Abstract

Trade liberalization is often thought to be detrimental for developing countries as it may be responsible for an expansion of the informal sector. Until now, evidence for this is mixed. Whereas in some countries informality increases after trade liberalization episodes, the size of other countries’ informal sector remains stable. So far, the literature has studied this phenomenon using case studies of individual countries, thereby neglecting the general equilibrium effects of international trade and the different levels of trade integration of individual countries. These general equilibrium effects depend on relative, not absolute trade costs of a country with respect to its trading partners. Taking into account the trading relationships between countries is crucial to capture these effects for the evaluation of the welfare and employment effects of trade liberalization in the presence of an informal sector. Standard models for the evaluation of welfare effects of trade liberalization hardly address employment issues, as they assume full employment. What is more, up to now none of these frameworks takes into account the existence of an informal sector. In this paper, I extend existing frameworks based on structural gravity models with net employment effects (see Heid and Larch, 2013) by explicitly modeling an informal sector. I demonstrate my approach by applying it to Latin American trade liberalization episodes.

Keywords: International trade; unemployment; informal labor markets; trade costs; structural estimation

JEL-Codes: F14; F16; F13
1 Introduction

Whereas trade liberalization in transition economies is mostly seen as positive by economists, some policy makers are worried about the potentially negative effects on unemployment due to the increased competition from international markets. Transition economies, in addition, tend to have large informal sectors where workers often have low-productivity jobs. A common fear is that the increase in foreign competition will lead to an increase in informal employment as workers are losing their jobs in the formal part of the economy. Empirical evidence for these channels, however, is scant and mixed. Depending on the countries and time periods studied, some scholars find negative effects of trade liberalization episodes on informal employment, while others do not find such effects. This paper argues that one potential explanation for these heterogeneous effects of trade liberalization is countries’ different exposure to international trade and trading partners. These general equilibrium third-country effects are at the heart of recent studies in empirical trade (see e.g. Anderson and van Wincoop 2003; Eaton and Kortum 2002; Helpman, Melitz and Rubin-stein 2008; Waugh 2010). Crucially, these studies imply that the effect of e.g. the same preferential trade agreement can be different across countries. In the following, I will present a simple estimable model of the informal sector which incorporates the insights of the international trade literature to study the impact of trade liberalization episodes on the level of informal employment. In addition, the model can be used to analyze the impact of labor market policies like changes in the amount of unemployment insurance or improvements in the productivity of informal businesses on the level of informality.

To illustrate, I estimate my structural model of informality, unemployment, and international trade for a set of 15 Latin American and Caribbean countries and apply it to trade liberalization episodes in Latin America.

A key problem in the literature on informality is the heterogeneity in definitions and concepts. Up to now, scholars have not agreed on a commonly accepted definition of informality (see Schneider 2005; for a discussion in the Latin American context, see Gasparini and Tornarolli 2009). Early studies of
informality define it as employment in a specific sector or specific firms, stressing low informal wages which are due to the low productivity and small scale of informal enterprises. More recent approaches focus on individual workers, as firms can in principle hire both formal and informal workers. Another distinction in theoretical models of informality is whether informal employment is voluntary or not. In the classic approach by Harris and Todaro (1970), the labor market is segmented. Workers are queuing for formal sector jobs in the informal sector as they have not gained a formal job. Wages cannot adjust to ensure full employment due to wage floors like minimum wages. Alternatively, scholars like Maloney (2004) have stressed that informal employment may as well be a voluntary decision of a worker as informal (self-)employment entails greater autonomy for the worker. Albrecht, Navarro and Vroman (2009) stress that worker differences in formal sector productivity can explain a voluntary sorting of high-skill workers into the formal sector.

In addition to the diversity in the definitions of informality, the literature describes an array of different reasons for why workers may become informally employed: Informal (self-)employment can be a fallback option if a worker cannot obtain a job in the formal economy (Harris and Todaro 1970); workers try to avoid payroll-taxes (e.g. Dessy and Pallage 2003); employers try to circumvent minimum wage regulations by employing workers informally (see e.g. Rauch (1991); firms can default on loans when they are informal, so informal firms face credit-constraints (Amaral and Quintin 2006); or, to the contrary, workers face credit-constraints to raise money to set up shop in the formal economy (for an overview of this literature see McKenzie and Woodruff 2006). For a recent overview of the prevalence of informality in Latin America using different definitions of informality, see Loayza, Serven and Sugawara (2009); for a more general extensive survey on informal economic activity in general, not only informal employment, see Enste and Schneider (2000).

The literature on the informality-trade nexus is rather small and has focused on case-studies for single countries, often using micro-level data sets of workers. Koujianou Goldberg and Pavcnik (2003) find an increase in informality after trade liberalization episodes in the 1980s and 1990s in Colombia; they
do not find such an effect in Brazil. Coşar, Guner and Tybout (2011) estimate a structural dynamic heterogeneous firm model to evaluate the impact of the trade liberalization episodes from the 1990s on informality in Colombia but find little to no effect. Fiess, Fugazza and Maloney (2010) apply a small open economy macro model with a tradeable formal and a non-tradeable informal sector to several Latin American countries. In their model, trade liberalization can be interpreted as an increase in the productivity of the tradeable sector which leads to a decline in informality along standard Stolper and Samuelson (1941) type arguments. Heid, Larch and Riaño (2013) use a calibrated heterogeneous firm model to study informality in Mexico during the 1990s and find that informality has slightly increased due to an increase in US offshoring.

All these studies stick to the small open economy assumption, i.e. they analyze the effect of trade liberalization neglecting general equilibrium effects. Hence they do not take into account the interdependency between trading countries, a core problem in the international economics literature, as stressed by Anderson and van Wincoop (2003). More importantly, as Egger et al. (2011) illustrate, these effects also matter quantitatively for the evaluation of free trade agreements. So far, quantitative studies of trade liberalization which take into account these general equilibrium effects have assumed perfect labor markets, or have abstracted from the labor market altogether. An exception to this is Heid and Larch (2013) who estimate employment effects of preferential trade agreements for a sample of OECD countries. However, they do not model informal employment. More generally, a large strand of the international economics literature deals with the impact of trade on aggregate unemployment using Pissarides (2000) type models of equilibrium search unemployment: Davidson, Martin and Matusz (1999) present a two sector general equilibrium model with search unemployment; more recently, Helpman et al. (2012) and Felbermayr, Prat and Schmerer (2011) analyze heterogeneous firm models with search unemployment. Helpman et al. (2012) apply such a model to study the effect of trade liberalization on labor market outcomes in Brazil. However, all these abstract from informality. Related to the present manuscript is Helpman and Itskhoki (2010) who present a heterogeneous firm
model with search unemployment with an outside sector whose good is traded internationally without cost. The model in the present manuscript dispenses with the outside sector as well as heterogeneous firms but introduces informal sector goods which are perfect substitutes but are produced with a productivity disadvantage.

Most closely related to this manuscript is Heid and Larch (2013) who, besides neglecting informality, provide a very similar quantitative model with aggregate employment effects of preferential trade agreements for a sample of OECD countries. I modify their approach to allow for the existence of an informal labor market which allows to apply it to less developed countries which are characterized by a large informal sector.

The remainder of this paper is structured as follows: Section 2 presents a simple model of informality and international trade, Section 3 describes the data used, Section 4 presents estimation results and results of counterfactual trade liberalization scenarios, and Section 5 concludes.

2 The model

Every country $j$ is populated by a representative household with labor endowment $L_j$. The household can decide how many members should work in the formal or informal sector, $L^f_j$ and $L^i_j$, respectively; hence $L_j = L^f_j + L^i_j$. $f$ will henceforth denote variables in the formal sector and $i$ variables in the informal sector. Once household members have chosen their sector, they cannot switch sectors.\footnote{While this is a strong assumption, allowing workers to switch between sectors is arguably important for modeling transitions of workers between formal and informal employment along the business cycle. This paper, however, focuses on the cross-country variation in experiences of the trade-informality nexus, following the international trade literature by deliberately abstracting from short-run fluctuations in economic activity. For a discussion of the cyclicality of informality, see Fiess, Fugazza and Maloney (2010).} Note that household members do not differ in terms of ability. As I am only interested in the impact of trade liberalization on the overall size of the informal sector, I abstract from the sorting of workers into different sectors.\footnote{See Gasparini and Tornarolli (2009) for which types of workers sort into informality.}
Workers who have chosen to work in the formal sector have to search for a job. Due to search frictions, a share $u_j L^f_j$ of formal sector workers is unemployed, where $u_j$ denotes the reported formal unemployment rate. The unemployed receive a lump-sum transfer from the workers in the formal sector of $\gamma_j w^f_j$, where $\gamma_j$ is the rate of unemployment benefits in terms of the formal sector wage $w^f_j$.

Workers who have chosen to work in the informal sector instantaneously find a job, hence their is no informal unemployment. Several authors argue that informal employment is not subject to search frictions in the labor market: Zenou (2008) argues that formal employment is preceded by a more or less formal application process whereas informal workers can always set up shop in the informal sector and become self-employed. Similar arguments are used by Wahba and Zenou (2005) and Heid, Larch and Riaño (2013).

In equilibrium, the risk-neutral household has to be indifferent between both modes of employment, i.e.

$$
(1 - u_j)L^f_j w^f_j + u_j L^f_j \gamma_j w^f_j = L^i_j w^i_j, 
$$

which is similar to the setup in Helpman and Itskikhoki (2010) which also essentially restate the equilibrium condition in Harris and Todaro (1970). In both Helpman and Itskikhoki (2010) and the present model, however, wages are not set exogenously but are determined in general equilibrium.

Firms in the formal sector have to pay an entry cost $c_j$ to open their one worker firm. They then have to search for a worker in order to start pro-

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3The key difference to Zenou (2008) is that he assumes decreasing returns to scale for production in the informal sector using a dynamic labor market model. However, he also remains silent on the effect of international trade on informality.

4Amaral and Quintin (2006) also reject the notion of search frictions or barriers to entry; instead, they argue that even formal labor markets are competitive.

5The household interpretation is needed in order to entice some workers to search for a job in the formal sector when there is no unemployment insurance, see Helpman and Itskikhoki (2010). Unemployment insurance is scant at best or completely absent in most countries which are characterized by large rates of informal employment as e.g. Latin American countries. Therefore, self-employment acts as the de facto unemployment insurance at the household level in many developing and emerging countries.
duction. Hence this entry cost can be interpreted as vacancy posting costs for searching a worker as well as general fixed costs of production like complying with formal sector regulatory requirements like statistical duties etc if we assume that firms are one-worker firms. These costs are paid in terms of formal sector output whose aggregate price is $P_f^j$. The formal labor market is characterized by search frictions according to a one-shot version of a Pissarides (2000) type model. At the beginning of the period, all household members who have chosen the formal sector are unemployed. The number of successful matches $M_j$ between unemployed workers $L_f^j$ and formal sector vacancies $V_j$ is characterized by the following constant returns to scale matching function:

$$M_j = m_j(L_f^j)^\mu V_j^{1-\mu},$$

(2)

where $\mu$ is the elasticity of matches with respect to the number of the unemployed, and $m_j$ is a measure of the overall matching efficiency of the labor market. This implies that workers who search for a formal job will find formal employment with probability $M_j/L_f^j = m_j\vartheta_j^{1-\mu}$ where $\vartheta_j$ is a measure of the formal labor market tightness and is defined as $\vartheta_j \equiv V_j/L_f^j$. From this we can define the unemployment rate as $u_j = 1 - m_j\vartheta_j^{1-\mu}$. Similarly, the probability that a firm will fill its vacancy is given by $M_j/V_j = m_j\vartheta_j^{-\mu}$, and expected firm setup costs are $V_j/M_jc_jP_f^j$.

After a successful match between a worker and a formal firm has been established, I assume that both parties bargain over the match surplus according to a generalized Nash bargaining solution. The surplus of the worker is the wage she gains minus her outside option, i.e. the unemployment benefit, i.e. $w_f^j - \gamma_jw_f^j$. Having sunk its setup costs, the surplus of the firm is the price for which it can sell the output minus the wage cost, i.e. $p_j - w_f^j$. Hence, the Nash

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6This is without loss of generality if total setup costs of a firm are a linear function of the number of workers.

7For a general discussion of one-shot models of search and matching frictions see Roger-son, Shimer and Wright (2005). One-shot labor market models are increasingly used in international trade if one is willing to abstract from the business cycle. Some examples are Helpman and Itskhoki (2010), Felbermayr, Larch and Lechthaler (2013), and Keuschnigg and Ribi (2009).
bargaining solution wage maximizes \((w_f^j - \gamma_j w_f^j)^{\xi_j} (p_f^j - w_f^j)^{1-\xi_j}\), where \(\xi_j\) is the bargaining power of the worker and \(\xi_j \in (0, 1)\). The first order conditions of the bargaining problem yield the wage curve \(w_f^j = \xi_j/(1 + \gamma_j \xi_j - \gamma_j) p_f^j\). As the fraction on the right-hand side of the wage curve is always smaller than 1, workers get paid less than their marginal product. Note that due to the one-shot nature of the model, the wage curve does not depend on the formal labor market tightness \(\vartheta_j\).

Firms enter the formal sector until expected setup costs equal firm profits, i.e. until

\[
m_j^{-1} \vartheta_j^\mu c_j P_f^j = p_f^j - w_f^j,
\]

which can be reformulated to get the job creation curve \(w_f^j = p_j - c_j P_f^j m_j^{-1} \vartheta_j^\mu\).

Equilibrium formal labor market tightness is determined by the intersection of the wage and job creation curves and is given by

\[
\vartheta_j = \left( \frac{p_f^j}{P_f^j} \right)^{1/\mu} \left( \frac{c_j}{m_j} \frac{1 - \gamma_j + \gamma_j \xi_j}{1 - \gamma_j + \gamma_j \xi_j - \xi_j} \right)^{-1/\mu}.
\]

Equation (4) reveals that domestic labor market tightness is determined by \(p_f^j / P_f^j\), the real price of the formal sector output good. If country \(j\) consumes goods from abroad, any reduction in the prices of imports directly feeds into a reduction of the general price level in country \(j\), which in turn affects the country’s labor market tightness and hence formal unemployment rate.\(^8\)

Let us now turn to production in the informal sector. Workers who have chosen to become self-employed in the informal sector do not have to incur firm setup and worker search costs. They produce the same good as workers in the formal sector. However, their labor productivity is inferior to formal sector firms. Equivalently, one can assume that informal products can only be sold at a discount due to their lower quality, or because consumers cannot

\(^8\)The same mechanism is used in Heid and Larch (2013) as well as Felbermayr, Prat and Schmerer (2011) and Felbermayr, Jung and Larch (2013); Helpman and Itskhoki (2010) use a similar mechanism in a two sector setup with comparative advantage.
enforce their contract in the sense that they cannot enforce producer liability in case the product does not work. Both assumptions are reflected in the data which show that informal workers have, on average, lower wages.\(^9\) Informal sector firms operate under perfect competition, and produce the same good as formal sector firms. Hence, in equilibrium,

\[ p_j = p^i_j = p^f_j = \frac{1}{\phi^i_j} w^i_j, \]  

(5)

where \(0 < \phi^i_j < 1\) is the productivity in the informal sector relative to the formal sector where labor productivity is 1. Equation (5) combined with the assumption that workers cannot leave a sector after their initial choice implies that informal sector wages are lower than formal sector wages. Combining the wage curve and Equation (5) determines the equilibrium formal sector wage premium as

\[ \frac{w^f_j}{w^i_j} = \phi^i_j \frac{1 + \gamma_j \xi_j - \gamma_j}{\xi_j}. \]  

(6)

We can combine Equations (1), (4), and (6) to express the share of informal workers as

\[ \frac{L^i_j}{L_j} = \frac{(m_j \vartheta^1_j - \mu + \gamma_j (1 - m_j \vartheta^1_j - \mu))}{(m_j \vartheta^1_j - \mu + \gamma_j (1 - m_j \vartheta^1_j - \mu)) + \frac{\xi_j}{\phi^i_j (1 + \gamma_j \xi_j - \gamma_j)}}. \]  

(7)

which only depends on parameters as well as on the labor market tightness \(\vartheta_j\), which is in turn determined, by the real domestic price.\(^10\)

Having specified the labor market, I describe preferences and consumer decisions to determine international trade arise endogenously. I use the simplest model to generate trade between countries by following Armington (1969) who

\(^9\)See Gasparini and Tornarolli (2009) and Pratap and Quintin (2006). Note that I do not argue that in the data, informal workers tend to sort into the formal sector according to skill-levels in a Roy (1951) type fashion. Assuming a productivity penalty in the informal sector or assuming sorting of less productive workers into the informal sector is observationally equivalent for the analysis of the aggregate effect of trade liberalization on informality rates.

\(^1\)For the derivation see Appendix A.
assumes that goods are differentiated across $n$ countries. The utility function of the representative household in country $j$ is given by

$$U_j = \left[ \sum_{i=1}^{n} q_{ij}^{\sigma} \right]^{\frac{\sigma}{\sigma-1}},$$

where $q_{ij}$ denotes the quantity of goods from country $i$ consumed in country $j$. Note that consumers do not differentiate between formally and informally produced goods. Transporting goods from country $i$ to $j$ incurs symmetric iceberg-type transport costs $t_{ij}$ such that the price of good $i$ in country $j$, $p_{ij}$, is given by $t_{ij}p_i$, where $p_i$ is the price of the good at the factory gate.

The representative household maximizes Equation (8) subject to its budget constraint $\bar{y}_j = \sum_{i=1}^{n} p_it_{ij}q_{ij}$, i.e. national income or GDP is given by the sum of sales. Note that sales include domestic and international sales by both formal and informal firms. Utility maximization then yields the following expression for sales of goods from country $i$ in country $j$:

$$x_{ij} = p_it_{ij}q_{ij} = \left( \frac{p_it_{ij}}{P_j} \right)^{1-\sigma} \bar{y}_j,$$

where $P_j$ is the ideal price index given the CES utility function and is defined by $P_j = \sum_{i=1}^{n} (p_it_{ij})^{1-\sigma})^{1/(1-\sigma)}$. By using the general equilibrium adding-up constraint, $y_i = \sum_{i=1}^{n} x_{ij}$, in combination with Equation (9), Anderson and van Wincoop (2003) show that the utility-maximizing behavior of households implies a so-called gravity equation, one of the most robust empirical regular-

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11Arkolakis, Costinot and Rodríguez-Clare (2012) show that the trade structure arising from this setting is observationally equivalent for a wider class of more complex trade models including Ricardian technology differences between countries as in Eaton and Kortum (2002) or heterogeneous firms as in Melitz (2003). Heid and Larch (2013) demonstrate that this isomorphism is true even in models with aggregate employment effects similar to the model in this paper.

12From now on, I drop the superscript to indicate the formal or informal sector price as they are the same in equilibrium.

13Fiess, Fugazza and Maloney (2010) document that informal firms virtually never export. As in the present model international trade only implies iceberg trade costs, we can as well assume that only formal firms export without loss of generality.
It is defined as
\[
x_{ij} = \frac{y_i y_j}{y^W} \left( \frac{t_{ij}}{P_i P_j} \right)^{1-\sigma}, \quad \text{where}
\]
\[
P_j = \left[ \sum_{i=1}^{n} \left( \frac{t_{ij}}{P_i} \right)^{1-\sigma} \frac{y_i}{y^W} \right]^{1/(1-\sigma)},
\]
and \(y^W\) is defined as \(\sum_{j=1}^{n} y_j\). The system of \(n\) equations given in (11) determines the price levels in all \(n\) countries in general equilibrium. Given the vector of price levels, we can determine the domestic variety price \(p_j\) as
\[
p_j = \left[ \frac{y_j}{\sum_{i=1}^{n} \left( \frac{t_{ji}}{P_i} \right)^{1-\sigma} y_i} \right]^{1/(1-\sigma)},
\]
where I have again used the general equilibrium adding-up constraint. This, in turn, determines labor market tightness \(\theta_j\) and hence the relative size of the formal and informal sector.

We can now use the model to derive general equilibrium effects of a reduction in bilateral tariffs and general trade costs brought about by preferential trade agreements. This reduction in trade costs impacts the price levels across all countries and, via the general equilibrium effects, also affects unemployment and informality levels. Specifically, we will evaluate the impact of preferential trade agreements on unemployment as well as informality rates across countries. As shown before, employment characteristics depend on the vector of price levels consistent with a given amount of trade costs. Given knowledge of the trade cost parameters as well as the labor market parameters like the formality premium, we can solve our model for the equilibrium price vectors, once for the trade costs observed in the data, i.e. with all PTAs which are currently signed between countries, and once in a counterfactual world where we

\[\text{For a recent in-depth survey of gravity equations, see Head and Mayer (2013).}\]
abolish these trade agreements. Given the price vectors in both the observed and counterfactual scenarios, we can calculate counterfactual changes in the unemployment as well as informality rates.

To be able to do this, we express the change in the endogenous variables of interest in terms of the price vectors. It can be shown that

$$\hat{e}_j \equiv \frac{e_j^c}{e_j} \equiv \frac{1 - u_j^c}{1 - u_j} = \left( \frac{p_j^c}{p_j} \right)^{\frac{1-\mu}{\mu}} \left( \frac{P_j}{P_j^c} \right)^{\frac{1-\mu}{\mu}},$$

(13)

where $c$ denotes the counterfactual situation and $e_j$ denotes the employment rate. Note that we can write

$$\hat{u}_j \equiv \frac{u_j^c}{u_j} \equiv \frac{1 - e_j^c}{1 - e_j} = \frac{1 - e_j\hat{e}_j}{u_j}.$$

(14)

We can use this equation to express the change in the informal labor share as

$$\hat{L}_j \equiv \frac{L_j^{i,c}}{L_j} = \frac{1 - u_j\hat{u}_j + \gamma_ju_j\hat{u}_j}{(1 - u_j\hat{u}_j + \gamma_ju_j\hat{u}_j) + \frac{w_f}{w_j}},$$

(15)

where we have made use of the fact that the informality wage premium does not change in the counterfactual equilibrium.

We now have everything in place to calculate the counterfactual change in (nominal) GDPs brought about by trade liberalization. GDP is given by $p_j(1 - u_j)L_j + p_jL_j^f = p_j[e_j(L_j - L_j^f) + L_j^f]$, hence we can write the change in GDP as

$$\hat{y}_j = \frac{y_j^c}{y_j} = p_j[e_j\hat{e}_j(L_j - L_j^f) + L_j^f\hat{L}_j],$$

(16)

such that it can be expressed in terms of changes in prices using the derivations from above.

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15Details on the system of equations can be found in Appendix B.

16Changes in welfare in this model can be calculated by changes in real GDP.
3 Data and estimation

3.1 Estimation of trade agreement effects

To analyze the impact of signing a preferential trade agreement (PTA) on informality, we first need an estimate of the actual size of the reduction of trade costs brought about by a typical PTA. Whereas the previous literature has relied on direct measures of tariff reductions (see Koujianou Goldberg and Pavcnik 2003), it is well known that tariffs only make up a part of actual trade costs which also consist in non-tariff barriers like differences in languages, customs, culture etc. Similarly, trade agreements often include a considerable amount of harmonization of product standards and regulations as well as other measures which reduce NTBs, which are not measured by a change in tariff rates. Therefore, trade policy measures are only a very rough measure of actual trade cost reductions (see Anderson and van Wincoop 2004). I therefore follow the standard approach in international trade and estimate the gravity equation of international trade implied by the theoretical model to get an estimate of the impact of a PTA. In addition, gravity estimation allows to take into account the trade creation and diversion effects typical of PTAs.\footnote{For an overview of trade diversion and creation of PTAs, see Panagariya (2000).} As trade agreements are not signed randomly between countries, I follow the estimation approach outlined in Baier and Bergstrand (2007) and Anderson and Yotov (2011) to control for the potential endogeneity of the PTA measure.\footnote{The same estimation approach is used in Heid and Larch (2013).} Specifically, we can reformulate Equation (10), i.e. bilateral trade flows between country $i$ and $j$, as

$$\frac{x_{ij\tau}}{y_{i\tau}y_{j\tau}} = \exp \left( y^W_{i\tau} + (1 - \sigma) \ln t_{ij\tau} - \ln P_{i\tau}^{1-\sigma} - \ln P_{j\tau}^{1-\sigma} + \varepsilon_{ij\tau} \right),$$

(17)

where I have added a time superscript $\tau$ as well as a stochastic error term $\varepsilon_{ij\tau}$ which is assumed to be (contemporaneously) exogenous. I still have to specify
the trade cost function $t_{ij\tau}$ which I assume is given by

$$t_{ij\tau} = \exp(\beta_1 PTA_{ij\tau} + \beta_2 \ln DIST_{ij} + \beta_3 \ln CONTIG_{ij} + \beta_4 \ln COMLANG_{ij}),$$

where $PTA_{ij\tau}$ is an indicator variable of preferential trade agreement membership between country pair $ij$ in year $\tau$, $DIST_{ij}$ is bilateral distance, $CONTIG_{ij}$ is a dummy variable indicating whether countries $i$ and $j$ are contiguous, and $COMLANG_{ij}$ indicates whether the two countries share a common official language. I use data on trade flows between 15 Latin American and Caribbean countries for which also data on the informal sector are available from ILO.19

To account for the heteroscedasticity of trade flows, I follow the suggestion by Santos Silva and Tenreyro (2006) and use a Poisson Pseudo Maximum Likelihood (PPML) estimator to estimate the trade cost parameters.

### 3.2 Labor market data

For the counterfactual analysis, I need data on the following characteristics of countries' labor markets: The unemployment rate, the rate of unemployment benefits, the size of the total labor force, the rate of employment in the informal sector as well as information about the formality premium, i.e. the wage of formal sector workers relative to informal sector workers.

Data on the rate of unemployment benefits are hard to come by for Latin American countries. In addition, many Latin American countries rely on severance payments instead of a system of unemployment insurance with mandatory or voluntary contributions. Finally, some countries have individual insurance accounts.20 Therefore, focusing on a single instrument of unemployment insurance may hinder the comparability across countries. Instead, I use data from ILO (2010) on the effective share of unemployed workers who are covered

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19Trade data are from CEPII and are described in Head, Mayer and Ries (2010). The countries are: Argentina, Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Honduras, Nicaragua, Panama, Paraguay, Peru, Uruguay, and Venezuela.

20For a detailed overview, see OECD (2011).
by some form of income support system.\textsuperscript{21}

I use data on the formality premium from Gasparini and Tornarolli (2009) who report relative wages for male self-employed workers.\textsuperscript{22}

4 Evaluation of Latin American trade liberalization episodes

Results from the gravity estimations for the trade cost parameters can be found in Table 1.

5 Conclusion

References


\textsuperscript{21}The share is for the latest available year at the time of publication of ILO (2010), no further details are provided. The use of this data can be rationalized in terms of the model if we assume for simplicity that workers who receive some form of support when they are unemployed receive the full going wage; however, only with probability $\gamma_j$. If the probability of becoming unemployed is independent of the probability of receiving the unemployment benefit, $\gamma_j$ is exactly the share of unemployed workers covered.

\textsuperscript{22}Gasparini and Tornarolli (2009) do not report formality wage premia for Colombia, Ecuador, and Nicaragua. For these countries, I set the formality wage premium equal to the simple average in the sample.
Table 1: Estimation results for the Latin American and Caribbean sample, 1950-2006

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<td>-0.0153</td>
<td>-0.364***</td>
</tr>
<tr>
<td></td>
<td>(0.0552)</td>
<td>(0.0537)</td>
</tr>
<tr>
<td>$COMLANG_{ij}$</td>
<td>-1.108***</td>
<td>0.883</td>
</tr>
<tr>
<td></td>
<td>(0.192)</td>
<td>(0.781)</td>
</tr>
<tr>
<td>$N$</td>
<td>11,787</td>
<td>11,787</td>
</tr>
</tbody>
</table>

Notes: Results for trade flows between 15 Latin American and Caribbean countries between 1950 and 2006 estimated by Poisson pseudo-maximum-likelihood (PPML). $z_{ij}$ are trade flows standardized by importer and exporter GDPs. $\ln DIST$ is distance between exporting and importing country, $CONTIG$ is an indicator variable equal to 1 if the exporting and importing countries $i$ and $j$ share a common border, $COMLANG$ is an indicator variable equal to 1 if the exporting and importing country share a common official language, and $PTA$ is an indicator variable equal to 1 if the exporting and importing country have signed a preferential trade agreement. All regressions control for multilateral resistance terms (MRTs) via exporter-time and importer-time fixed effects. (Robust) standard errors in parentheses, *** $p < 0.01$. 

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A Derivation of Equation (7)

Replacing $L^i_j$ by $L_j - L^i_j$, we can write Equation (1) as

$$(L_j - L^i_j)[w^f_j(1 - u_j + \gamma_j u_j)] = L^i_j w^i_j.$$ (18)

Solving for $L^i_j$, we can write the share of informal workers as

$$\frac{L^i_j}{L_j} = \frac{w^f_j(1 - u_j + \gamma_j u_j)}{w^f_j(1 - u_j + \gamma_j u_j + w^i_j)}.$$ (19)

We can then divide the numerator and denominator of the fraction on the right hand side of this equation by $w^f_j$ to get

$$\frac{L^i_j}{L_j} = \frac{(1 - u_j + \gamma_j u_j)}{(1 - u_j + \gamma_j u_j + \frac{w^i_j}{w^f_j}).}$$ (20)
We can now plug in Equation (6) as well as the definition of the unemployment rate, \( u_j = 1 - m_j \vartheta_j^{1-\mu} \), to receive

\[
\frac{L^j_i}{L^j_j} = \frac{(m_j \vartheta_j^{1-\mu} + \gamma_j (1 - m_j \vartheta_j^{1-\mu}))}{(m_j \vartheta_j^{1-\mu} + \gamma_j (1 - m_j \vartheta_j^{1-\mu})) + \frac{\xi_j}{\varphi_j^{(1+\gamma_j \xi_j-\gamma_j)}}}.
\]  

(21)

B Computational details about the system of equations of the price vectors

For convenience, I repeat the system of equations given in (11):

\[
P_j = \left[ \sum_{i=1}^{n} \left( \frac{t_{ij}}{P_i} \right)^{1-\sigma} \frac{y_i}{y^W} \right]^{1/(1-\sigma)}.
\]

For computational reasons, it is convenient to rewrite this system of equations as

\[
\mathfrak{P}^{1-\sigma}_j = \sum_{i=1}^{n} t_{ij}^{1-\sigma} \mathfrak{P}_i,
\]

where I have defined \( \theta_i \equiv y_i/y^W \) and \( \mathfrak{P}_i \equiv P_i^{\sigma-1} \theta_i \). Equation (22) is a system of \( n \) equations in the \( n \) unknowns \( \mathfrak{P}_i \) which can be solved by standard nonlinear equation solvers. The algorithm for computing the counterfactual changes in the informality rate, unemployment, and GDP can be summarized as:

1. Given an estimate of the trade cost matrix \( t_{ij} \) as well as a value for the elasticity of substitution, solve for the vector of \( \mathfrak{P}_i \)'s in the baseline scenario.

2. After changing the trade cost matrix (or any other model parameter) accordingly, resolve the system of equations for the now counterfactual vector of \( \mathfrak{P}_i \)'s. However, in this second solution step, take into account the general equilibrium effect that, due to the changes in GDPs, the relative income shares in the counterfactual \( \theta^c_j \) also change by plugging
in the change implied by the model into the solution algorithm.

3. Calculate the counterfactual changes according to the formulae in the main text. For this, note that the variety price \( p_j \) is given by \( \theta_j p_j^{\sigma-1} = \mathcal{P}_j \).