Regional Trade Agreements, Unemployment, and the Informal Sector

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Abstract

What are the welfare and employment consequences of regional trade agreements (RTAs) for developing and emerging countries? Standard quantitative models of international trade which are generally used to assess the impact of RTAs assume full employment and hence abstract from (net) employment effects. This paper presents a quantitative framework to study the welfare and employment effects of RTAs taking into account the key feature of labor markets in emerging economies: A large share of workers is employed in the informal sector which is characterized by low productivity and hence lower wages than those in the formal part of the economy. To illustrate, I apply this framework to a set of 13 Latin American and Caribbean countries to evaluate observed trade liberalization episodes since 1950, taking into account the general equilibrium trade diversion and income effects of RTAs which have been neglected in the literature so far.

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1 Introduction

What are the welfare consequences of regional trade agreements? And what are their employment effects? These questions are of major concern for policy makers in both developed and emerging economies. To answer the first question, trade economists have delevoped quantitative models of international trade which allow to analyze the effect of trade liberalization on aggregate trade flows and welfare, taking into account the interdependencies of trade flows between trading partners. Today, these structural gravity frameworks in the vein of Anderson and van Wincoop (2003) are the de facto industry standard to answer the first question. Interestingly, these frameworks have to remain silent on the second question, as they do not model employment, or assume full employment. Hence, in these type of models, trade liberalization cannot have any (net) employment effects, as all workers are assumed to be employed before and after a trade liberalization scenario.[1] An exception to this approach is Heid and Larch (2012a) who estimate employment effects of regional trade agreements for a sample of OECD countries by introducing a unified labor market characterized by search and matching frictions into a structural gravity framework.

However, labor markets in emerging economies are remarkably distinct from labor markets in developed economies like the OECD countries. For example, irrespective of the variety of definitions used, informal employment comprises between 25 to more than 70 percent of the labor force in Latin American countries. Informal employment is not only restricted to Latin America, however: In general, the share of informal workers is higher in countries with lower GDP per capita (see Perry et al., 2007). The informal sector is

[1] Whereas Anderson and van Wincoop (2003) present a model driven by love of variety considerations of consumers, Eaton and Kortum (2002) present a quantitative trade model with Ricardian technology differences across countries. Despite their differences in interpretation, Arkolakis et al. (2012) show that both models imply the same gains from trade for a move from autarky to observed trade levels. Another quantitative trade model which can in principle be used for the evaluation of trade liberalization episodes which is not covered by the Arkolakis et al. (2012) equivalence is e.g. Fieler (2011). All these frameworks assume full employment.

characterized by low productivity, small scale establishments. Informal workers are often self-employed, or, when they work as employees, do not possess a written labor contract, or do not have access to social security or health insurance (see ILO, 2010). Therefore, informal sector employment has generally been seen as detrimental for the welfare of workers.[2]

In this paper, I extend the structural gravity framework of Heid and Larch (2012a) by introducing an informal sector to study the impact of trade liberalization on welfare and unemployment as well as on the size of the informal sector. To illustrate, I apply my quantitative framework to a set of 13 Latin American and Caribbean countries and use it to evaluate the welfare and employment effects of regional trade agreements signed since 1950. I find that these regional trade agreements have, on average, increased welfare by 11.7 percent, decreased informal employment by 20.3 percent, and decreased the official unemployment rate by 1.2 percentage points. These results are quantitatively and qualitatively different from standard frameworks assuming either full employment or a unified labor market with search and matching frictions.

The literature uses several definitions of informality or informal employment. Following Gasparini and Tornarolli (2009), informality can either be defined using a productive or legalistic definition. The productive definition declares a worker to be informal when she is an unskilled self-employed, is employed in a small scale establishment, or does not receive a monetary reward for her work but is paid in kind. According to the legalistic definition, a worker is declared informal if she does not possess a written labor contract, or does not have access to social security (mostly the pension system) or health insurance.[3] Both definitions can also focus on firms instead of individual workers, and both definitions have deficiencies. For example, small scale establishments need not necessarily be informal or employ informal workers. In addition, it may well be that larger firms partly employ informal workers, e.g. a firm may pay social security contributions for its manufacturing workers but employ a parking

[2]For example, Attanasio et al. (2004) find that informal employment is correlated with lower job satisfaction and generally worse job conditions in Colombia.

[3]For an in depth review of social security and its relation to informal employment see ILO (2010).

lot attendant informally. Therefore, depending on the specific definitions used, the share of informal workers as a percentage of the labor force varies; however, the measures correlate substantially (see Gasparini and Tornarolli, 2009). Irrespective of the definition used, informal employment is characterized by low productivity and hence low wages. Informal establishments are also characterized by no strict distinction between private and firm accounts, and often, workers are family members or close relatives (see de Laiglesia and Jütting, 2009 and de Mel et al., 2009).

Early attempts at modeling the informal sector theoretically treat it as a last resort for workers who did not manage to find a job in the formal part of the economy where regulatory restrictions like minimum wages prevent that workers can bid down wages (see Harris and Todaro, 1970). Maloney (2004) challenges this view by noting that informal employment is a multi-faceted phenomenon: Whereas informal employment is the last resort for some workers for want of better employment opportunities, others voluntarily leave the formal sector to start their own informal business. Accordingly, Albrecht et al. (2009) stress that worker differences in formal sector productivity can explain a voluntary sorting of high-skill workers into the formal sector. Empirical evidence about these two competing views is mixed. If informal employment is characterized by workers which are queuing for formal sector jobs, then the share of informal workers should increase during recessions. Instead, if informal employment is a voluntary decision, it should not be related to the business cycle or could also be pro cyclical. Fiess et al. (2010) study the comovement of the informal sector with the overall business cycle in several Latin American countries and find that both views are supported by the data, depending on the country and time period studied.[4]

A different strand of the literature dealing with informal employment was started by Lewis (1954) who describes a model of an economy with two sectors: A modern "capitalist" sector of formal salaried workers, and an informal "subsistence" sector where casual workers engage in income sharing.[5] Cru-

[4]Günther and Launov (2012) also find that both views describe parts of the reality of informal employment in Côte d'Ivoire.

[5]The term "informality" or "informal sector" did not exist at the time of Lewis' writing.

cially, workers in the subsistence sector can leave the sector without reducing its output by much as the remaining workers can increase productivity by reorganizing jobs.

The empirical 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. 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. Using time series data on the in- and outflows into and from informality, Bosch et al. (2012) also study the effect of trade liberalization during the same period in Brazil and find that it accounts for about an 1 to 2.5 percent increase in informal employment. Fiess et al. (2010) investigate the empirical implications of a small open economy macro model with a tradeable formal and a non-tradable informal sector for Argentina, Brazil, Colombia, and Mexico. In their model, trade liberalization can be interpreted as an increase in the productivity of the tradable sector which leads to a decline in informality along standard Stolper and Samuelson (1941) type arguments. Coşar et al. (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. Arias et al. (2013) analyze the effects of a hypothetical tariff reduction on informal employment in Brazil and Mexico estimating dynamic discrete choice models for workers who chose in which sector to work. They find a slight increase in informal employment. Finally, Heid et al. (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 U.S. offshoring.

All these studies stick to a small open economy assumption, i.e. they analyze the effect of trade liberalization for a single country. Hence they abstract from the interdependence of trade flows between trading countries as well as income effects, key features of the structural gravity models used for evaluating

It was only used about 20 years later by Hart (1973). Lewis (1954) refers to "casual workers" or "petty retail trading", giving examples which nowadays would be considered primordial examples of informal employment.

the welfare consequences of trade liberalization mentioned in the beginning. Importantly, as Egger et al. (2011) illustrate, these effects also matter quantitatively for the evaluation of regional trade agreements.

The remainder of this paper is structured as follows: Section 2 presents a simple quantitative framework of international trade in the presence of search-generated unemployment and an informal sector. Section 3 illustrates how this framework can be used to counterfactually evaluate the effects of a change in trade costs brought about by e.g. regional trade agreements. Section 4 brings the model to the data, followed by the evaluation of the effects of regional trade agreements signed between 13 Latin American Caribbean countries since 1950 in Section 5. Section 6 presents robustness checks. Section 7 concludes.

2 The model

2.1 The decision of the worker

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_j^f and L_j^i, respectively.; hence $L_j = L_j^f + L_j^i$. Superscripts f and i will henceforth denote variables in the formal and informal sector, respectively. Once household members have chosen their sector, they cannot switch sectors.[6] Note that household members do not differ in terms of ability.

Workers who have chosen to work in the formal sector have to search for a job. Due to search frictions, a share $u_j^f L_j^f$ of formal sector workers is unemployed, where u_j^f denotes the probability that workers who chose to search in the formal sector will not find a formal job and hence will be unemployed.

[6] 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 e.g. Bosch and Maloney (2010), Fiess et al. (2010), and Bosch and Esteban-Pretel (2012).

The unemployed receive a lump-sum transfer from the employed workers in the formal sector of $\gamma_j w_j^f$, where γ_j is the rate of unemployment benefits as a fraction of the formal sector wage w_j^f.

Workers who have chosen to work in the informal sector instantaneously find a job, as they can always become self-employed. Hence there 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 et al. (2013).[7]

In equilibrium, a member of the risk-neutral household has to be indifferent between formal and informal employment, i.e.

$$(1 - u_j^f)w_j^f + u_j^f \gamma_j w_j^f - f_j^f w_j^f = w_j^i, \tag{1}$$

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

In addition to the search effort, workers who have chosen to work in the formal sector have to incur a cost $f_j^f w_j^f$. These costs can be interpreted as moving costs, taxes and contributions to finance other social security provisions than unemployment benefits.[8] These taxes may even be wasteful, at least from the perspective of the worker. In many Latin American countries, formal sector social security and health care provisions often include free insurance for family members so that often only one family member works in the formal sector. For

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

[8] To focus squarely on the effects of the labor market structure on the welfare effects of trade liberalization and to allow for a direct comparison with standard quantitative trade models, I deliberately abstract from explicitly modeling the demand and supply of a public good like e.g. publicly provided health care or a public pension system. Hence, in the context of the model, the formal sector fixed costs are pure costs for formal sector workers.

example, in Colombia, about 54 percent of informal self-employed workers do not contribute to health insurance as they have access through a relative, see Perry et al. (2007). Finally, it can also be the monetary equivalent of the cost of being a salaried worker instead of being one's own boss as a self-employed worker as stressed by Maloney (2004). The assumption of entry fixed costs of formal employment are also in line with empirical evidence provided by Arias et al. (2013) who find that entry costs into formal employment are substantially larger than for informal employment. In the empirical application, I will solve for $f_j^f w_j^f$ so that workers are indifferent between the two sectors using the observed data. Therefore, f_j^f captures in a catch-all way the several factors which prevent Equation (1) to hold without any entry costs.

2.2 Formal and informal firms

Firms in the formal sector have to pay a cost c_j to open their one worker firm.[9] They then have to search for a worker in order to start production. 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.[10] These costs are paid in terms of formal sector output whose aggregate price is P_j^f. Hence, they can also be interpreted as a form of capital requirement to set up a firm. The formal labor market is characterized by search frictions according to a one-shot version of a Pissarides (2000) type model.[11] At the beginning of the period, all household members who have chosen the formal sector are unemployed. The number of successful

[9] The following description of the behavior of formal firms draws heavily from Felbermayr et al. (2013) and Heid and Larch (2012a) as it borrows the labor market model used there. The difference is that whereas these authors consider only one unified labor market, I apply their model to only the formal part of the economy.

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

[11] For a general discussion of one-shot models of search and matching frictions see Rogerson et al. (2005). One-shot labor market models are increasingly used in international trade. Some examples are Keuschnigg and Ribi (2009), Helpman and Itskhoki (2010), and Felbermayr et al. (2013).

matches M_j between unemployed workers L_j^f and formal sector vacancies V_j is characterized by the following constant returns to scale matching function:

$$M_j = m_j (L_j^f)^{\mu} V_j^{1-\mu}, \tag{2}$$

where μ 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 $M_j/L_j^f = m_j \vartheta_j^{1-\mu}$ where ϑ_j is a measure of the formal labor market tightness and is defined as $\vartheta_j \equiv V_j/L_j^f$. From this we can define the probability of not finding a job in the formal sector as $u_j^f = 1 - m_j \vartheta_j^{1-\mu}$. Note that this is not the overall or official unemployment rate in the economy which is reported by national statistical agencies. The latter is defined as the number of unemployed, U_j, divided by the labor force, hence $u_j^o = U_j/L_j$, where o is short for official. As informal sector workers are not unemployed, this may explain low official unemployment rates in countries with a large informal sector.

The probability that a formal sector firm will fill its vacancy is given by $M_j/V_j = m_j \vartheta_j^{-\mu}$, and expected firm setup costs are $V_j/M_j c_j P_j^f$. 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. As the worker's decision for a sector is irreversible, her outside option in the formal sector is the unemployment benefit b_j, i.e. the worker's surplus is given by $w_j^f - b_j$. In equilibrium, $b_j = \gamma_j w_j^f$. 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. $p_j - w_j^f$. Hence, the Nash bargaining solution wage maximizes $(w_j^f - b_j)^{\xi_j} (p_j^f - w_j^f)^{1-\xi_j}$, where ξ_j is the bargaining power of the worker and $\xi_j \in (0, 1)$. The first order condition of the bargaining problem yields the formal wage curve $w_j^f = \xi_j/(1 + \gamma_j \xi_j - \gamma_j) p_j^f$.[12] As

[12]Note that I follow Pissarides (2000) in assuming that both the firm and the worker do not take into account that their bargaining affects the level of unemployment benefits b_j. Felbermayr et al. (2013) and Heid and Larch (2012a) use the same model of the labor

the fraction on the right-hand side of the wage curve is always smaller than 1, workers get paid less than their marginal value product. Note that due to the one-shot nature of the model, the wage curve does not depend on the formal labor market tightness ϑ_j.

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

$$m_j^{-1}\vartheta_j^{\mu}c_jP_j^f = p_j^f - w_j^f, \tag{3}$$

which can be reformulated to get the job creation curve $w_j^f = p_j - c_jP_j^f m_j^{-1}\vartheta_j^{\mu}$.

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

$$\vartheta_j = \left(\frac{p_j^f}{P_j^f}\right)^{1/\mu}\left(\frac{c_j}{m_j}\frac{1-\gamma_j+\gamma_j\xi_j}{1-\gamma_j+\gamma_j\xi_j-\xi_j}\right)^{-1/\mu}. \tag{4}$$

Equation (4) reveals that formal labor market tightness is determined by p_j^f/P_j^f, 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 formal labor market tightness and hence the probability of becoming unemployed in the formal sector.[13] Also note that formal labor market tightness does neither depend on the number of informal workers nor their share in the labor force. Hence the number of unemployed workers is determined only by institutional parameters of the formal labor market and the prevailing price level which is determined in general equilibrium.

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. Hence, the price of the good is the same, irrespective of

market but I extend their frameworks to include informality.

[13]The same mechanism is used in Heid and Larch (2012a) as well as Felbermayr et al. (2011a) and Felbermayr et al. (2013) but applies to the economy as a whole; Helpman and Itskhoki (2010) use a similar mechanism in a two sector setup with comparative advantage.

whether it was produced in the formal or informal sector, i.e. $p_j^f = p_j^i = p_j$. This can be rationalized by the fact that consumers do not care about the working conditions under which a good has been produced, as I assume that consumers only derive utility from the consumption of a good. In principle, one could also assume that informal sector firms produce a different good, and that there exists some imperfect substitutability between the goods. However, I argue that this is not satisfactory on conceptual grounds. When one assumes that utility of consumers is given by e.g. a Cobb-Douglas or CES composite of formally and informally produced goods, the informal sector is assumed into existence by consumer preferences instead of institutional features of the labor market or the economy.[14]

The production mode in the informal sector is different to that in the formal sector. Whereas the formal sector is organized along capitalist lines where firms equate marginal benefit to marginal cost to determine how many workers to employ, informal sector firms engage in income sharing. Therefore, the informal sector wage, w_j^i, is equal to the average product of an informal sector firm. In addition, the informal sector is characterized by what Lewis (1954) describes as 'surplus labor'. Informal sector establishments are often organized around families, do not distinguish between family and firm accounts and employ family members or workers who often do not get a monetary wage but are paid in kind. Crucially, Lewis argues that if an additional worker is employed in an informal establishment, productivity is reduced as work is simply shared amongst the family members.

Several authors provide micro foundations and develop the implications of this mode of production (see e.g. Sen, 1966 and Takagi, 1978 as well as the gentle introduction in Chapter 10 in Ray, 1998). I endogenize informal sector

[14] Other authors who do not distinguish between consumption derived from formally and informally produced goods are e.g. Rauch (1991), Dessy and Pallage (2003), Goldberg and Pavcnik (2003), Amaral and Quintin (2006), Chong and Gradstein (2007), Marjit et al. (2007), Galiani and Weinschelbaum (2012), and Arias et al. (2013). Notable exceptions are Fiess et al. (2010) who assume that the non-tradable sector is identical to the informal sector and tradable and non-tradable goods are imperfect substitutes as well as Ulyssea (2010) who assumes that the final consumption good is a CES composite of formally and informally produced intermediate goods.

productivity in the simplest possible way and assume that productivity in the informal sector is a decreasing function of the relative size of the informal sector, i.e. informal sector output of a typical firm is given by

$$y_j^i = \left(\frac{L_j^f}{L_j}\right)^{\alpha} = \left(1 - \frac{L_j^i}{L_j}\right)^{\alpha}. \tag{5}$$

Hence, informal sector firms are less productive than formal sector firms which have a constant productivity of 1. α can be interpreted as the elasticity of an informal sector firm's productivity with respect to a change in the relative size of the formal sector. If the formal sector employment share increases by one percent, informal sector productivity increases by α percent. Obviously, α is a key elasticity for the model. In Section 4.4, I will present a simple method to estimate α from aggregate labor market data.

The productivity disadvantage of informal firms is compensated by a lower informal sector wage. As mentioned before, informal sector firms engage in income sharing, i.e. the informal sector wage is the value of the average informal sector output:

$$w_j^i = \frac{p_j y_j^i L_j^i}{L_j^i} = p_j \left(\frac{L_j^f}{L_j}\right)^{\alpha}. \tag{6}$$

Equivalently, one can assume that informal products can only be sold at a discount due to their lower quality, or because consumers cannot enforce their contract in the sense that they cannot enforce producer liability in case the product does not meet its advertised standard. Both interpretations are consistent with the data which show that informal workers have, on average, lower wages.[15]

[15] I report the formality to informality wage ratio from the data set used in the empirical application in Table 2. For further evidence, see also Gasparini and Tornarolli (2009) and Pratap and Quintin (2006). In the data, informal workers tend to sort into the formal sector according to skill-levels in a Roy (1951) type fashion. Still, assuming a productivity penalty in the informal sector or assuming sorting of less productive workers into the informal sector is observationally equivalent if one is not interested in who selects into the informal sector but in the analysis of the aggregate effect of trade liberalization on informality as I am.

Combining the wage curve and Equation (6) determines the equilibrium formal sector wage premium as

$$\frac{w_j^f}{w_j^i} = \left(\frac{L_j^f}{L_j}\right)^{-\alpha} \frac{1+\gamma_j\xi_j-\gamma_j}{\xi_j}. \tag{7}$$

Inspection of Equation (7) shows that for $\alpha > 0$ the formal sector wage premium decreases with the size of the formal sector. The larger the formal sector, the smaller is the productivity disadvantage of the informal sector. This increases the informal sector wage and therefore reduces the formality premium.

2.3 Consumers and determination of trade flows

Having specified the labor market and the production structure, I describe preferences and consumer decisions which endogeneously determine international trade. I use the simplest model to generate trade between countries by following Armington (1969) who assumes that goods are differentiated across n countries.[16] The utility function of the representative consumer in country j is given by

$$U_j = \left[\sum_{i=1}^{n} \beta_i^{\frac{1-\sigma}{\sigma}} q_{ij}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \tag{8}$$

where q_{ij} denotes the quantity of goods from country i consumed in country j, σ is the elasticity of substitution between varieties, and β_i is a preference parameter which reflects the relative attractiveness of goods from country i. Note that consumers do not differentiate between formally and informally produced goods. One could describe an observationally equivalent model where

[16] Arkolakis et al. (2012) show that the gains from trade arising from this setting are 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 (2012a) demonstrate that an equivalent isomorphism holds even in models with aggregate employment effects similar to the model in this paper.

goods produced in the informal sector are of lower quality, when lower quality is interpreted as lower "effective" consumption of the good. Transporting goods from country i to j incurs (potentially asymmetric) iceberg-type transport costs t_{ij} such that the price of a good from country 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 consumer maximizes Equation (8) subject to her budget constraint $y_j = \sum_{i=1}^{n} p_i t_{ij} q_{ij}$, i.e. national income or GDP is given by the sum of sales. We can also generalize this budget constraint by allowing for exogenously given trade deficit shares. Then, the budget constraint becomes $\tilde{y}_j = \sum_{i=1}^{n} p_i t_{ij} q_{ij}$, where $\tilde{y}_j = y_j(1 + d_j)$, with y_j denoting nominal income in country j and d_j the share of the trade deficit (if $d_j > 0$) or surplus (if $d_j < 0$) of country j as a percentage of GDP.[17]

Note that sales include domestic and international sales by both formal and informal firms.[18] Utility maximization then yields the following expression for sales of goods from country i in country j:

$$x_{ij} = p_i t_{ij} q_{ij} = \left(\frac{\beta_i p_i t_{ij}}{P_j} \right)^{1-\sigma} \tilde{y}_j, \tag{9}$$

where P_j is the ideal price index given the CES utility function and is defined by $P_j = [\sum_{i=1}^{n} (\beta_i p_i t_{ij})^{1-\sigma}]^{1/(1-\sigma)}$. 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 relations

[17] In the empirical analysis, I allow for trade imbalances similar to Dekle et al. (2007) as my sample only includes 13 countries, potentially exacerbating the importance of trade imbalances. Appendix C reports results assuming balanced trade. Results are very similar.

[18] Fiess et al. (2010) document that informal firms virtually never export. In my model, only data on aggregate exports are needed to uncover the trade cost reducing effect of trade agreements, irrespective of which firms export which amount. Therefore, we can as well assume that only formal firms export without loss of generality.

in economics.[19] We can write bilateral trade flows as

$$x_{ij} = \frac{y_i \tilde{y}_j}{y^W} \left(\frac{t_{ij}}{\tilde{\Pi}_i \tilde{P}_j} \right)^{1-\sigma}, \quad \text{where} \tag{10}$$

$$\tilde{\Pi}_i \equiv \left(\sum_{j=1}^{n} \left(\frac{t_{ij}}{\tilde{P}_j} \right)^{1-\sigma} \tilde{\theta}_j \right)^{1/(1-\sigma)}, \quad \tilde{P}_j \equiv \left(\sum_{i=1}^{n} \left(\frac{t_{ij}}{\tilde{\Pi}_i} \right)^{1-\sigma} \theta_i \right)^{1/(1-\sigma)}, \tag{11}$$

where we substituted equilibrium scaled prices into the definition of the price index to obtain the multilateral resistance terms $\tilde{P}_j$ $\tilde{\Pi}_i$ and defined $y^W \equiv \sum_j y_j$, $\tilde{y}^W \equiv \sum_j \tilde{y}_j$ and income shares $\theta_j \equiv y_j / y^W$ and $\tilde{\theta}_j \equiv \tilde{y}_j / \tilde{y}^W$.

The system of $2n$ equations given in (11) determines the $2n$ outward and inward multilateral resistance terms $\tilde{\Pi}_i$ and $\tilde{P}_j$. $\tilde{\Pi}_i$ and $\tilde{P}_j$ can be interpreted as weighted averages of export and import trade costs.[20] From these, we can derive the price levels in all n countries in general equilibrium. Crucially, they are the key variables to identify the effect of regional trade agreements on trade, welfare, and the size of the informal economy.

3 Counterfactual analysis

We can now use the model to derive the general equilibrium effects of a reduction in bilateral tariffs and general trade costs brought about by regional 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, I will evaluate the impact of regional trade agreements on unemployment as well as informal employment across countries. As shown in Equation (4), the level of employment depends 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,

[19] For a recent in-depth survey of gravity equations, see Head and Mayer (2014).

[20] For a discussion of the interpretation of multilateral resistance terms see Anderson and van Wincoop (2004).

once for the trade costs observed in the data, i.e. with all RTAs which are currently signed between countries, and once in a counterfactual world where we abolish these trade agreements.[21] Given the price vectors in both the observed and counterfactual scenarios, we can calculate counterfactual changes in welfare, unemployment, and informal employment.

3.1 Counterfactual size of the formal sector

In equilibrium, the variety price charged by formal and informal firms is the same. Hence we can combine Equation (6) with the formal wage curve to receive the following expression for the counterfactual change in the number of formal sector workers when we assume that labor market parameters remain constant:

$$\hat{L}_j^f \equiv \frac{L_j^{f,c}}{L_j^f} = \left(\frac{\frac{w_j^{i,c}}{w_j^{f,c}} \frac{1+\gamma_j \xi_j - \gamma_j}{\xi_j}}{\frac{w_j^i}{w_j^f} \frac{1+\gamma_j \xi_j - \gamma_j}{\xi_j}} \right)^{\frac{1}{\alpha}} = \left(\frac{w_j^{f,c}/w_j^{i,c}}{w_j^f/w_j^i} \right)^{-\frac{1}{\alpha}}, \tag{12}$$

where the hat denotes a change expressed as a ratio and c denotes the counterfactual values. Note that as the labor force remains constant, this expression also gives the change in the formal employment share, L_j^f/L_j. The change in formal sector employment is inversely related to the change in the formal sector premium. When α decreases towards 0, implying a smaller reaction of informal sector productivity to changes in formal sector employment, the same percentage change in the formal sector wage premium is magnified.

Note that we can then calculate the change in the informal sector as

$$\hat{L}_j^i \equiv \frac{L_j^{i,c}}{L_j^i} = \frac{L_j - \hat{L}_j^f L_j^f}{L_j - L_j^f}. \tag{13}$$

[21] Details on the system of equations can be found in Appendix A.

3.2 Counterfactual formal employment probability

To derive the counterfactual change in formal employment, we express the change in the endogenous variables of interest in terms of the price vectors. Following Anderson and van Wincoop (2003), we can use the general equilibrium adding up constraint that total sales equal income, i.e. $y_i = \sum_{j=1}^{n} x_{ij}$, in combination with the definition of sales given in Equation (9) to express variety prices in a country as:

$$(\beta_j p_j)^{1-\sigma} = \frac{y_j}{\sum_{i=1}^{n} (\frac{t_{ji}}{\tilde{P}_i})^{1-\sigma} \tilde{y}_j} = \frac{y^W}{\tilde{y}^W} \theta_j \tilde{\Pi}_j^{\sigma-1} = \frac{y^W}{\tilde{y}^W} \mathfrak{k}_j, \tag{14}$$

where $\mathfrak{k}_j \equiv \theta_j \tilde{\Pi}_j^{\sigma-1}$ is determined by the system of equations given in Equation (11).[22]

Plugging Equation (4) into the definition of the probability of becoming unemployed, $u_j^f = 1 - m_j \vartheta_j^{1-\mu}$, and keeping labor market parameters constant, it can be shown that

$$\hat{e}_j^f \equiv \frac{e_j^{f,c}}{e_j^f} \equiv \frac{1 - u_j^{f,c}}{1 - u_j^f} = \left(\frac{p_j^c}{p_j}\right)^{\frac{1-\mu}{\mu}} \left(\frac{P_j}{P_j^c}\right)^{\frac{1-\mu}{\mu}} \tag{15}$$

$$= \left(\frac{\mathfrak{k}_j^c}{\mathfrak{k}_j}\right)^{\frac{1-\mu}{\mu(1-\sigma)}} \left(\frac{\sum_i t_{ij}^{1-\sigma} \mathfrak{k}_i}{\sum_i \left(t_{ij}^c\right)^{1-\sigma} \mathfrak{k}_i^c}\right)^{\frac{1-\mu}{\mu(1-\sigma)}}, \tag{16}$$

where e_j^f denotes the formal employment rate. Note that we can write the change in the probability of a formal sector worker becoming employed as

$$\hat{u}_j^f \equiv \frac{u_j^{f,c}}{u_j^f} = \frac{1 - e_j^{f,c}}{1 - e_j^f} = \frac{1 - e_j^f \hat{e}_j^f}{u_j^f}. \tag{17}$$

The algebraic expression for $\hat{e}_j^f$ is identical to the expression of the counterfactual change of employment in Heid and Larch (2012a). The difference, however, lies in its interpretation: whereas in Heid and Larch (2012a) it gives the change for employment in the whole economy, in the present framework it

[22] Details on how to solve this system can be found in Appendix A.

only gives the employment change for the formal sector.

3.3 Counterfactual official unemployment rate

Note that $\hat{u}_j^f$ does not give the change in the official unemployment rate, $u_j^o = U_j/L_j$, as the latter depends on the absolute number of unemployed formal sector workers. It is given by

$$\hat{u}_j^o \equiv \frac{u_j^{o,c}}{u_j^o} = \frac{u_j^{f,c} L_j^{f,c}}{u_j^f L_j^f} = \hat{u}_j^f \hat{L}_j^f. \tag{18}$$

When trade is liberalized, and the price level in a country falls, then the probability of a formal sector worker finding a job increases, as the vacancy posting costs for formal firms are lower. The lower probability of becoming unemployed, however, makes the formal sector more attractive, as the expected formal sector wage is higher. Therefore, more workers leave the informal sector and seek formal employment. Whether the official unemployment rate decreases or increases depends on the interplay of the elasticities of the model: The elasticity of substitution, σ, the matching elasticity, μ, and the elasticity of informal sector productivity, α. Compared to Heid and Larch (2012a), who assume a single labor market in the whole economy, the reduction of the official unemployment rate is dampened by the rising attractiveness of the formal part of the economy. This may partly explain why empirical evidence on the observed correlation between official unemployment rates and changes in openness is mixed, and a relation between trade and unemployment is downplayed by some economists.[23]

[23] Felbermayr et al. (2011b) find that higher trade openness decreases unemployment. Similar conclusions can be drawn from Dutt et al. (2009) and Hasan et al. (2012). Heid and Larch (2012b), however, find no significant effect. Using detailed regional data for the United States, Autor et al. (2013) find that higher imports increase unemployment.

3.4 Counterfactual formal wage premium

Using the indifference condition of workers given in Equation (1), we can express the change in the formal wage premium as

$$\widehat{w_j^f/w_j^i} \equiv \frac{w_j^{f,c}/w_j^{i,c}}{w_j^f/w_j^i} = \frac{1-u_j^f+u_j^f\gamma_j-f_j^f}{1-u_j^f\hat{u}_j^f+u_j^f\hat{u}_j^f\gamma_j-f_j^f}. \tag{19}$$

This implies that the change in the formality premium is independent of the value of α, the elasticity of informal sector productivity.

3.5 Counterfactual (nominal) GDP

We now have everything in place to calculate the counterfactual change in (nominal) GDPs brought about by trade liberalization. GDP is given by

$$p_j(1-u_j^f)L_j^f + p_jL_j^i(L_j^f/L_j)^\alpha = p_j[(1-u_j^f)L_j^f + L_j^i(L^f/L_j)^\alpha]. \tag{20}$$

Hence we can write the counterfactual change in GDP in terms of changes in prices, formal employment as well as changes in the sectoral labor force composition:

$$\hat{y}_j = \frac{y_j^c}{y_j} = \frac{p_j^c}{p_j}\frac{[e_j^f\hat{e}_j^f(L_j-L_j^i\hat{L}_j^i)+L_j^i\hat{L}_j^i(1-(L_j^i\hat{L}_j^i)/L_j)^\alpha]}{[e_j^f(L_j-L_j^i)+L_j^i(1-L_j^i/L_j)^\alpha]}, \tag{21}$$

such that it can be expressed in terms of changes in prices using the derivations from above. Note that the change in the variety price can be deduced from Equation (14) by constructing $\hat{p}_j \equiv p_j^c/p_j$.

3.6 Counterfactual welfare

A model consistent welfare measure is the equivalent variation, i.e. the amount of income the representative consumer would need to make her as well off under current prices $\tilde{P}_j$ as in the counterfactual situation with price level $\tilde{P}_j^c$. We

can express the equivalent variation in percent as follows:

$$EV_j = \frac{\check{y}_j^c \frac{\tilde{P}_j}{\tilde{P}_j^c} - \check{y}_j}{\check{y}_j} = \frac{\check{y}_j^c}{\check{y}_j}\frac{\tilde{P}_j}{\tilde{P}_j^c} - 1 = \hat{\check{y}}_j \frac{\tilde{P}_j}{\tilde{P}_j^c} - 1, \tag{22}$$

where $\hat{\check{y}}_j$ is the change in consumable income $\check{y}_j$ in country j. The change in the price indices can be recovered from the multilateral resistance terms.[24] As the vacancy posting costs of formal sector firms consume part of the final output good, the change in consumamble income is not equal to the change in GDP. The former is given by the total wage sum augmented by the exogenous trade deficit share, $(1+d_j)[(1-u_j^f)w_j^f L_j^f + p_j(L_j^f/L_j)^\alpha L_j^i]$. Assuming that the trade deficit share is constant and exogenous, and using the formal sector wage curve, we can write the change in consumable income as:

$$\hat{\check{y}}_j \equiv \frac{\check{y}_j^c}{\check{y}_j} = \frac{p_j^c}{p_j}\frac{\hat{e}_j^f e_j^f[\xi_j/(1+\gamma_j\xi_j-\gamma_j)]\hat{L}_j^f L_j^f + (\hat{L}_j^f L_j^f/L_j)^\alpha \hat{L}_j^i L_j^i}{e_j^f[\xi_j/(1+\gamma_j\xi_j-\gamma_j)]L_j^f + (L_j^f/L_j)^\alpha L_j^i}. \tag{23}$$

Hence welfare can be calculated by using the expressions derived previously as well as the changes in the variety price implied by Equation (14).

4 Bringing the model to the data

4.1 Estimation of trade agreement effects

To analyze the impact of signing a regional trade agreement (RTA) on welfare, unemployment, and informal employment, we first need an estimate of the actual size of the reduction of trade costs brought about by a typical RTA. Whereas the previous literature has relied on direct measures of tariff reductions (see Goldberg and Pavcnik, 2003), it is well known that tariffs only make up a part of actual trade costs which also consist of non-tariff barriers like differences in languages, customs, culture etc. Similarly, trade agreements often include a considerable amount of harmonization of product standards

[24] For computational details, see Appendix A.

and regulations as well as other measures which reduce non-tariff barriers and which are not measured by a change in tariff rates. Therefore, tariff measures are only an incomplete 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 estimate the impact of a RTA on trade flows. In addition, gravity estimation allows to take into account the trade creation and diversion effects typical of RTAs.[25] 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 RTA measure.[26] Specifically, we can reformulate Equation (10), i.e. exports from country i to j, as

$$\frac{x_{ij\tau}}{y_{i\tau}y_{j\tau}} = \exp\left(y_{\tau}^{W} + (1-\sigma)\ln t_{ij\tau} - \ln \tilde{\Pi}_{i\tau}^{1-\sigma} - \ln \tilde{P}_{j\tau}^{1-\sigma} + \varepsilon_{ij\tau}\right), \tag{24}$$

where I have added a time superscript τ as well as a stochastic error term $\varepsilon_{ij\tau}$. I follow most of the structural gravity literature and specify the trade cost function $t_{ij\tau}$ as

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

where $RTA_{ij\tau}$ is an indicator variable of regional trade agreement membership between country pair ij in year τ, $DIST_{ij}$ is bilateral distance, and $CONTIG_{ij}$ is a dummy variable indicating whether countries i and j are contiguous.[27]

I use data on trade flows between 13 Latin American and Carribbean countries for which also data on the informal sector are available.[28]

[25] For an overview of trade diversion and creation of RTAs, see Panagariya (2000).

[26] The same estimation approach is used in Heid and Larch (2012a).

[27] Note that nearly all countries in the sample have Spanish as their official language; only Brazil has a different language, Portuguese. When including exporter and importer (times year) dummies, a common language dummy would be perfectly collinear. A similar argument applies to a common colonizer dummy. I hence omit these regressors which are normally used in the gravity literature.

[28] Trade and gravity variables except RTA are from CEPII and are described in Head et al. (2010). RTA is taken from Mario Larch's RTA database. The countries are: Ar-

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. The approach by Anderson and Yotov (2011) proceeds in two steps: In a first estimation, Equation (24) is estimated including a set of exporter times year and importer times year dummies to control for the outward and inward multilateral resistance terms, $\ln \tilde{\Pi}_{i\tau}^{1-\sigma}$ and $\ln \tilde{P}_{j\tau}^{1-\sigma}$. In addition, a set of $n \times (n-1)/2$ dummies for each bilateral trade relation is included when one is willing to assume symmetric trade costs, and a set of $n \times (n-1)$ bidirectional dummies for each bilateral trade relation when one assumes that trade costs are asymmetric. Either way, the set of dummies controls for the special nature of a trade relation between two countries, effectively controlling for the endogeneity of the RTA variable caused by time-invariant unobserved factors influencing the probability that a specific country pair signs a regional trade agreement. This first step regression drops regressors like bilateral distance and contiguity, and only β_1, the coefficient of the RTA variable, can be identified. Hence, in a second step, the coefficient β_1 is constrained to its estimated value, the bilateral dummies are dropped and thus the influence of the time-invariant regressors $\ln DIST$ and $CONTIG$ can be identified. Results from the gravity estimations for the trade cost parameters can be found in Table 1. Columns (1) and (2) assume symmetric bilateral trade costs, whereas columns (3) and (4) assume symmetric trade costs. Columns (1) and (3) do not constrain the elasticity of trade flows with respect to exporter and importer GDP to unity by using simply trade flows as the dependent variable.[29] Columns (2) and (4) use scaled trade flows as a dependent variable, implicitly imposing unitary elasticities, consistent with the theoretical framework which assumes homothetic preferences. The coefficients in Table 1 can be interpreted as partial equilibrium average treatment effects. As the Poisson model is a

gentina, Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Nicaragua, Paraguay, Peru, Uruguay, and Venezuela. Summary statistics of the gravity data set used can be found in Appendix B.

[29]Note that I cannot report coefficients for importer and exporter GDP as these are controlled for by the exporter and importer times year dummies.

log-linear model, coefficients can be interpreted directly as elasticities. Using this interpretation, all estimated coefficients have the correct sign and are in the expected ballpark: For example, an increase in the distance between two trading partners by one percent decreases bilateral trade flows by about 1.6 percent. Whether one assumes symmetric or asymmetric trade costs hardly affects the coefficient estimates. However, results for the other regressors are remarkably different, depending on whether one imposes the homotheticity assumption: Sharing a common border increases bilateral trade by about 6 percent assuming homothetic preferences, and by about 20 percent when not imposing the unitary income elasticities.[30] Interestingly, contiguity loses its significance assuming homothetic preferences. When two countries have signed a regional trade agreement, bilateral trade flows increase between 47 (column (3)) and 179 (column (4)) percent on average.

For the counterfactual general equilibrium analysis, I also need a value of σ. Bergstrand et al. (2013) use a structural gravity model to derive an estimator for σ. I use their estimate and set $\sigma = 7.1$. This is also broadly in line with the estimate of $\sigma = 9.3$ from Eaton and Kortum (2002).[31]

4.2 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. I use the year 2006 for all data or the year closest to 2006 available in the data.[32] If there are

[30] I calculate partial equilibrium average treatment effects of discrete regressors as $[\exp(\hat{\beta}_k) - 1] \times 100$.

[31] Eaton and Kortum (2002) use a Ricardian model of trade to derive a gravity equation for trade flows which depend on the comparative advantage parameter θ. Their model is observationally equivalent to a model with Armington (1969) preferences where $\sigma = 1 + \theta$, see Arkolakis et al. (2012). Using plant-level data, Bernard et al. (2003) estimate $\sigma = 3.8$.

[32] I use data on the share of adults in the labor force for 2007 for Bolivia and for 2005 for Nicaragua. Wage rates are for 2008 for Colombia. Data for Argentina are the simple average of the two waves of the same survey available for 2006.

Table 1: Estimation results for a sample of 13 Latin American and Caribbean countries, 1950-2006

	(1) PPML $x_{ij\tau}$	(2) PPML $z_{ij\tau}$	(3) PPML $x_{ij\tau}$	(4) PPML $z_{ij\tau}$
First stage				
$RTA_{ij\tau}$	0.396***	0.951***	0.382***	1.025***
	(0.080)	(0.147)	(0.068)	(0.109)
Second stage				
$\ln DIST_{ij}$	−1.578***	−1.645***	−1.579***	−1.637***
	(0.041)	(0.052)	(0.041)	(0.052)
$CONTIG_{ij}$	0.185***	0.063	0.186***	0.064
	(0.059)	(0.074)	(0.059)	(0.074)
symmetric $t_{ij\tau}$	X	X		
asymmetric $t_{ij\tau}$			X	X
N	8,743	8,743	8,743	8,743

Notes: Results for trade flows between 13 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, and RTA is an indicator variable equal to 1 if the exporting and importing country have signed a regional 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.

different measures from surveys at the national and sub-national level available for a country, I always use the survey on the national level. To estimate α, I use a panel of the same data for 1989 to 2013.

The main data source on informality is the Socio-Economic Database for Latin America and the Caribbean (SEDLAC) from CEDLAS and The World Bank (2013).[33] It contains data on the unemployment rate, the share of adults in informal jobs, as well as formal and informal hourly wages. For the counterfactuals, I use the data based on a legalistic definition of informality. Hence individuals are considered to work in the informal sector when they do not have the right to a pension when they retire.

To transform the share data into data in levels, I use data on total population and labor force participation rates from the World Development Indicators (WDI) from The World Bank (2013).[34] I use urban informality shares and assume that the number of informal workers in the economy is given by the share of urban informal workers times the labor force.

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.[35] 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 by some form of income support system.[36]

I also have to set the bargaining power of formal sector workers. I follow

[33]The database can be accessed via `http://sedlac.econo.unlp.edu.ar/`. I use the data as of 08/16/2013.

[34]The database can be accessed via `http://data.worldbank.org/data-catalog/world-development-indicators`. I use the data as of 08/16/2013.

[35]For a detailed overview, see OECD (2011).

[36]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 γ_j. If the probability of becoming unemployed is independent of the probability of receiving the unemployment benefit, γ_j is exactly the share of unemployed workers covered.

Heid and Larch (2012a) and set it equal to 0.5 in all countries.

Finally, I need a value for the elasticity of the matching function with respect to the unemployed, μ. Papers which structurally estimate matching functions normally focus on labor markets in developed countries and estimate μ in a range between 0.12 and 0.81 (see the survey by Petrongolo and Pissarides, 2001).[37] An exception are Meghir et al. (2015) who estimate $\mu = 0.66$ using Brazilian worker-level data. Most studies use OLS which suffers from several biases. Also, the literature discusses data measurement issues which may also bias the estimates (see Petrongolo and Pissarides, 2001; Yashiv, 2007, and Borowczyk-Martins et al., 2013 as well as the references cited therein for a discussion). I follow Satchi and Temple (2009) who study informality in Mexico using a closed economy model and set $\mu = 0.5$. This is also the value most commonly used in the literature. In the robustness checks, I will use the higher value of $\mu = 0.66$ from Meghir et al. (2015) as well.

4.3 Solving for the entry fixed costs into the formal sector

To bring the model to the data, I first solve for the level of the entry fixed costs into the formal sector, f_j^f, by using Equation (1). For this, I calculate the formality wage premium, w_j^f/w_j^i, as well as the probability of becoming unemployed in the formal sector, u_j. Following the model, the latter is given by the ratio of the number of unemployed workers to the number of workers in the formal sector, as all informal sector workers cannot become unemployed. I report these in Table 2.

[37] More recent estimates use data on U.S. job vacancies from the Job Openings and Labor Turnover Survey (JOLTS) and lie in the range between 0.32 and 0.72 (see Rogerson and Shimer, 2011 and Borowczyk-Martins et al., 2013).

Table 2: Formal and informal sector statistics

Country	u_j^f	L_j^i/L_j	w_j^f/w_j^i	$f_j^f w_j^f/w_j^i$
Argentina	0.11	0.34	1.77	0.59
Bolivia	0.11	0.57	2.22	0.97
Brazil	0.09	0.25	2.13	0.96
Colombia	0.15	0.38	2.52	1.15
Costa Rica	0.04	0.21	1.74	0.67
Dominican Rep.	0.05	0.36	1.59	0.50
Ecuador	0.11	0.46	1.58	0.41
El Salvador	0.06	0.32	2.11	0.99
Nicaragua	0.14	0.51	1.41	0.22
Paraguay	0.16	0.63	2.11	0.78
Peru	0.08	0.47	2.42	1.22
Uruguay	0.09	0.17	1.85	0.70
Venezuela	0.11	0.34	1.36	0.21

Notes: Formal and informal sector statistics for 13 Latin American and Caribbean countries in (roughly) 2006. u_j^f is the probability of becoming unemployed in the formal sector. L_j^i/L_j is the share of informal workers. w_j^f/w_j^i is the formal to informal sector wage ratio. $f_j^f w_j^f/w_j^i$ is the monetary formal sector entry cost in multiples of the informal sector wage. For details about the data sources used and the calculation see Section 4.2.

4.4 Estimating the informal sector productivity elasticity

To get an estimate of the informal sector productivity elasticity, we can log-linearize Equation (7) and shuffle terms to receive an estimable equation for α:

$$\ln\left(\frac{w_j^f}{w_j^i}\right) - \ln\left(\frac{1+\gamma_j\xi_j-\gamma_j}{\xi_j}\right) = \alpha_0 - \alpha\ln\left(\frac{L_j^f}{L_j}\right) + \eta_j, \tag{25}$$

where I have added a constant term α_0 as well as a stochastic error term η_j. Table 3 reports the estimates. For these regressions, I use a panel of all countries included in SEDLAC for the years 1989 to 2013. To maximize the number of observations, I set $\gamma_j = 0$ for these regressions. As explained above, given the near absence of unemployment benefits in Latin America and the Carribean, this is not unduly restrictive.

Columns (1) to (3) present estimates which use data on the formality wage premium and the formality share using a productive definition of informality, columns (4) to (6) use a legal definition. Column (1) presents pooled OLS estimates. I estimate $\alpha = 0.384$ (note that the regression actually estimates $-\alpha$). This implies that an increase in the formal sector share of 1 percent increases the productivity in the informal sector by about 0.4 percent.

As the formality premium is jointly determined with the formality share in equilibrium, using OLS may well deliver biased estimates of α. Therefore, in column (2) I reestimate Equation (25) by including country fixed effects exploiting the panel dimension. As the formality premium in the data is very likely determined by unobserved country-specific factors, the fixed effects regression should mitigate the endogeneity problem. The estimate of α increases to 0.421. In column (3), I address the endogeneity head on by using the dynamic panel estimator from Arellano and Bond (1991) which exploits the panel structure by using internal instruments to tackle the endogeneity of the formality share. Using this method, α remains highly significant and increases even further to 0.576. I also report p-values of tests on autocorrelation in the

differenced error terms which do not invalidate the internal instruments used by the dynamic panel estimator. Reestimating the models using data based on a legal definition of informality, I find slightly smaller estimates of α which remain significant. Note that the legal definition data are only available for a smaller set of countries and years, hence the lower number of observations.

Evidently, the proposed model to estimate α is very coarse and more descriptive realism on the labor market side could be added by using worker-level data sets. This added realism, however, would come at the cost of losing the cross-country character of the present study which allows to take into account general equilibrium and third country effects. As comparable worker-level data sets for several countries are hard to come by, the present method to estimate α should be seen as complementary to more detailed country case studies.

Table 3: Estimation results for the informal sector productivity elasticity for a panel of Latin American and Caribbean countries

	informality					
	productive definition			legal definition		
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	FE	Diff. GMM	OLS	FE	Diff. GMM
$-\alpha$	-0.384***	-0.421**	-0.576**	-0.183***	-0.572**	-0.312***
	(0.049)	(0.146)	(0.281)	(0.048)	(0.175)	(0.064)
$y_{i,t-1}$			0.354**			0.535***
			(0.172)			(0.116)
α_0	1.035***	1.005***	0.420***	1.061***	0.811***	0.377***
	(0.039)	(0.118)	(0.099)	(0.046)	(0.112)	(0.128)
AR(1)			0.045			0.172
AR(2)			0.777			0.118
$\bar{R}^2$	0.301	0.095		0.120	0.253	
N	135	135	85	77	77	46

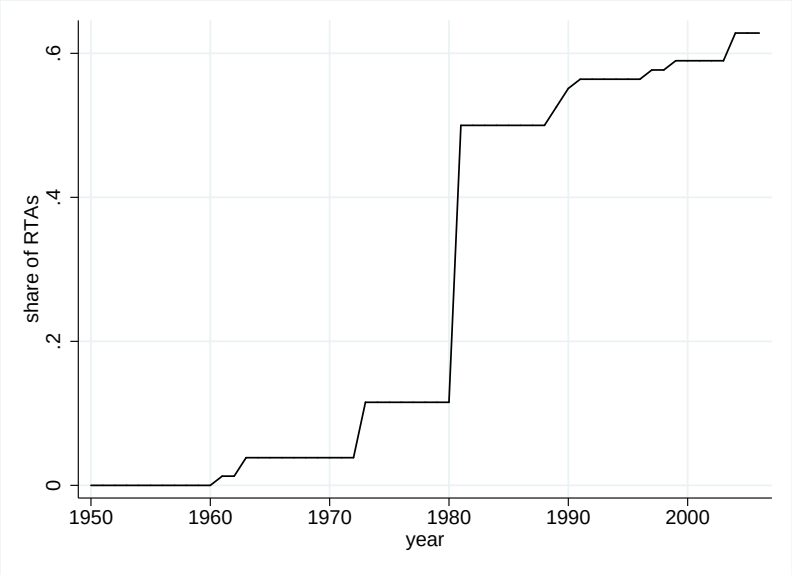
Notes: Results for the regression given in Equation (25) for a panel of Latin American and Caribbean countries from 1989 to 2013. OLS indicates estimates using pooled OLS; FE indicates country-fixed effects regressions; Diff. GMM indicates the Arellano and Bond (1991) dynamic panel estimator. The latter treats the regressor for $-\alpha$ as endogenous. AR(1) and AR(2) report the p-values of the tests for autocorrelation in the first differenced residuals for orders 1 and 2. Robust standard errors in parentheses, *** $p<0.01$., ** $p<0.05$.

5 Evaluation of Latin American regional trade agreements

In the following, I will evaluate the welfare and employment effects of the regional trade agreements which have been signed between the 13 Latin American and Caribbean countries since 1950. Figure 1 shows the proliferation of regional trade agreements between these countries by depicting the share of country pairs with an agreement. The first trade agreement was signed in 1961, after which the number of agreements slowly increased. In 1981, the

share of country pairs with an agreement jumped from little more than 10 percent to more than 50 percent. Since then, there was a steady increase to reach more than 60 percent of all country pairs at the turn of the century. The counterfactual situation I will consider is a world without any regional trade agreement. I will compare this situation with the observed agreements in place in 2006. I report results from this counterfactual exercise in Table 4. It shows the effect of trade liberalization, i.e. changes are calculated as moving from the counterfactual scenario to the observed data. The table is organized as follows: The column labeled $\Delta\%e_j^f$ reports the percentage change in the probability of finding a job in the formal sector. $\Delta\%pts\,u_j^f$ gives the according change in the probability of becoming unemployed in the formal sector in percentage points. $\Delta\%w_j^f/w_j^i$ gives the percentage change in the formality premium, and $L_j^i\Delta\%$ the accompanying percentage change in the size of the informal sector. $\Delta\%pts\,u_j^o$ gives the change in the official unemployment rate in percentage points. $\Delta\%EV$ gives the percentage change in the equivalent variation. For comparison, I report the equivalent variation implied by the framework with a perfect labor market (PLM) by Anderson and van Wincoop (2003) as well as for the framework which assumes a unified labor market with search and matching frictions (SMF) from Heid and Larch (2012a). Besides values for individual countries, I report weighted average effects which use a country's labor force as weight. Concerning the elasticities, I use the same elasticity of substitution, $\sigma = 7.1$, for the calculation of all three equivalent variation measures, and set the same elasticity of the matching function, $\mu = 0.5$, for both the model with informality and the framework from Heid and Larch (2012a). I set the productivity elasticity of the informal sector to 0.576, the value from column (3) of Table 3. To specify the trade cost function, I use the parameter estimates from column (4) of Table 1.

On average, I find that switching on regional trade agreements increases employment in the formal sector by 5.8 percent, and the according probability of becoming unemployed in the formal sector decreases by 4.7 percentage points. As trade liberalization brought about by the regional trade agreements makes the formal sector more attractive, the indifference condition given in



Notes: Share of country pairs covered by a regional trade agreement (RTA) in a sample of 13 Latin American and Caribbean countries. For a description of data sources, see Section 4.

Figure 1: Share of country pairs covered by regional trade agreements

Equation (1) implies that the formality wage premium has to decrease in order to restore the equilibrium. On average, I find that the formality premium decreases by 9.3 percent due to the shrinking productivity gap between the formal and informal sector. The change in the formality premium in turn implies a change in the share of formal workers. On average, the informal sector is reduced by 20.3 percent. This is a large effect of trade liberalization. Results from individual country case studies which use detailed worker-level data find much more modest effects of trade liberalization on informality, if at all. For example, Attanasio et al. (2004) find that informal employment in Colombia in 1998 is 4.4 percentage points larger due to tariff reductions compared to 1984. Bosch et al. (2012) find that trade liberalization accounts for 1-2.5 percent of the increase in informality in Brazil during the 1990s. Contrary to that, Goldberg and Pavcnik (2003) find no effect of trade liberalization on informality in Brazil during the same period. Note, however, that these results are not directly comparable as they use tariff reductions to model trade liberalization which might be unilateral and not necessarily linked to regional trade agreements. Also, the mentioned papers only study trade liberalization episodes in the mid 1980s to 1990s, whereas I evaluate the effect of regional trade agreements signed since 1950. As the largest increase in the number of regional trade agreements happened in 1981, it may well be that the effects of trade liberalization on informal employment are different from those from later periods of trade liberalization.

As the probability of becoming unemployed is reduced by the regional trade agreements, workers move into the formal sector. The combined effect on the official unemployment rate is given in column $\%pts\, u_j^o$ in percentage points. On average, the official unemployment rate is 1.2 percentage points lower. In Section 6, I investigate under which parameter constellations the official unemployment rate may increase after trade liberalization.

Finally, we can turn to the changes in the equivalent variation, our welfare measure. I find that on average, welfare increases by 11.7 percent.

This stands in contrast to the frameworks which either assume full employment or a unified labor market with search frictions. Both frameworks

find that welfare on average is increased by 6.3 percent with full employment and 12.6 percent with search frictions, in line with the relative magnitudes of effects by Heid and Larch (2012a). Evidently, the presence of labor market frictions increases the gains from the reduction in trade costs brought about by regional trade agreements. This is in line with the model by Davidson and Matusz (2009) who also show that higher labor market frictions increase the benefits from liberalizing trade. Interestingly, even though the labor market setup in my framework is remarkably different due to the inclusion of an informal sector, average welfare implications are roughly in the same ball park as those from Heid and Larch (2012a). However, this similarity only holds for the averages. The individual country effects of regional trade agreements are both quantitatively and qualitatively different across the model setups. For example, I find negative welfare effects for the Dominican Republic and El Salvador whereas both the frameworks of Anderson and van Wincoop (2003) and Heid and Larch (2012a) would ascertain positive welfare effects for these countries. This highlights the importance of taking into account the heterogeneity in labor markets across countries to evaluate trade liberalization episodes.

It can also be seen that the change in the size of the informal sector varies substantially across countries: whereas Uruguay sees its informal sector reduced by 64 percent, the Dominican Republic actually experiences an increase in the informal sector by 1.7 percent.

The Dominican Republic also experiences an increase in its official unemployment rate by 0.2 percent after the trade liberalization episode. This may explain the fact that politicians fear a net increase in unemployment due to trade liberalization, especially in countries with a large informal sector.

As a robustness check, I redid the counterfactual analysis assuming balanced trade between the 13 countries. Results hardly change. I report these results in Table 7 in the Appendix.

Summing up, I find that regional trade agreements have reduced the informal sector, decreased the official unemployment rate, and increased welfare in most countries in the sample. Obviously, the presented, highly stylized framework should no be taken as a literal description of the reality of experiences in

Latin America and the Caribbean brought about by trade liberalization. However, the large quantitative and qualitative difference in the welfare effects as compared with standard quantitative trade models highlights the importance of assumptions about the structure of labor markets for the evaluation of regional trade agreements and trade liberalization in general.

6 Robustness check: sensitivity to elasticities

The quantitative and qualitative results of the counterfactual exercise depend on the interplay between three key elasticities: the elasticity of substitution, σ, the elasticity of the matching function, μ, and the productivity elasticity of the informal sector, α. To investigate the sensitivity of my results, I redo the counterfactual exercise by varying these elasticities across a wide range of parameter values. The results of these robustness checks are presented in Table 5. I report the average results from the counterfactual exercise for different values of the elasticities. Columns depict the same quantities as in Table 4. The four rows at the top depict results for $\sigma = 7.1$. The lower four rows redo the counterfactual setting $\sigma = 5$, the preferred value from Anderson and van Wincoop (2003). Across all parameter values, the standard result that a higher substitutability between varieties of goods decreases the welfare gains of trade across all three models (informal sector, perfect labor markets, search and matching frictions) is confirmed. More interestingly, the model with the informal sector is more sensitive to variations in the elasticity of substitution when compared to the two other frameworks. For example, comparing case 1 and case 5, i.e. reducing σ from 7.1 to 5 roughly doubles the welfare gains from the preferential trade agreements. The standard Anderson and van Wincoop (2003) framework implies a less stark increase in the welfare gains. The same picture emerges when comparing column 2 and 6 and so forth.

Roughly halfing the productivity elasticity of the informal sector from 0.58 to 0.31 (case 1 and case 2), i.e. from the value from column (3) to column (6) in Table 3, we see that the welfare gains decrease. As the productivity catch up the informal sector becomes slower, the reorientation of workers into

Table 4: Comparative static effects of switching on all observed RTAs in 2006

Country	$\Delta\%e_j^f$	$\Delta\%pts\,u_j^f$	$\Delta\%w_j^f/w_j^i$	$\Delta\%L_j^i$	$\Delta\%pts\,u_j^o$	$\Delta\%EV$	$\Delta\%EV(PLM)$	$\Delta\%EV(SMF)$
Argentina	9.9	-8.0	-12.9	-29.0	-2.6	16.6	10.8	21.5
Bolivia	22.6	-16.4	-36.3	-29.0	-0.6	85.9	25.0	49.4
Brazil	2.0	-1.8	-3.6	-15.9	-0.9	1.4	2.2	4.4
Colombia	8.7	-6.8	-17.3	-31.3	-0.5	17.6	9.5	18.8
Costa Rica	0.4	-0.3	-0.6	-3.7	-0.2	-0.5	0.4	0.9
Dominican Rep.	-0.4	0.4	0.6	1.7	0.2	-1.5	-0.4	-0.6
Ecuador	9.0	-7.4	-11.7	-18.6	-2.1	17.9	9.9	19.8
El Salvador	0.5	-0.5	-1.0	-3.5	-0.2	-0.1	0.5	1.1
Nicaragua	13.4	-10.2	-14.4	-18.6	-2.3	27.9	14.9	29.6
Paraguay	21.1	-14.7	-30.9	-21.5	-0.1	73.3	23.4	46.4
Peru	10.0	-8.3	-20.1	-26.6	-1.6	28.1	10.8	21.5
Uruguay	19.1	-14.5	-23.5	-63.8	-4.6	25.8	21.5	42.8
Venezuela	6.1	-5.1	-6.9	-18.8	-2.1	8.4	6.7	13.2
Average (L_j-weighted)	5.8	-4.7	-9.3	-20.3	-1.2	11.7	6.3	12.6

Notes: Counterfactual analysis based on parameter estimates from column (4) of Table 1 and column (3) of Table 3. PLM gives results assuming perfect labor markets. SMF gives results using a unified labor market with search and matching frictions. Averages are weighted averages using a country's labor force as weight.

the more productive formal sector translates more slowly into higher welfare. Accordingly, the informal sector reduces by a larger amount (31.1 versus 21.4 percent).

When we change the matching elasticity from the default value of 0.5 to the estimate of 0.66 from Meghir et al. (2015) (case 1 and case 3), i.e. we reduce the amount of formal labor market search frictions, welfare gains decrease.

Case 6 is an especially interesting case as the official unemployment rate actually increases when switching on all observed preferential trade agreements. In this case, the increase in the employment probability in the formal sector does not outweigh the influx of more workers into the formal sector of the economy. In sum, the two effects combine to increase the official unemployment rate by 0.2 percentage points. The chosen parameter values for σ and μ are quite standard and also α lies in the middle of the range of estimates from Table 3. Hence, the possibility that trade liberalization may actually increase official reported unemployment rates even though formal employment possibilities go up is not a mere theoretical possibility but may plausibly occur in the data.

7 Conclusion

The standard tools to evaluate the welfare effects of trade liberalization episodes and regional trade agreements are structural gravity models. State of the art quantitative frameworks assume perfect labor markets. Recently, Heid and Larch (2012a) introduced search and matching frictions into a structural gravity model and evaluate regional trade agreements between developed OECD countries. I extend their framework to include an informal sector, a decisive feature of labor markets in emerging economies. I apply this framework to a set of 13 Latin American and Caribbean countries to evaluate the employment and welfare effects of regional trade agreements. I find that the regional trade agreements which have been signed since 1950 have, on average, increased welfare by 11.7 percent, decreased informal employment by 20.3 percent, and decreased the official unemployment rate by 1.2 percentage points. These re-

Table 5: Sensitivity of comparative static effects of switching on all observed RTAs in 2006—average effects

	$\Delta\%e_j^f$	$\Delta\%pts\,u_j^f$	$\Delta\%w_j^f/w_j^i$	$\Delta\%L_j^i$	$\Delta\%pts\,u_j^o$	$\Delta\%EV$	$\Delta\%EV(PLM)$	$\Delta\%EV(SMF)$
$\sigma =$ ***7.10***								
case 1: $\mu =$***0.50,*** $\alpha =$***0.58***	6.3	-5.1	-10.1	-21.4	-1.2	12.4	6.3	13.1
case 2: $\mu =$***0.50,*** $\alpha =$***0.31***	6.3	-5.1	-10.1	-31.1	-0.1	7.0	6.3	13.1
case 3: $\mu =$***0.66,*** $\alpha =$***0.58***	3.2	-2.7	-5.3	-13.0	-0.8	8.7	6.3	9.8
case 4: $\mu =$***0.66,*** $\alpha =$***0.31***	3.2	-2.7	-5.3	-20.5	-0.2	5.3	6.3	9.8
$\sigma =$ ***5.00***								
case 5: $\mu =$***0.50,*** $\alpha =$***0.58***	9.8	-7.5	-14.9	-28.3	-1.5	23.9	9.9	20.9
case 6: $\mu =$***0.50,*** $\alpha =$***0.31***	9.8	-7.5	-14.9	-38.7	0.2	16.6	9.9	20.9
case 7: $\mu =$***0.66,*** $\alpha =$***0.58***	4.9	-4.0	-8.0	-18.1	-1.1	14.7	9.9	15.5
case 8: $\mu =$***0.66,*** $\alpha =$***0.31***	4.9	-4.0	-8.0	-27.1	-0.2	9.9	9.9	15.5

Notes: Counterfactual analysis based on parameter as indicated, allowing for trade imbalances. PLM gives results assuming perfect labor markets. SMF gives results using a unified labor market with search and matching frictions. Averages are weighted averages using a country's labor force as weight.

sults are quantitatively and qualitatively different from standard frameworks assuming either full employment or a unified labor market with search and matching frictions.

Similar to single country studies by Goldberg and Pavcnik (2003) and Attanasio et al. (2004), my results highlight the importance of labor market institutions for evaluating the consequences of trade liberalization for welfare in general and informal employment in particular.

A potential avenue for future research is to consider the agricultural sector to quantify the classic Harris and Todaro (1970) view of informality. In such a framework, workers would choose between secure employment in the agricultural sector or in the urban manufacturing sector where there is a probability of becoming unemployed. The urban unemployed work in the informal sector. Another avenue for further research could be taking into account tariff liberalization in addition to regional trade agreements within a multi-sector framework for trade flows. This setup would allow to evaluate the economy-wide effects of sectoral trade liberalization episodes, e.g. for rurally produced agricultural goods versus manufacturing goods produced in urban areas. In such a framework, if trade liberalization decreases the probability of becoming unemployed, informal sector size may increase or decrease, depending on the net effect of rural to urban migration, similar to the effect on the official unemployment rate in the present manuscript.

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A Computational details about the system of equations of the multilateral resitance terms and the counterfactuals

In the following, I describe the algorithm for computing the counterfactual changes in the informality rate, unemployment, GDP, etc. It is essentially identical to the one given in Anderson and van Wincoop (2003).

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

$$\tilde{\Pi}_i \equiv \left(\sum_{j=1}^{n} \left(\frac{t_{ij}}{\tilde{P}_j} \right)^{1-\sigma} \tilde{\theta}_j \right)^{1/(1-\sigma)}, \quad \tilde{P}_j \equiv \left(\sum_{i=1}^{n} \left(\frac{t_{ij}}{\tilde{\Pi}_i} \right)^{1-\sigma} \theta_i \right)^{1/(1-\sigma)}.$$

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

$$\theta_i = \mathfrak{k}_i \sum_{j=1}^{n} t_{ij}^{1-\sigma} \mathfrak{P}_j, \quad \tilde{\theta}_j = \mathfrak{P}_j \sum_{i=1}^{n} t_{ij}^{1-\sigma} \mathfrak{k}_i, \tag{26}$$

where I have defined $\mathfrak{P}_j \equiv \tilde{P}_j^{\sigma-1} \tilde{\theta}_j$ and $\mathfrak{k}_i \equiv \tilde{\Pi}_i^{\sigma-1} \theta_i$.[38] The equations given in (26) constitute a system of $2n$ equations in the n unknowns $\mathfrak{P}_j$ and the n unknowns $\mathfrak{k}_i$ which can be solved by standard nonlinear equation solvers.

The steps to compute the counterfactual values are as follows:

1. Having estimated the gravity equation given in Equation (24), one can obtain an estimate of the trade cost matrix (risen to the power of $1-\sigma$), $t_{ij}^{1-\sigma}$, in the observed baseline scenario. Given this estimate as well as the observed income shares, θ_js and $\tilde{\theta}_j$s, in the data, one can solve the system of equations given in Equation (26) for the vector of unknown $\mathfrak{k}_i$s and $\mathfrak{P}_j$s in the baseline scenario.

2. After changing the trade cost matrix (or any other model parameter) to the values of the unobserved counterfactual, one has to resolve the system of equations given in Equation (26) for the now counterfactual values of the $\mathfrak{k}_i$s and $\mathfrak{P}_j$s. However, in this solution for the counterfactual situation, one has to take into account general equilibrium effects, i.e. the changes in GDPs, and the associated income shares in the counterfactual, θ_j^c. To calculate the change in the income shares, one has to take into account the counterfactual change in GDPs by multiplying the observed GDPs in the data by the counterfactual change in GDP implied by the model as given in Equation (21).

[38] For a derivation see Heid and Larch (2012a).

3. Having obtained the solution, one can calculate counterfactual changes according to the formulae given in the main text, normalizing nominal variables by a numéraire, as the system of equations given in Equation (26) determines the solutions only up to a scalar due to Walras' law.

B Summary statistics gravity data set

Table 6: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
$x_{ij\tau}$	76.500	428.768	0	12,885.180	8,743
$z_{ij\tau}$	4.61×10^{-7}	2.08×10^{-6}	0	4.34×10^{-5}	8,743
$RTA_{ij\tau}$	0.282	0.450	0	1	8,743
$\ln DIST_{ij\tau}$	7.864	0.676	5.854	8.759	8,743
$CONTIG_{ij}$	0.220	0.414	0	1	8,743

Notes: Summary statistics for the sample of 13 Latin American and Caribbean countries from 1950 to 2006. The 13 countries included are: Argentina, Boliva, Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Nicaragua, Paraguay, Peru, Uruguay, Venezuela. Data are from Head et al. (2010).

C Comparative static results with balanced trade

Table 7: Comparative static effects of switching on all observed RTAs in 2006, balanced trade

Country	$\Delta\%e_j^f$	$\Delta\%pts\,u_j^f$	$\Delta\%w_j^f/w_j^i$	$\Delta\%L_j^i$	$\Delta\%pts\,u_j^o$	$\Delta\%EV$	$\Delta\%EV(PLM)$	$\Delta\%EV(SMF)$
Argentina	9.9	-8.0	-12.9	-29.0	-2.6	16.6	10.8	21.5
Bolivia	22.5	-16.3	-36.2	-29.0	-0.6	85.4	24.9	49.2
Brazil	2.0	-1.8	-3.6	-15.8	-0.9	1.4	2.2	4.4
Colombia	8.7	-6.8	-17.2	-31.2	-0.5	17.5	9.4	18.7
Costa Rica	0.3	-0.3	-0.6	-3.5	-0.2	-0.6	0.3	0.9
Dominican Rep.	-0.4	0.4	0.6	1.8	0.2	-1.5	-0.5	-0.7
Ecuador	9.1	-7.4	-11.7	-18.7	-2.1	18.0	10.0	19.9
El Salvador	0.5	-0.5	-1.0	-3.5	-0.2	-0.2	0.5	1.1
Nicaragua	13.7	-10.4	-14.7	-18.9	-2.3	28.6	15.3	30.3
Paraguay	21.3	-14.8	-31.2	-21.6	-0.1	74.3	23.7	46.8
Peru	10.0	-8.4	-20.2	-26.7	-1.6	28.4	10.9	21.6
Uruguay	19.3	-14.6	-23.7	-64.0	-4.6	26.1	21.7	43.3
Venezuela	6.1	-5.1	-6.9	-18.9	-2.1	8.5	6.7	13.3
Average (L_j-weighted)	5.8	-4.7	-9.3	-20.2	-1.2	11.7	6.3	12.6

Notes: Counterfactual analysis based on parameter estimates from column (4) of Table 1 and column (3) of Table 3. PLM gives results assuming perfect labor markets. SMF gives results using a unified labor market with search and matching frictions. Averages are weighted averages using a country's labor force as weight.