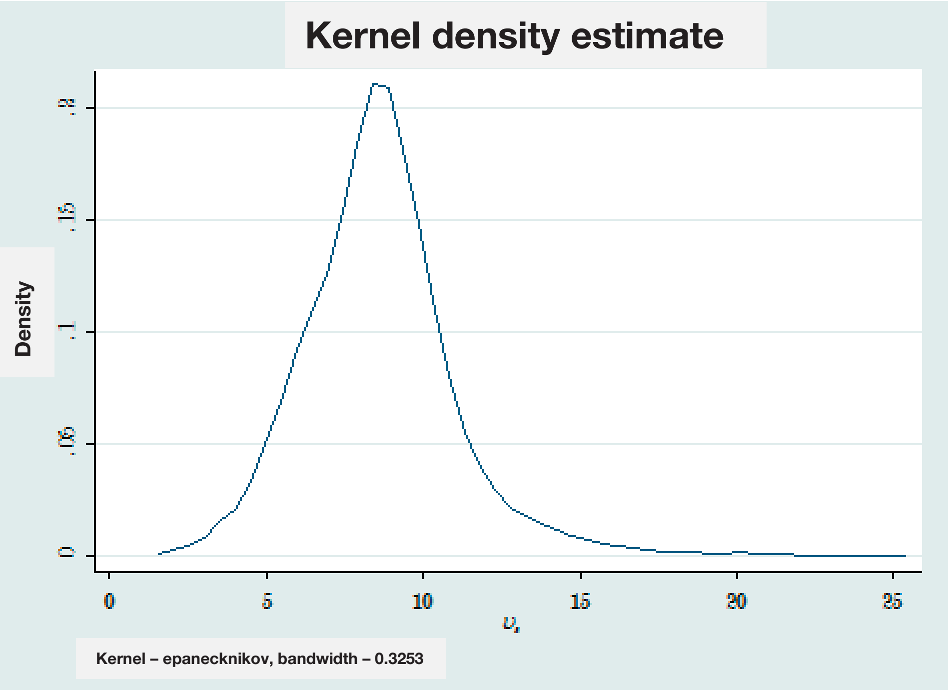
[5] Indeed, as discussed in Proudman and Redding (2000), Balassa's original measure makes impossible comparisons across sectors and countries because depending on the distribution of trade flows across sectors and countries Balassa's measure will have different means in different countries.

[6] Ideally one would have like to use production, rather than export data, but production data is only available for a much smaller number of countries and a much smaller number of sectors.

variance decomposition of v_s calculated at the six-digit level of the HS tends to suggest that most of the variance occurs across six-digit HS goods and within four-digit HS sector.[7]

Figure 1 shows the distribution of v_s when calculated at the six-digit level of the HS. It has a mean and a median around 8.5 with a standard deviation of 2.5 and a maximum of 25.1 and a minimum of 1.9. These values can be interpreted as sector level unemployment rates (in %) due to labour market frictions. Table 1 provides the top and bottom fifteen HS 2-digit sectors when ranked in terms of the median v_s (calculated at the six-digit level of the HS). Sectors such as iron and steel, which are well known for its strong labour unions around the world are ranked among the sectors with the highest labour market frictions. There are also several primary sectors, which is consistent with McMillan and Rodrik (2011) who argue that the growth of primary sectors tends not to generate a significant amount of new jobs. On the other hand sectors, such as clock and watch, which are not well known for their strong labour unions come at the bottom of the ranking. Indeed a google search on “labour union” and “steel workers” or “iron workers” yields more than 350 thousand hits, whereas a search on “labour union” and “clock workers” or “watch workers” yields a bit more than 1 thousand hits.[8]

Figure 1
Distribution of sector level labour market frictions v_s



Note: Authors’ computation using export data at the six-digit of the HS from CEPII’s BACI and aggregate unemployment data from the ILO.

[7] Indeed, less than half of the total variance of v_s is explained by four-digit HS dummies, and only 14 per cent of the total variance in v_s is explained by two-digit HS dummies.

[8] It is a bit more difficult to find anecdotic evidence regarding search frictions in the labour markets. We did however the same google searches but substituting “labour union” with “search frictions” and we found 170 hits for iron and steel, and 0 hits for clocks and watches.

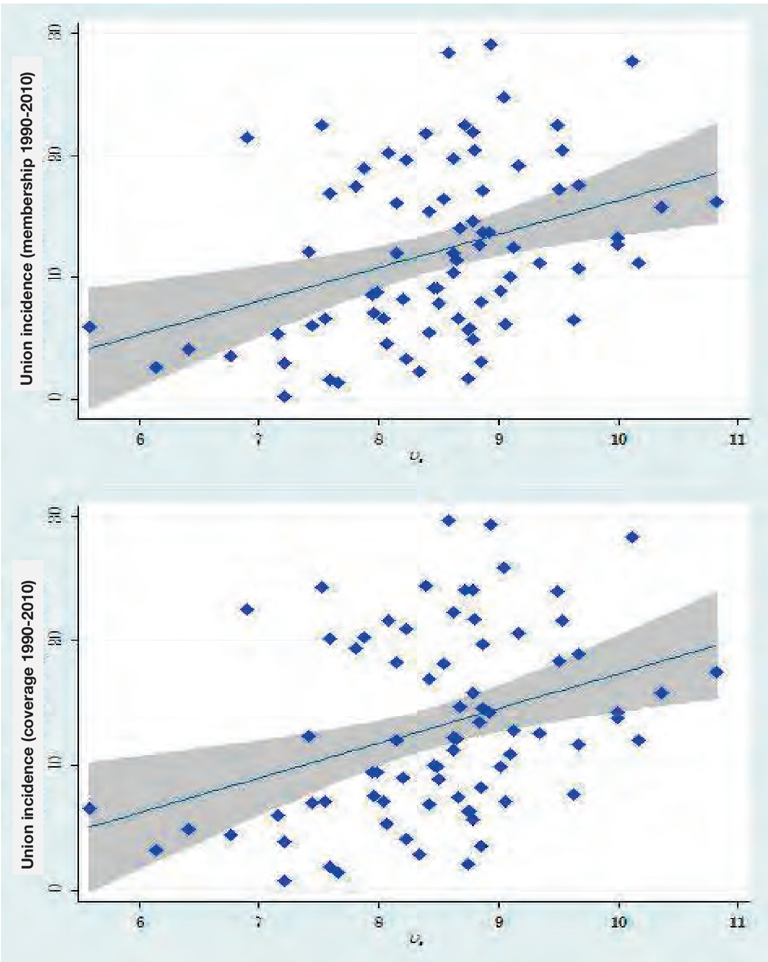
Table 1
Labour market frictions: top and bottom fifteen HS 2-digit sectors

Top fifteen sectors		
HS-2	*Description*	*Median* v
31	Fertilisers	10.77
43	Furskins and artificial fur; manufactures thereof	9.45
08	Edible fruit and nuts; peel of citrus fruit or melons	9.42
27	Mineral fuels, oils & product of their distillation; etc	9.39
72	Iron and steel	9.13
86	Railw/tramw locom, rolling-stock & parts thereof; etc	9.10
62	Art of apparel & clothing access, not knitted/crocheted	9.08
20	Prep of vegetable, fruit, nuts or other parts of plants	9.04
22	Beverages, spirits and vinegar	8.95
64	Footwear, gaiters and the like; parts of such articles	8.94
07	Edible vegetables and certain roots and tubers	8.84
18	Cocoa and cocoa preparations	8.81
78	Lead and articles thereof	8.79
45	Cork and articles of cork	8.69
36	Explosives; pyrotechnic prod; matches; pyrop alloy; etc	8.59
Bottom fifteen sectors		
HS-2	*Description*	*Median* v
91	Clocks and watches and parts thereof	5.34
67	Prepr feathers & down; arti flower; articles human hair	6.09
80	Tin and articles thereof	6.23
50	Silk	6.42
95	Toys, games & sports requisites; parts & access thereof	6.51
92	Musical instruments; parts and access of such articles	6.61
37	Photographic or cinematographic goods	6.76
05	Products of animal origin, nes or included	6.79
03	Fish& crustacean, mollusc & other aquatic invertebrate	6.80
66	Umbrellas, walking-sticks, seat-sticks, whips, etc	6.85
46	Manufactures of straw, esparto/other plaiting mat; etc	6.95
90	Optical, photo, cine, meas, checking, precision, etc	6.97
52	Cotton	7.01
96	Miscellaneous manufactured articles.	7.02
97	Works of art, collectors' pieces and antiques	7.12

Note: We take the median v across six-digit HS goods and within two-digit HS sectors.

As a more systematic external test for our estimates of sector level labour market frictions, we correlated υ_s with an index of labour union incidence constructed using data from the Union Membership and Coverage Database.[9] The available estimates are compiled from the Current Population Survey in the United States using BLS methods. We use estimates for the period 1990-2010. Figure 2 shows the unconditional correlation between union membership expressed as a share of total employment and our measure υ_s in the top panel, and between union coverage as share of total employment and υ_s in the bottom panel. Both panels also plot the underlying linear correlation and the 95 per cent confidence interval. It is clear from both panels that there is a positive correlation between our measure of labour market frictions and measures of union membership and coverage at the sector level in the United States.[10]

Figure 2
Correlation between υ_s and indices of labour union incidence



Note: Computed using the estimated υ_s and the Union Membership and Coverage Database (www.unionstats.com). The top panel provides the correlation with union membership and the bottom panel the correlation with union coverage measured between 1990-2010.

9 Available at www.unionstats.com.

10 We also used different reference periods 1995-2010 and 2000-2010 and obtained very similar results with correlation coefficients around 0.4. We also use the estimates available for forty Canadian industries by Robinson (1995) and obtain similar results with a positive and statistically significant correlation of 0.5.

To be able to measure the correlation between sector level labour market frictions and comparative advantage, we also need a measure of the latter. It is important that the measure of comparative advantage takes into account not only the trade-induced potential adjustments on the export side, but also on the import side. Note also that because we are interested in the correlation within a country and year, it is not necessary to have measures of comparative advantage that are comparable across countries and years. We only need them to be comparable within countries in a given year. However, we want a measure that can compare the comparative advantage on the export and import side for a given sector. This is problematic with measures of comparative advantage a la Balassa or Proudman and Redding because the theoretical distribution is highly asymmetric. Indeed, for sectors without a comparative disadvantage their measures takes values between 0 and 1, whereas for values with a comparative advantage their measures take values between 1 and infinity. Thus, to be able to compare the measure of comparative advantage on the import and export side we suggest a transformation that results values for sectors with a comparative disadvantage ranging between -1 and 0, while for sectors with a comparative advantage the measure ranges between 0 and 1:[11]

$$RCA_{cs}^{x} = \frac{\widetilde{RCA}_{cst}^{x}}{1+\widetilde{RCA}_{cst}^{x}} - \frac{\widetilde{RCA}_{cst}^{m}}{1+\widetilde{RCA}_{cst}^{m}} \tag{7}$$

where

$$\widetilde{RCA}_{cst}^{x} = \frac{x_{cst}/\sum_s x_{cst}}{\frac{1}{S}\sum_s\left(x_{cst}/\sum_s x_{cst}\right)} \text{ and } \widetilde{RCA}_{cst}^{m} = \frac{m_{cst}/\sum_s m_{cst}}{\frac{1}{S}\sum_s\left(m_{cst}/\sum_s m_{cst}\right)}$$

where m_{cst} are sector s imports of country c at time t, and S is the total number of sectors. Note that $\widetilde{RCA}$ is different from RCA. The latter makes possible the comparison of revealed comparative advantage indices across countries within a sector, given that the denominator is the average share across countries for each sector. This was the type of comparison we needed when building the measure of labour market frictions at the sector level. $\widetilde{RCA}$ makes possible the comparison of revealed comparative advantage across sectors within a country, which is what we need when trying to measure the correlation between labour market frictions and comparative advantage within a country (and year). Finally, in sectors with a comparative advantage, r_{cst} takes a positive value, and in sectors without a comparative advantage r_{cst} is negative.[12] The correlation between our measures of labour market frictions v_s and comparative advantage r_{cst} is given by:

$$\rho_{ct} = \frac{\sum_s (r_{sct}-\bar{r}_{ct})(v_s-\bar{v})}{\left(\sum_s (r_{sct}-\bar{r}_{ct})^2 \sum_s (v_s-\bar{v})^2\right)^{0.5}} \tag{8}$$

According to our model in the previous section, the higher is ρ the more likely is trade liberalization to result in an increase in unemployment, whereas the lower is ρ the more likely is trade liberalization to lead to a decrease in unemployment as resources are reallocated to sectors with a comparative advantage which tend to have lower labour market frictions.

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[11] Vollrath (1991) proposes for the same reason a log transformation of Balassa's comparative advantage index, but he works at a higher level of aggregation. In our dataset a log transformation is not feasible because of the large number of zero imports and exports at the six-digit of the HS.

[12] The symmetry of r is also a desirable property as ultimately we are interested in the correlation of r with v.

Table 2

Correlation between labour market frictions and comparative advantage (median ρ for 1995-2009)

Economy	*ISO code*	*Median ρ*
Iceland	ISL	-0.33
Panama	PAN	-0.30
Bolivia (Plurinational State of)	BOL	-0.30
Kazakhstan	KAZ	-0.29
Ethiopia	ETH	-0.27
Belize	BLZ	-0.27
Algeria	DZA	-0.27
Mali	MLI	-0.26
Uganda	UGA	-0.25
Qatar	QAT	-0.25
Zambia	ZMB	-0.24
Maldives	MDV	-0.23
Mongolia	MNG	-0.23
Yemen	YEM	-0.23
Madagascar	MDG	-0.23
Nicaragua	NIC	-0.22
Benin	BEN	-0.22
Paraguay	PRY	-0.21
Bahamas	BHS	-0.21
Kuwait	KWT	-0.19
Zimbabwe	ZWE	-0.18
Chile	CHL	-0.18
Jamaica	JAM	-0.18
Seychelles	SYC	-0.18
Georgia	GEO	-0.17
Bhutan	BTN	-0.16
Peru	PER	-0.16
Fiji	FJI	-0.15
Honduras	HND	-0.14
Iran, Islamic Republic of	IRN	-0.14
Sierra Leone	SLE	-0.14
Norway	NOR	-0.14
Trinidad and Tobago	TTO	-0.14
Kyrgyzstan	KGZ	-0.14
Uruguay	URY	-0.13
Russian Federation	RUS	-0.13
Dominican Republic	DOM	-0.12
Cyprus	CYP	-0.12
Kenya	KEN	-0.12
Republic of Moldova	MDA	-0.12
Malta	MLT	-0.11
Ireland	IRL	-0.09
Guatemala	GTM	-0.08
Estonia	EST	-0.08
Syrian Arab Republic	SYR	-0.08
Australia	AUS	-0.08
New Zealand	NZL	-0.07
The Former Yugoslav Republic of Macedonia	MKD	-0.06
Venezuela (Bolivarian Republic of)	VEN	-0.06
Jordan	JOR	-0.06

Economy	***ISO code***	***Median ρ***
Ukraine	UKR	-0.05
El Salvador	SLV	-0.05
Bahrain	BHR	-0.05
Hong Kong SAR, China	HKG	-0.04
Latvia	LVA	-0.04
Croatia	HRV	-0.04
Morocco	MAR	-0.04
Sri Lanka	LKA	-0.04
Macao SAR, China	MAC	-0.04
Nepal	NPL	-0.03
Pakistan	PAK	-0.03
Lithuania	LTU	-0.02
Israel	ISR	-0.02
Singapore	SGP	-0.02
Lebanon	LBN	-0.02
Argentina	ARG	-0.02
South Africa	ZAF	-0.02
Indonesia	IDN	0.00
Egypt	EGY	0.00
India	IND	0.00
Philippines	PHL	0.01
Tunisia	TUN	0.01
Mexico	MEX	0.01
Greece	GRC	0.02
China	CHN	0.02
Bangladesh	BGD	0.03
Bulgaria	BGR	0.03
Denmark	DNK	0.04
Slovakia	SVK	0.04
Germany	DEU	0.05
Finland	FIN	0.05
Austria	AUT	0.05
Hungary	HUN	0.06
United States of America	USA	0.06
Czech Republic	CZE	0.06
Brazil	BRA	0.07
Slovenia	SVN	0.07
Switzerland	CHE	0.08
Malaysia	MYS	0.09
Thailand	THA	0.09
Colombia	COL	0.10
France	FRA	0.10
Poland	POL	0.10
Belgium	BEL	0.11
Turkey	TUR	0.14
Republic of Korea	KOR	0.20
Italy	ITA	0.31

Table 2 provides the median ρ during the period 1995-2009 for each country in our sample. The country with the highest ρ is Italy, suggesting that trade liberalization is likely to bring an increase in unemployment in Italy. The country with the lowest ρ is Iceland, which makes it the country where trade liberalization is the more likely to result in a fall in unemployment. Note that the United States, Mexico and Brazil, which are countries for which there are studies suggesting that trade liberalization contributed to increases in unemployment are among the countries with the highest correlation between comparative advantage and labour market frictions as would have been predicted by the model. Note however that the value of ρ is not a sufficient statistic to predict the impact of trade liberalization on unemployment as trade liberalization may have a direct impact on unemployment that does not go through the reallocation of resources. Indeed trade liberalization may lead to increases or decreases in real wages which will in turn affect labour demand and aggregate unemployment. Indeed, depending on the sign of β_2 and its relative size with $\beta_3 < 0$ in (5) trade liberalization can always result in an increase or decrease in unemployment.

There are several problems associated with the estimation of (5), which require some testing of our benchmark specification. First, trade restrictiveness may be endogenous. Indeed, there is a quite significant literature reviewed in Costinot (2009) that suggests that trade protection increases with unemployment which creates a problem of reverse causality. The natural way of solving this problem would be to find an instrument for trade restrictiveness. Unfortunately, we could not find any variable that would satisfy the exclusion restriction at least intuitively. We therefore decide to rely on a difference-in-difference (diff-in-diff) estimator using data for large trade liberalization episodes collected by Wacziarg and Welch (2008), while testing for parallel trends in unemployment between countries in the treatment and control groups before trade liberalization occurs. Because trade liberalization does not occur in the same year we construct five different dummies that take a value of 1 in each of the treated countries one to five years before trade liberalization. If these dummies are not statistically different from zero, then we can conclude that there are not systematic changes in unemployment previous to trade liberalization, which would dampen worries about reverse causality. To check whether the impact of trade liberalization on unemployment depends on ρ we will interact the treatment dummy with ρ.[13] Our prediction would imply that the coefficient on the interaction is positive and statistically different from zero, as trade liberalization (the opposite of trade restriction) will lead to higher unemployment in countries with a relatively high correlation between labour market frictions and comparative advantage.

A second problem is the potential endogeneity of trade flows that are used to construct indices of revealed comparative advantage, the measure of sector level labour market frictions and their correlation. We follow Freyer (2009) and use a gravity setup where traditional geography determinants such as contiguity, common language, colonial relationship, common colonizer which are time invariant are complemented with time variant geography variable such as air and sea distance between countries (whose effect is allowed to vary by year). The predicted bilateral trade flows estimated at the six-digit of the HS are then aggregated across partners to obtain aggregate exports and imports, $\hat{x}_{cst}$ and $\hat{m}_{cst}$. These are then used to recalculate indices of comparative advantage $\hat{r}_{cst}$, sector level labour market frictions $\hat{v}_s$ and finally their correlation across sectors, $\hat{\rho}_{ct}$ which is used as an instrument for ρ_{ct}. Figure 3 shows the correlation between ρ_{ct} and $\hat{\rho}_{ct}$.

A third issue is the degree of aggregation at which we measure the correlation between sector level labour market frictions and comparative advantage. There are advantages and disadvantages associated with disaggregation. The tradeoff consists in being able to capture the trade-induced reallocation of workers, which tend to occur within industries as argued in the empirical literature, and therefore calls for a sufficient degree of disaggregation, versus capturing the relevant labour market for a given friction, which may call for a certain degree of aggregation. We argued earlier in favour of using as much disaggregation as possible as most of the variation in our measure of sector level labour market

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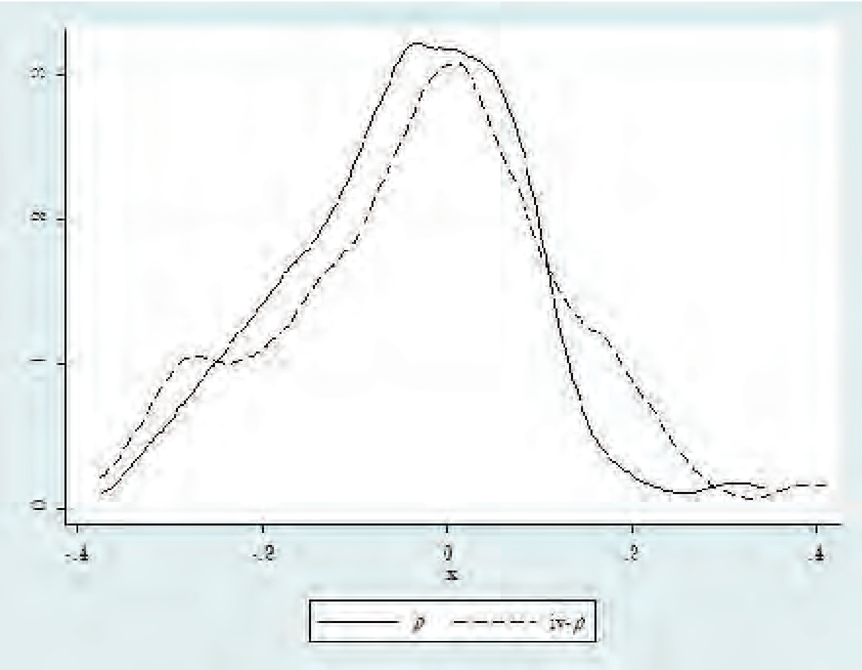
[13] We cannot introduce ρ by itself because we do not have measures of ρ that vary across time for the entire period of the sample used in this regression. We are constrained by the Wacziarg and Welsch's (2008) dataset, which spans from 1980 to 2001, and Comtrade's trade data that is only available at the HS level for a wide range of countries since the early 1990s.

frictions occurs within HS four-digit sectors. However, we will also provide estimates where r_{cst} , υ_s and ρ_{ct} are constructed using export and import data at the two and four-digit of the HS.

Figure 3
Distribution of ρ and $\hat{\rho}$ (iv-ρ)



Note: $\hat{\rho}$ is constructed using the predicted trade flows from gravity setup, which are then used to construct $\hat{r}$ and $\hat{\upsilon}$ and their correlation $\hat{\rho}$.

A fourth concern is that we have assumed that labour market frictions are common across all countries. This may be overly restricting, and we will test the robustness of our results when we assume that labour market frictions are different in developed and developing countries, by estimating υ_s using data for developed and developing countries separately.

The final concern may be that the value of υ_s and r are not very relevant in our theoretical framework. The ranking of sector matters in our world with a continuum of goods, but not the value of υ or r. We will therefore test the robustness of results when υ, r and ρ are estimated using ranks rather than their value.

4. EMPIRICAL RESULTS

We start discussing the main results associated with the estimation of (5) and then turn to the different robustness tests.

4.1 BASELINE RESULTS

The results of the estimation of (5) are reported in table 3. The first column uses simple average tariffs as a measure of trade restrictiveness and the second column uses collected duties as a share of imports. The predictions of the theoretical model are largely confirmed. First, there is a statistically positive coefficient β_1 on the correlation between comparative advantage and labour market frictions (ρ) a negative and statistically significant coefficient on the interaction between trade restrictiveness measures and the correlation between comparative advantage and sector level labour market frictions ($\tau \times \rho$).

Second, β_3 which is the coefficient on the interaction between ρ and trade restrictiveness, τ, is negative and statistically significant. Thus, the impact of tariffs on unemployment is more likely to be negative (and therefore trade liberalization more likely to increase unemployment) the larger is the correlation between labour market frictions and comparative advantage.[14]

Table 3

The impact of trade liberalization on unemployment depends on ρ (benchmark estimates)[a]

ln(u)	*Average tariff*	*Collected duties*
Employment size ln (H)	-0.257*** (0.11)	-0.262** (0.12)
GDP per capita ln(w)	-0.270*** (0.10)	-0.380*** (0.09)
Trade restrictiveness τ	-0.008* (0.00)	-0.010 (0.01)
Correlation btw r and v ρ	2.162*** (0.65)	2.547*** (0.68)
$\tau \times \rho$	-0.083* (0.05)	-0.230** (0.06)
Observations	878	747
# clusters	97	94
Period	1995-2009	1995-2009
Marginal impact of zero for ρ equal to [b]	-0.099	-0.045

[a] These are OLS estimates. All regression have country and year fixed effects. Numbers in parenthesis are robust standard errors, which are clustered at the country level. *** stands for statistical significance at the 1 per cent level, ** for statistical significance at the 5 per cent level, and * for statistical significance at the 10 per cent level.

[b] This is the value of ρ for which the marginal impact of trade restrictiveness on unemployment is equal to zero and therefore changes sign. For countries with a value of ρ below these values the estimated marginal impact of trade protection on unemployment is positive, whereas for countries with a value of ρ above these values the impact of trade protection on unemployment is negative.

Thus, the marginal effect of average tariffs and collected duties on unemployment depends on the correlation between sector level labour market frictions and comparative advantage (ρ). The marginal effect of average tariffs is illustrated in Figure 4, and the marginal effect of collected duties is illustrated in Figure 5 alongside the 90 per cent confidence intervals. Both Figures confirm that for sufficiently large values of ρ trade frictions have a negative impact on unemployment (i.e., trade liberalization increases unemployment), whereas for sufficiently small values of ρ trade frictions have a positive impact on unemployment (i.e., trade liberalization reduces unemployment). The turning point occurs for values of ρ around -0.094 for average tariffs and for values of ρ around -0.050 for collected duties. In the case of average tariffs, Figure 4 shows that the impact of tariffs on unemployment is statistically above zero for values of ρ below -0.24, and it is statistically below zero for values of ρ above 0.02. Similarly, in the case of collected duties (Figure 5), the impact of tariffs on unemployment is statistically above zero for values of ρ below -0.14, and it is statistically below zero for values of ρ above 0.04. For values within those thresholds the impacts are not statistically different from zero. As reported in table 2 here are only eleven countries in the sample with a median value of ρ below -0.24, and which in principle would benefit from a reduction in unemployment as trade protection is reduced.[15] There are twenty countries in the sample with

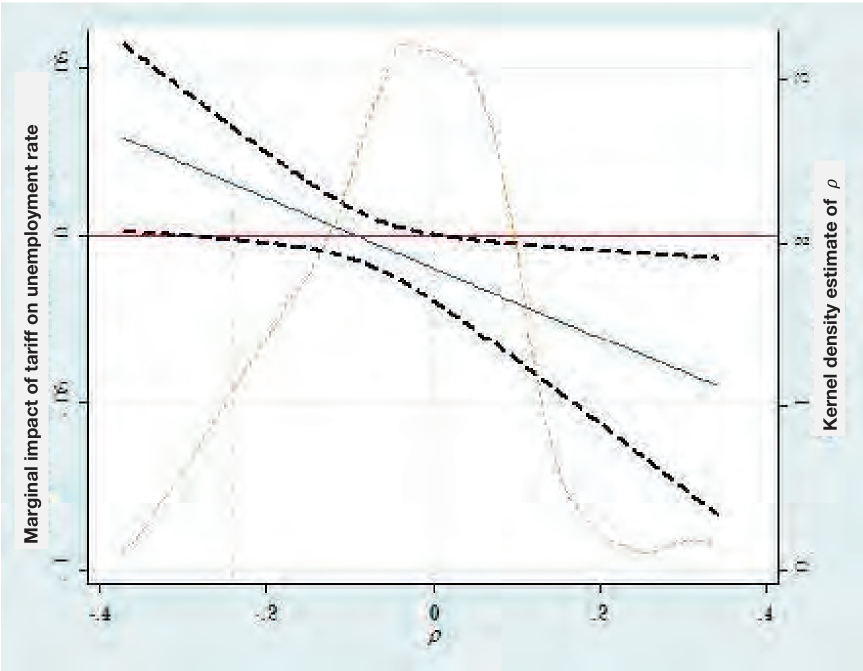
[14] We run the same specification but without using logs on the left-hand-side and without controlling for employment levels. The results are identical in terms of sign and statistical significance as the ones reported in table 3. Only the size of the coefficients obviously changes when we do not take logs in the left-hand-side.

[15] These are Algeria, Belize, Bolivia (Plurinational State of), Ethiopia, Iceland, Kazahkhstan, Mali, Panama, Qatar, Uganda and Zambia.

a median value of ρ above 0.04, and which in principle would see unemployment increase with reductions in trade protection.[16]

The other estimates reported in table 3 also have the expected sign. GDP per capita, which controls for the real wage, but also institutional quality and business cycles is negatively correlated with unemployment. Employment size is negatively correlated with unemployment perhaps suggesting that as labour markets get larger it is easier to find a job for a given labour market friction. The direct impact of tariffs on unemployment is not statistically different from zero.

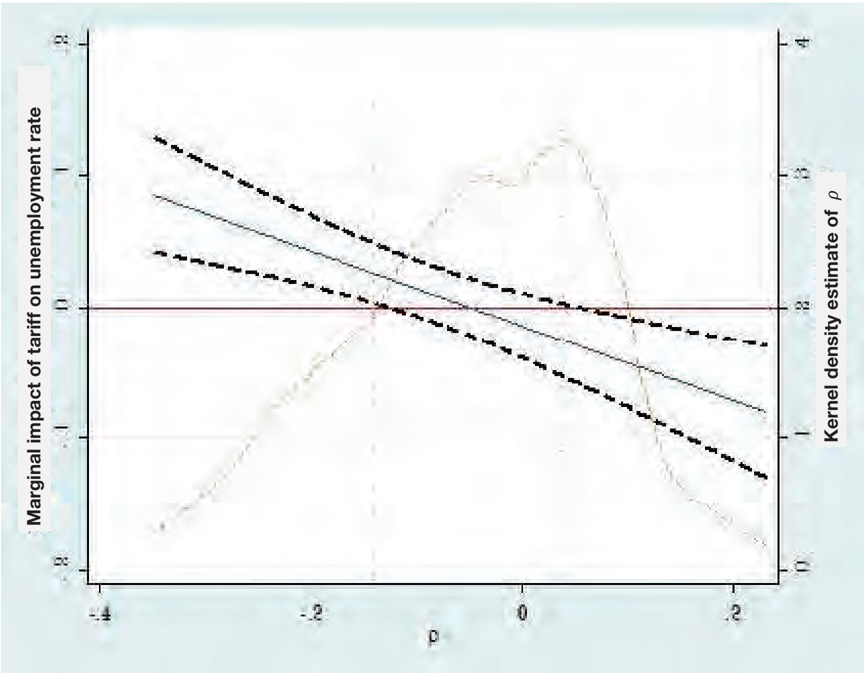
Figure 4
Marginal impact of average tariffs on unemployment as a function of ρ



Note: The thick dashed lines provide the 90 per cent confidence intervals.
The thin dashed line is a kernel density estimate of ρ.

[16] These countries are Austria, Belgium, Brazil, Colombia, Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Malaysia, Poland, Republic of Korea, Slovakia, Slovenia, Switzerland, Thailand, Turkey and United States.

Figure 5
Marginal impact of collected duties on unemployment as a function of ρ



Note: The thick dashed lines provide the 90 per cent confidence intervals. The thin dashed line is a kernel density estimate of ρ.

4.2 ROBUSTNESS CHECKS

We perform five robustness checks. The first robustness check aims to correct for the potential reverse causality between trade protection and unemployment by using a diff-in-diff framework. We also check for possible differences in the evolution of unemployment rates of countries in the treatment and control groups, before the treatment occurs. To do so, we replace our proxies for τ (average tariffs or collected duties), by a dummy variable constructed by Wacziarg and Welch (2008) that indicates large episodes of trade liberalization from the 1970s until 2001. Because most trade liberalization episodes occur in the very early 1990s or 1980s, we extend the unemployment data to also include the 1980s so that we can apply a meaningful diff-in-diff framework and test for differences in trends before treatment. We find 28 countries in our sample that open to trade after 1985. Another 11 countries never open to trade in this sample that spans from 1980 to 2001. Thus, the sample in this exercise includes the 39 countries that were not open to trade in the early 1980s according to Wacziarg and Welch (2008), and it spans from 1980 to 2001, when the data for trade liberalization episodes stops.[17]

We estimate the heterogeneity of the impact of these trade liberalization episodes on unemployment for different levels of ρ using a diff-in-diff setup for these 39 countries. The results are reported in table 4. The direct impact of trade liberalization on unemployment is statistically insignificant. The coefficient on the interaction between trade liberalization and ρ is positive and statistically different from zero, confirming the results of table 3. Trade liberalization leads to higher levels of unemployment in countries that have a relatively large ρ.

[17] The Harmonized System only started being used by a large number of countries in the 1990s. So for this exercise we construct measures of revealed comparative advantage from 1980 to 2001 using the disaggregation available in its predecessor: the SITC revision 2 classification. If instead we use the median of ρ for each country in our original sample (1995-2009), results are qualitatively the same as the ones reported in table 4.

Table 4

Diff-in-diff impact of trade liberalization episodes on unemployment[a]

(u)	Diff-in-Diff	Pre-trend?
Wacziarg and Welch trade liberalization dummy	0.843	1.473
(WW)	(1.272)	(2.094)
Correlation Correlation btw r and v	-6.317	-6.133
(ρ)	(6.394)	(6.541)
$WW \times \rho$	15.244**	15.126**
	(6.276)	(6.239)
WW_{t-1}		1.062
		(1.704)
WW_{t-2}		0.563
		(1.325)
WW_{t-3}		0.530
		(1.175)
WW_{t-4}		0.351
		(0.926)
WW_{t-5}		0.680
		(0.822)
Observations	512	512
# clusters	39	39
Period	1980-2001	1980-2001

[a] These are OLS estimates. All regression have country and year fixed effects. Numbers in parenthesis are robust standard errors, which are clustered at the country level. *** stands for statistical significance at the 1 per cent level, ** for statistical significance at the 5 per cent level, and * for statistical significance at the 10 per cent level.

A necessary condition for the diff-in-diff estimates to correct for the potential reverse causality between unemployment and trade liberalization is that unemployment trending upwards was not part of the reason for these countries to engage in large reforms such as trade liberalization. A test of parallel trends before liberalization can ensure that this was not the case. Since, the trade liberalization episodes occur at different times for different countries, we construct five dummies that take the value of 1 in each treated country five to one year before a trade liberalization event. As can be seen from column 2 in table 4 these five dummies are statistically insignificant.

The second robustness check addresses the potential endogeneity of ρ, as the the trade flows behind the construction of ρ may be endogenous. We follow Freyer (2009) to predict trade flows that are determined by time-varying geography variables and recalculate $\hat{r}$, $\hat{v}$and $\hat{\rho}$ using these predicted trade flows. We use this new measure of $\hat{\rho}$ as an instrument for ρ and for the interaction of ρ with τ. The results are reported in table 5 and they largely confirm the results of table 3. Countries with large ρs will experience an increase in unemployment as protection is reduced. The magnitude of the estimated β_3 (the coefficient of the interaction between ρ and τ) in tables 3 and 5 are comparable. Interestingly, trade protection now has a statistically significant impact on unemployment, and the direct impact of ρ on unemployment is no longer statistically different from zero. The marginal impact of protection on unemployment as a function of ρ is plotted in Figures 6 and 7. The marginal impact is zero for values of ρ around -0.1. The impact is statistically larger than zero for values of ρ below -0.2 and statistically smaller than zero for $\rho > 0$. The IV estimates have smaller standard errors, which implies that there is a larger number of countries for which the impact of trade reform on unemployment is statistically different from zero. Relative to the cutoffs of the OLS estimation in table 3, we have an additional eight countries for which trade liberalization leads to a statistically significant reduction in unemployment.[18] Similarly, we have an additional ten countries where trade liberalization leads to a statistically significant increase in unemployment.[19]

Table 5

The impact of trade liberalization on unemployment depends on ρ (IV estimates)[a]

ln(u)	*Average tariff*	*Collected duties*
Employment size	-0.229***	-0.272**
ln (H)	(0.06)	(0.07)
GDP per capita	-0.310***	-0.431***
ln(w)	(0.05)	(0.06)
Trade restrictiveness	-0.015*	-0.016*
τ	(0.00)	(0.01)
Correlation btw r and v	0.844***	-0.470***
ρ	(0.63)	(0.98)
$\tau \times \rho$	-0.123***	-0.161**
	(0.04)	(0.06)
Observations	878	747
# clusters	97	94
Period	1995-2009	1995-2009
Marginal impact of zero for ρ equal to [b]	-0.118	-0.098

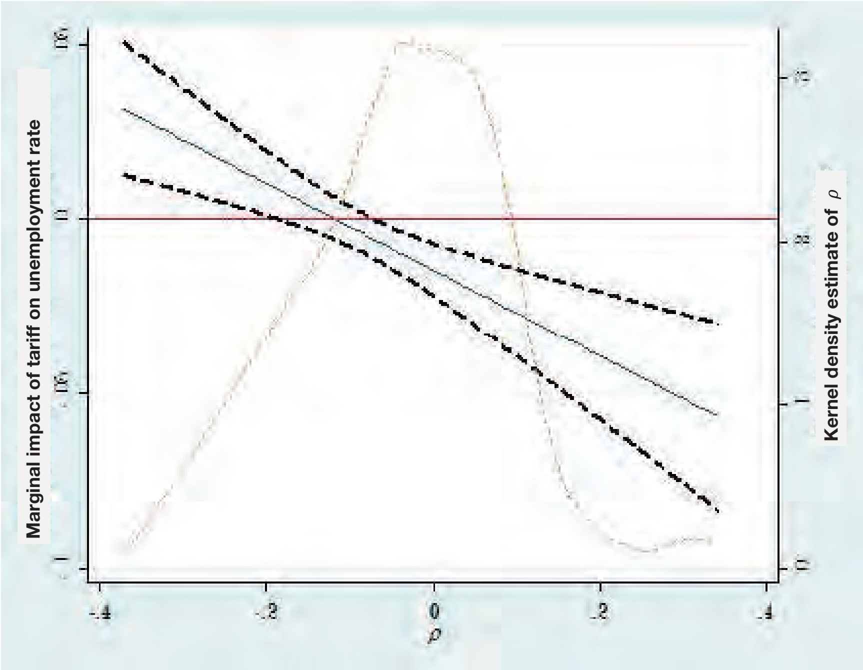
[a] These are IV estimates. Both ρ and $\tau \times \rho$ are instrumented using using predicted trade flows from time-varying geography determinants of bilateral trade flows in a gravity setup. All regression have country and year fixed effects. Numbers in parenthesis are robust standard errors, which are clustered at the country level. *** stands for statistical significance at the 1 per cent level, ** for statistical significance at the 5 per cent level, and * for statistical significance at the 10 per cent level.

[b] This is the value of ρ for which the marginal impact of trade restrictiveness on unemployment is equal to zero and therefore changes sign. For countries with a value of ρ below these values the estimated marginal impact of trade protection on unemployment is positive, whereas for countries with a value of ρ above these values the impact of trade protection on unemployment is negative.

[18] These are countries with a ρ ranked between Zambia and Kuwait in table 2.

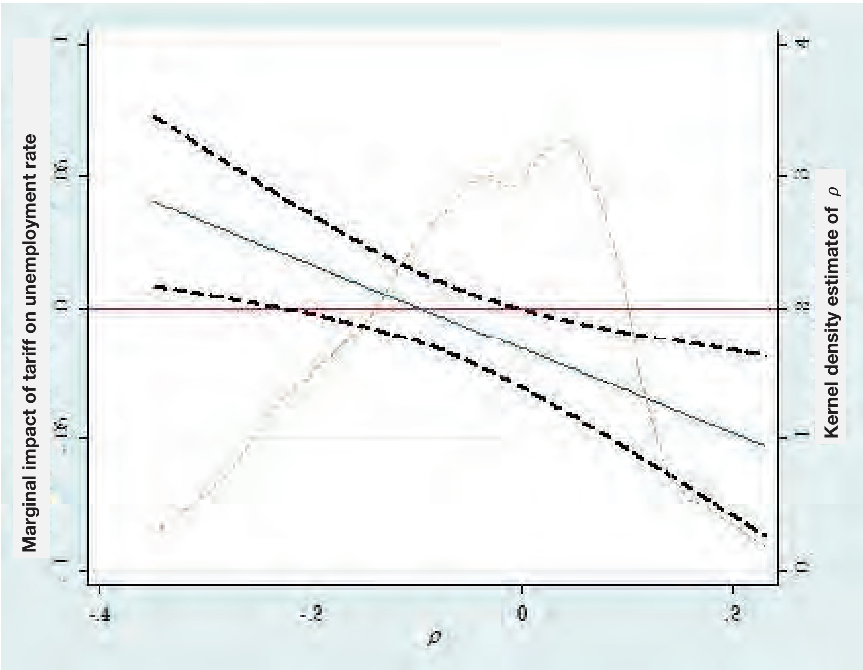
[19] These are countries with a ρ ranked between South Africa and Denmark in table 2.

Figure 6
Marginal impact of average tariffs on unemployment as a function of ρ (IV estimates)



Note: The thick dashed lines provide the 90 per cent confidence intervals. The thin dashed line is a kernel density estimate of ρ.

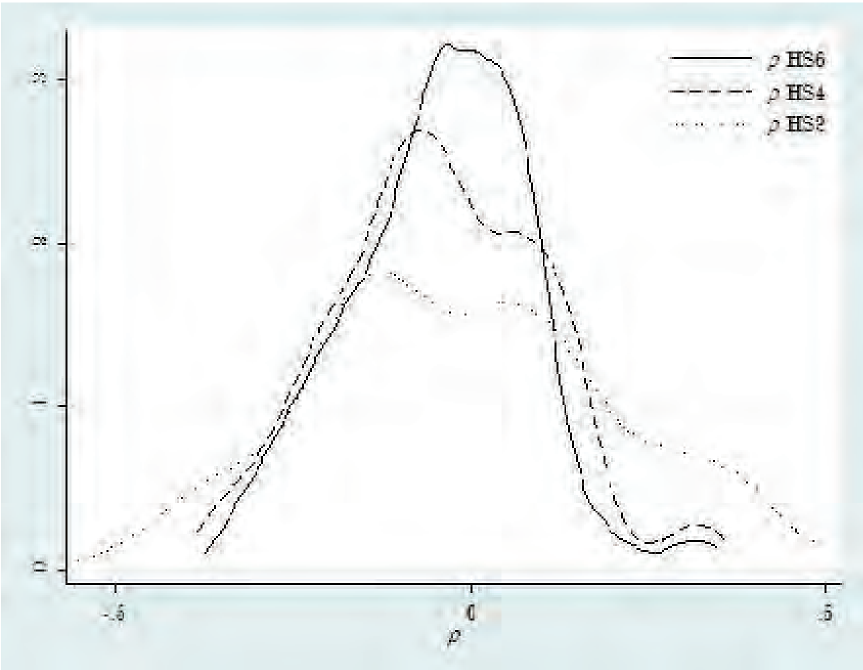
Figure 7
Marginal impact of collected duties on unemployment as a function of ρ (IV estimates)



Note: The thick dashed lines provide the 90 per cent confidence intervals. The thin dashed line is a kernel density estimate of ρ.

The third robustness test consists of computing ρ using trade data at higher levels of aggregation, i.e., at the four and two-digit of the HS. Figure 8 shows the distribution of ρs calculated using trade data at different levels of aggregation. Interestingly, the distribution of ρs estimated using trade data at the two-digit of the HS (96 sectors) has a larger standard deviation than the distribution of ρs estimated using trade data at the four-digit of the HS (1240 sectors), and the latter has a larger standard deviation than the distribution of ρs estimated using trade data at the six-digit of the HS (4975). This is partly explained by the fact that we have more zeroes in the disaggregated data, which mechanically drives ρ towards zero. tables 6 and 7 provide estimates using trade data at the four and two-digit of the HS, respectively. Qualitatively, the estimates confirm the results of table 3. In particular, the coefficient of the interaction between trade protection measures and ρ is negative and statistically different from zero. The fact that results at the very disaggregated level are not very different from the more aggregated results is consistent with Wacziarg and Wallack (2004) or Menzes-Filho and Muendler (2011) who suggest that most reallocations of workers occur within sectors and not across sectors.

Figure 8
Distributions of ρ estimated at different levels of production aggregation



The fourth robustness test relaxes the assumption that labour market frictions are common across all countries and estimates them separately for OECD and no-OECD countries. The correlation between the two types of υ_s is positive and significant, but the value is only 0.21, which suggests that the assumption of common sectoral labour market frictions is worth relaxing. Table 8 reports the results. The results are very similar to those reported in table 3, except that the interaction coefficient between ρ and τ becomes statistically insignificant when using average tariffs as a measure for τ (even though it is still negative and not statistically different from the one reported in table 3).

The final robustness test uses the rank correlation between comparative advantage and labour market frictions to control for measurement error in the estimation of υ and r. This is also consistent with our theoretical prediction that tell us that it is the ranking of sectors that matters and not how far apart they are from each other in a world with a continuum of goods. The results are reported in table 9 and they largely confirm the results of table 3.

Table 6

The impact of trade liberalization on unemployment depends on ρ (using 4-digit HS trade data)[a]

ln(u)	*Average tariff*	*Collected duties*
Employment size	-0.270***	-0.262**
ln (H)	(0.11)	(0.07)
GDP per capita	-0.269***	-0.380***
ln(w)	(0.10)	(0.09)
Trade restrictiveness	-0.008*	-0.010
τ	(0.00)	(0.01)
Correlation btw r and v	2.162***	2.547***
ρ	(0.65)	(0.68)
$\tau \times \rho$	-0.083*	-0.230**
	(0.05)	(0.06)
Observations	878	747
# clusters	97	94
Period	1995-2009	1995-2009
Marginal impact of zero for ρ equal to [b]	-0.099	-0.045

[a] These are OLS estimates. All regression have country and year fixed effects. Numbers in parenthesis are robust standard errors, which are clustered at the country level. *** stands for statistical significance at the 1 per cent level, ** for statistical significance at the 5 per cent level, and * for statistical significance at the 10 per cent level.

[b] This is the value of ρ for which the marginal impact of trade restrictiveness on unemployment is equal to zero and therefore changes sign. For countries with a value of ρ below these values the estimated marginal impact of trade protection on unemployment is positive, whereas for countries with a value of ρ above these values the impact of trade protection on unemployment is negative.

Table 7

The impact of trade liberalization on unemployment depends on ρ (using 2-digit HS trade data)[a]

ln(u)	*Average tariff*	*Collected duties*
Employment size	-0.242**	-0.286*
ln(H)	(0.10)	(0.12)
GDP per capita	-0.296***	-0.411***
ln(w)	(0.10)	(0.09)
Trade restrictiveness	-0.011*	-0.007
τ	(0.01)	(0.01)
Correlation btw r and v	1.115***	0.880**
ρ	(0.38)	(0.42)
$\tau \times \rho$	-0.054*	-0.091**
	(0.03)	(0.04)
Observations	878	747
# clusters	97	94
Period	1995-2009	1995-2009
Marginal impact of zero for ρ equal to [b]	-0.195	-0.074

[a] These are OLS estimates. All regression have country and year fixed effects. Numbers in parenthesis are robust standard errors, which are clustered at the country level. *** stands for statistical significance at the 1 per cent level, ** for statistical significance at the 5 per cent level, and * for statistical significance at the 10 per cent level.

[b] This is the value of ρ for which the marginal impact of trade restrictiveness on unemployment is equal to zero and therefore changes sign. For countries with a value of ρ below these values the estimated marginal impact of trade protection on unemployment is positive, whereas for countries with a value of ρ above these values the impact of trade protection on unemployment is negative.

Table 8

Estimating vs for developed and developing countries[a]

ln(u)	*Average tariff*	*Collected duties*
Employment size	-0.258**	-0.258**
ln(H)	(0.11)	(0.12)
GDP per capita	-0.266**	-0.365***
ln(w)	(0.10)	(0.09)
Trade restrictiveness	-0.006*	-0.009
τ	(0.01)	(0.01)
Correlation btw r and v	2.587***	3.478**
ρ	(0.87)	(0.89)
$\tau \times \rho$	-0.084	-0.283***
	(0.06)	(0.09)
Observations	878	747
# clusters	97	94
Period	1995-2009	1995-2009
Marginal impact of zero for ρ equal to [b]	-0.076	-0.032

[a] These are OLS estimates. All regression have country and year fixed effects. Numbers in parenthesis are robust standard errors, which are clustered at the country level. *** stands for statistical significance at the 1 per cent level, ** for statistical significance at the 5 per cent level, and * for statistical significance at the 10 per cent level.

[b] This is the value of ρ for which the marginal impact of trade restrictiveness on unemployment is equal to zero and therefore changes sign. For countries with a value of ρ below these values the estimated marginal impact of trade protection on unemployment is positive, whereas for countries with a value of ρ above these values the impact of trade protection on unemployment is negative.

Table 9

Using ranks of v and r rather than their value[a]

ln(u)	*Average tariff*	*Collected duties*
Employment size	-0.252**	-0.248**
ln(H)	(0.10)	(0.12)
GDP per capita	-0.268**	-0.390***
ln(w)	(0.10)	(0.09)
Trade restrictiveness	-0.014*	-0.024
τ	(0.01)	(0.02)
Correlation btw r and v	2.115***	2.597***
ρ	(0.74)	(0.82)
$\tau \times \rho$	-0.080*	-0.234***
	(0.04)	(0.08)
Observations	878	747
# clusters	97	94
Period	1995-2009	1995-2009
Marginal impact of zero for ρ equal to [b]	-0.177	-0.100

[a] These are OLS estimates. All regression have country and year fixed effects. Numbers in parenthesis are robust standard errors, which are clustered at the country level. *** stands for statistical significance at the 1 per cent level, ** for statistical significance at the 5 per cent level, and * for statistical significance at the 10 per cent level.

[b] This is the value of ρ for which the marginal impact of trade restrictiveness on unemployment is equal to zero and therefore changes sign. For countries with a value of ρ below these values the estimated marginal impact of trade protection on unemployment is positive, whereas for countries with a value of ρ above these values the impact of trade protection on unemployment is negative.

5. CONCLUDING REMARKS

We embedded a model of the labour market with sector-specific search frictions into a Ricardian model with a continuum of goods to show that the impact of trade liberalization on unemployment is ambiguous in general, and how this ambiguity resolves itself in particular. Trade liberalization causes higher unemployment in countries with comparative advantage in sectors with strong labour market frictions, and leads to lower unemployment in countries with comparative advantage in sectors with weak labour market frictions.

We tested this prediction in a panel dataset of 97 countries during the period 1995-2009, and found that the data supports the theoretical prediction. This partly explains why the previous empirical literature had not reach a consensus on the impact of trade liberalization on unemployment: there is no consensus to be reached if one does not control for the correlation between sector level labour market frictions and comparative advantage. Our model and empirical findings help explain this apparent lack of consensus in the literature. Autor, Dorn and Hanson (2013), Ebeinstein et al. (2009) and Pierce and Schott (2013) found that trade increased unemployment in the United States. Revenga (1997) found a similar result for Mexico, and Menezes-Filho and Muendler (2007) and Mesquita and Najberg (2000) do so for Brazil. These are all countries for which our empirical model predicts a positive and statistically significant impact of trade liberalization on unemployment. Currie and Harrison (1997) and Hasan et al. (2012) found no impact of trade liberalization on unemployment in Morocco and India, respectively. This is again consistent with our empirical results, since the correlation between comparative advantage and sector level labour market frictions is in the statistical insignificant range for these countries. Finally, Kpdoar (2007), Nicita (2008) and Balat, Brambilla and Porto (2007) find that trade liberalization led to a reduction in unemployment in Algeria, Madagascar and Zambia, respectively. This is once again consistent with our empirical results because we estimate a statistically negative correlation between labour market frictions and comparative advantage for these countries.

President Obama argued that free trade with the Republic of Korea will create American jobs, and senator Obama argued that Nafta destroyed American jobs. The framework in this paper can potentially explains why both President and Senator Obama can be right at the same time. If the United States bilateral comparative advantage with the Republic of Korea is negatively correlated with its sector level labour market frictions, and its comparative advantage with Mexico is positively correlated with its sector level labour market frictions, then it is possible that Obama was right both times. However, to confidently answer these questions require a trade framework that allows for different bilateral trade relationship among countries. This is explored in Grujovic and Robert-Nicoud (2013).

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DATA APPENDIX

We use trade and unemployment data for 97 countries for the period 1995-2009. Trade data comes originally from United Nations' Comtrade, but we use the clean version provided by CEPII's BACI (Gaulier and Zignago, 2010). Unemployment and Employment data is from the ILO. Average tariffs are from UNCTAD's Trains which is also available through WITS. Collected duties are from the World Bank's World Development Indicators. Gravity variables are from the CEPII.

The appendix table provides descriptive statistics for the variables used in the estimation of (5).

Appendix table: Descriptive statistics 1995-2009

Variable	Obs	Mean	Std. Dev.	Min	Max
$\ln(u_{ct})$	878	1.98	0.64	-0.69	3.62
$\ln(H_{ct})$	878	8.57	1.62	3.84	12.87
$\ln(w_{ct})$	878	8.66	1.40	5.29	11.46
ρ_{ct}	878	-0.04	0.13	-0.37	0.34
τ_{ct}					
Average tariff	878	8.09	7.03	0.00	50.10
Collected duties	747	3.18	3.92	0.06	26.48

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