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## Regional Trade Agreements, conflits and Welfare

Geoffroy Guepie

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# THÈSE

UNIVERSITE DE PAU ET DES PAYS DE L'ADOUR  
École doctorale Sciences Sociales et Humanités (481)

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*Sur le sujet :*

## Accords Régionaux de Commerce, Conflits et Bien-être

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# Regional Trade Agreements, conflicts and Welfare

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## **Abstract**

This thesis aims to contribute to recent debates on the potential benefits of trade openness among African countries. This, by addressing the triptych regional trade agreements, welfare and conflict.

The African continent is currently facing two major governance challenges: regional integration and the management of armed conflicts. Indeed, the trade performance of African countries remains marginal compared to the rest of the world. This is despite the different trade policies implemented since the 1970s (import substitution policy, North-South regional agreement, etc.). Among these trade policies, African governments have decided to focus on regional agreements in order to increase trade among member countries. Have these agreements had the expected effect ? To what extent ?

If we refer to popular belief, the answer seems to be no. However, this answer ignores the potential political benefits of trade openness. As such, the work presented here first examines the effect of African regional agreements on trade and welfare. This is done using the latest developments in international trade theory and the best techniques for estimating gravity equations. Second, we analyze both theoretically and empirically the effect of increased trade on the probability of a civil war occurring . The results obtained allow us to conclude, on the one hand, that nearly half of the trade between members of trade agreements in Africa would not have been possible without the signing of the RTAs.

On the other hand, both domestic and international trade, reduces the risk of civil conflict in Africa.

## **Abstract**

Cette thèse vise à contribuer aux récents débats sur les avantages potentiels de l'ouverture commerciale entre les pays Africains. Elle le fait en abordant la triptyque accords régionaux de commerce, bien-être et conflits.

Le continent Africain fait face aujourd'hui à deux enjeux majeurs de gouvernance : l'intégration régionale et la gestion des conflits armés. En effet, les performances commerciales des pays africains restent toujours marginales comparativement au reste du monde. Et ce, malgré les différentes politiques commerciales mises en œuvre depuis les années 70 (politique d'import-substitution, accord régional nord-sud, etc...). Parmi ces politiques commerciales, les gouvernements Africains ont décidé de privilégier les accords régionaux en vue d'accroître le commerce entre les pays membres. Ces accords ont-ils eu l'effet escompté ? Dans quelle mesure ?

Si on se réfère au point de vue largement partagé, la réponse semble être négative. Cependant cette réponse ignore les bénéfices politiques potentiels de l'ouverture commerciale. A ce titre, le travail présenté ici étudie l'effet des accords régionaux africains sur le commerce et le bien-être. Cela en utilisant les derniers développements de la théorie du commerce international ainsi que les meilleures techniques d'estimations des équations de gravité. Deuxièmement, Nous analysons l'effet de l'augmentation du commerce sur la probabilité de survenance d'une guerre civile à la fois de façon théorique et empirique. Les résultats obtenus, nous permettent de conclure que sans la signature des ACRs, près de la moitié des échanges entre leurs membres n'auraient pas été réalisés.

D'autre part, cette thèse affirme que le commerce, à la fois domestique et international permet de diminuer le risque de conflit civil en Afrique.

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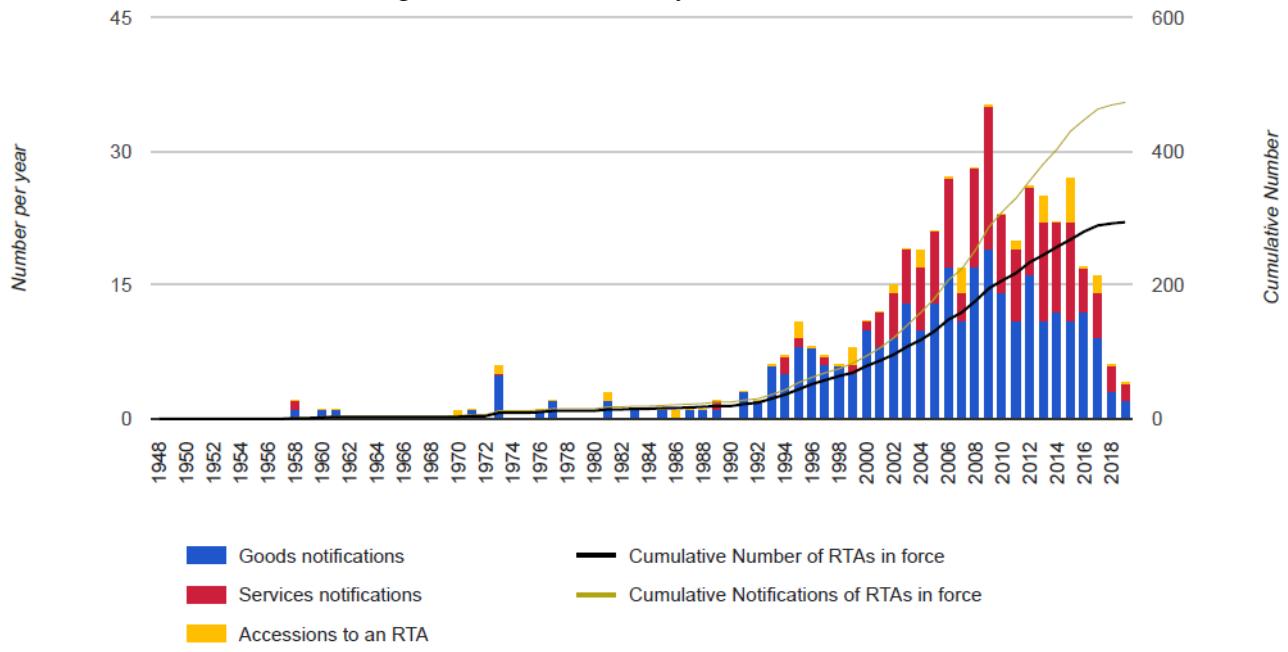
# **Part I**

## **General Introduction**

Since the 1950s, the World market has become highly integrated. This process of globalization is mainly due to an increase in demand fuelled by economic growth (Baier and Bergstrand 2001) and to a lesser extent, a decrease in transportation costs (Hummels 2007, Limao and Venables 2001), communication costs (Fink et al 2005, Harris 1995) and extant trade policies (Anderson and Yotov 2016).

Regarding trade policies, the proliferation of Regional Trade Agreements (RTA) since the Second World War is particularly striking (see Figure 1). The increased regionalisation may be explained by many factors: according to Bergsten (1996, 2002), RTAs are used by governments as an alternative to multilateralism which is more costly and time-consuming to implement. In response to the failure of import-substitution policies in the 1970s (Baldwin 2011, Bruton 1998), regional agreements have also been used as a substitute to promote trade in most developing countries. The expansion of RTAs can also be explained by the fact that discrimination against non members can lead them to join existing RTA or to create a new one. This argument is well known as domino theory of regionalisation (Baldwin 1995).

Figure 1: RTAs currently in force



Notes : Notifications of RTAs: goods, services and accessions to an RTA are counted separately. The cumulative lines show the number of RTAs/notifications currently in force.  
source : World Trade Organization (WTO) secretariat

Increased RTAs also occurred in Africa which has not remained on the fringe of the regionalisation wave. Since the creation of the East African Community (EAC) in 1917 between Kenya and Uganda, several agreements have been set up in different geographical

---

blocks of the continent. Firstly, with the political objective of facilitating continental unity after the colonial period, then the aspiration to increase trade and foster growth. However, the conviction that RTA stimulates trade between member countries, (Anderson et al 2007, Bergstrand et al 2015) appears to have less support in Africa. The conventional wisdom seems to be that many of the RTAs enforced have been inefficient and this seems to draw support from trade figures given by African union. Indeed, Africa contributes about 3% of world trade and only 15% of African trade is intra-zone which is well below other continental areas. Therefore improving regional trade agreement seems to be a key strategy for governments and inter-state organisations. The economic justification behind this logic is that the enforcement of trade agreements by removing tariff may lead to more economies of scale, access to a wider market and thus directly increase the volume of trade. Indirectly, African trade agreements could allow the continent greater negotiation power with the rest of the world, more and more specialization in production, more efficient transport system and stronger economic growth. Therefore, in addition to the direct effect that a regional agreement can have on trade, its welfare impact should also be taken into account before concluding about its effectiveness.

The pioneering work of Viner (1950) is quite informative about the effects of a trade agreement on well-being: according to Viner, the implementation of a trade agreement can potentially have two effects; a trade creation effect and a trade diversion effect. Trade creation comes from the fact that following the tariff reduction between new members, (say countries A and B), country A will import new goods that were not imported before. However, as a result of the tariff reduction between A and B, country A, which previously imported goods from the rest of the world, will now import the same goods from country B. This trade diversion is a loss for consumers in country A because it represents a switch of the import from a country where production cost is lower to a country where production cost is higher. However, empirical studies of the trade creation and trade diversion suffer statistical bias. We address these biases by taking into account possible unobservable export costs that may jointly explain trade with RTAs.

The content of RTAs has changed over time: in addition to standard gain described precedently, RTA can promote peace in two ways; directly by clauses on the preservation of peace and the establishment of a regional army as in Economic Community of West African States (ECOWAS) and indirectly by increasing trade between member countries. This idea that trade promote peace is an old debate dating back to Montesquieu and are generally opposed to realist conception of the role of economic interdependence in the probability of waging war. The second part of this thesis is devoted to this question.

From a liberal perspective, two dependent states have no interest in engaging in war

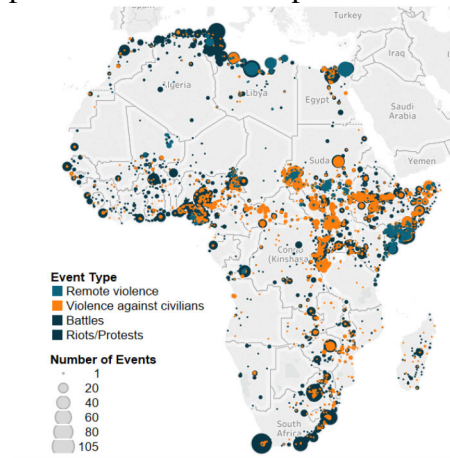


since a state's main objective is to maximize welfare through trade. The underlying economic argument being that the more countries trade with each other, the more they increase the opportunity cost of war (Martin et al 2012). From the point of view of realist theory, the main objective of each state is to maximize its security. As a result, the commercial interdependence relationship would make partners more vulnerable and each state would therefore compensate for this economic vulnerability through military power. This makes trade a mechanism for promoting war. This theoretical tradeoff is also found in empirical studies. Using the usual ratio of trade to GDP, Oneal and Russett (1997, 1999) find that increasing trade (interdependence) reduces the probability of war escalation while Barbieri (1996, 2002) conclude the reverse. But all these studies raise some doubts about the accuracy of their results. The different specifications fail to control for reverse causality and time-invariant characteristics that can explain the escalation of war.

The influential article of Martin, Mayer and Thoenig (2008) or MMT overcomes this problem of endogeneity by using different instrumental variables, but even more interesting, the results reconcile the two theoretical aspects. More precisely they find that bilateral trade deters dyad probability of conflict appearance whatever multilateral trade enforced those probability.

The literature described previously is about bilateral conflicts. However, the analysis can be extended to political violence, which often takes the form of civil conflicts or simple protests. Then trade can also reduce civil conflicts incentive. The category of civil conflicts is interesting to analyze in Africa because as argued by MMT 2008b, civil war constitute "an endemic form of violence in poor countries" and many regions in Africa are currently facing civil conflicts (see Figure2).

Figure 2: political violence and protest in Africa , 2016



source : Armed Conflict Location & Event Data Project's (ACLED) Conflict Trends report N°55.

## 0.1 Chapter summary

The objective of this thesis is twofold. Firstly we estimate the effect of African RTA on trade and welfare, secondly we analyse the contribution of increasing african countries trade on ethnic conflict likelihood.

The question of the impact of African RTA on trade is timely because the countries of the region are negotiating a continental free trade area (CFTA) and there is renewed interest on the impact of trade agreements in this region. Also, within the gravity literature the impact of RTAs in Africa has not been convincingly answered so far. Then we attempt to use different methodologies to assess the effects of the agreements hinges on the best practices in the academic literature. Concerning conflicts, more than half of the world's nations have been affected by civil wars in the past fifty years according to Blattman and Miguel (2010). Also as regional agreement in Africa, civil conflict become very prominent in this era of terrorism.

The first chapter of this thesis shows that African Regional Trade Agreements (RTAs) ushered in an era of economic integration with strong trade creation effects over the period 1965-2012. Some agreements failed to deliver the expected trade gains, but the Common Market for Eastern and Southern Africa (COMESA), the Economic Community of West African States (ECOWAS), and the Southern African Development Community (SADC) have significantly increased trade between members. Counterfactual exercises show that RTAs have strongly affected trade costs, multilateral resistances and finally trade flows but with small effects on welfare. The changes in trade costs associated to the trade agreements

are estimated using a gravity trade equation.

However, one of the main aspects of trade agreements is the change in tariffs. Changes in tariffs have a different impact on welfare from other trade costs by generating revenues.

Then the second chapter incorporates tariffs into the analysis. But tariffs data are available only for the most recent trade agreements. This is why we focus on the most recent trade agreements named EAC.

From birth to death in the 1970s, to rebirth in the 2000s, the East African Community (EAC) had several lives. What were the economic consequences of this regional trade agreement? This chapter shows that the former EAC was inefficient in term of trade creation while on the contrary the current one has increased trade by 75%. These results are obtained with a structural gravity equation with importer-year, exporter-year effects and bilateral fixed effects. To assess the global effect of the EAC, including trade diversion and general equilibrium effects, we then use a multi-sector and multi-country model. We find that despite trade creation, the total welfare gains of the EAC is small for most countries. All members endured a depreciation of the terms of trade, trade diversion and a decrease in real wages at the exception of Kenya.

Civil wars critically depend on countries's internal or domestic characteristics: the third chapter shows that these wars can also depend on international linkages to other states. We extend a model where local and international trade integration affect the location of capital and the welfare of individuals to analyse how these changes in welfare can affect the escalation in conflicts between the two regions. We find that when capital is agglomerated in one region to the detriment of the others, trade integration (international or local) reduce the risk of civil conflicts. However, above a certain threshold, trade integration increases the conflict likelihood. When capital is equally dispersed, international trade increases the risk of conflict while the internal trade reduces it.

Finally, the contribution of the fourth chapter is to analyze the effect of domestic, regional and international trade of ethnic groups on conflicts in Africa. We first find that domestic and international trade integration have peaceful effects while regional trade integration has no impact. The second contribution is to propose a two-step approach to capture all the effects of trade integration on conflicts at the national level (e.g. on cultural change, on the environment of ethnic groups etc). We find that the effect of protectionism on national identities increases the risk of ethnic wars.

## **Part II**

# **African Regional Trade Agreement,**

## **Trade and welfare**

# Chapter 1

## The Benefits of Regional Trade Agreements in Africa

### 1.1 Introduction

For more than forty years, African countries have enforced many different Regional Trade Agreements (RTAs) that differ in their degree of integration, going from free trade areas,<sup>1</sup> to common markets<sup>2</sup>, to customs unions<sup>3</sup> and finally to monetary unions<sup>4</sup>.

What have been the effects of these agreements on trade? In the meta-analysis on RTAs undertaken by Cipollina and Salvatici (2010) and by Head and Mayer (2014), it is striking to observe that the bulk of the literature has been interested mainly in the EU, NAFTA, MERCOSUR or by RTAs in general, but not by RTAs in Africa.<sup>5</sup> Starting from the fact that trade between African countries only represents 15 percent of their exchange with the world (which is a small percentage in comparison with other continents<sup>6</sup>) the conventional wisdom

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<sup>1</sup>The Southern African Development Community (SADC)

<sup>2</sup>The Common Market for Eastern and Southern Africa (COMESA) and the East African Community (EAC)

<sup>3</sup>The Economic Community of West African States (ECOWAS)

<sup>4</sup>The West African Economic and Monetary Union (WAEMU) and the Economic and Monetary Community of Central Africa (CEMAC)

<sup>5</sup>Focusing on African trade, the review of de Melo and Tsikata (2015) and Hoekman and Njinkeu (2017) document the lack of analysis of RTAs in Africa.

<sup>6</sup>Internal trade between North American countries represents almost 50 percent of their total trade. Similar numbers can be found for Asia, while internal trade in 'Fortress Europe' with 27 countries reaches 70 percent. Finally intra-trade between South American countries is around 30 percent.

seems to be that many of the RTAs enforced have been inefficient. However, there is a long list of individual and bilateral variables that can explain the weak continental integration (specialization patterns, regional or civil conflicts, preferential agreements with developed countries, etc) that must be controlled before concluding on the usefulness of RTAs.

Using the historical data on trade compiled by Fouquin and Hugot (2016), we undertake an identification from within the dimensions of the data, i.e. a dummy of RTAs that varies over time enabling us to control for the various variables explaining trade by using country pair, importer-year, and exporter-year fixed effects. All the aforementioned RTAs in Africa enforced between 1965 and 2014 are analyzed.

We find that RTAs have provided significant trade creation without trade diversion. We find that ECOWAS, SADC and COMESA have successfully fostered trade, only the WAEMU and to a lesser extent the CEMAC have been disappointing by bringing trade diversion without creation. We also assess the impact of past agreements, and find that the current RTAs have a most significant impact on trade than previous ones. For instance, only the current version of ECOWAS is clearly beneficial to trade.

Regarding the literature, only a handful of studies have been undertaken with the aim to better control for bilateral and individual-time unobserved characteristics in Africa. Carrère (2004) provides convincing evidence of the positive effect of RTAs on African trade using a panel specification with *random* bilateral effects. In comparison in this study, unobserved *time-invariant* bilateral variables (affecting the probability of signing a RTA and/or directly the volume of trade) are taken into account with bilateral fixed effects. From an economic point of view, a gravity equation with fixed effects seems more suitable than with random effects assuming zero correlation between unobservables and RTAs.<sup>7</sup> Furthermore, following Magee (2008), *importer-year* and *exporter-year* effects are used to control for institutional and cultural determinants of trade that vary over the period analyzed. Other studies devoted

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<sup>7</sup>From an econometric point of view, there are also arguments in the literature for the rejection of a random-effects gravity model (see Egger, 2000). Furthermore models with fixed effects take into account the multilateral frictions of trade that matter to explain bilateral exports (see Fally, 2015).

to Africa, do not use all these controls to resolve the endogeneity bias of omitted variables<sup>8</sup>, work with a shorter period of time and with a smaller sample of countries.

Lastly, in comparison with the literature, we lead different counterfactual analysis removing the COMESA, the SADC and the ECOWAS with a simple quantitative trade model (Arkolakis, Costinot and Rodriguez-Clare, 2012) which has the great advantage of transparency based on a tight connection between theory, data and estimations of key parameters. This kind of model has been increasingly used to quantify the gains from trade in Europe (Mayer et al., 2019; Dhingra et al., 2017) and in North America (Caliendo and Parro, 2015) but to our knowledge has never been used to quantify trade integration in Africa. The experiment which consists to turn off dummies of RTAs in order to calculate the counterfactual trade flows for all pair, shows that the COMESA, the SADC and the ECOWAS have created a substantial volume of trade by reducing trade costs and multilateral resistances of trade. This fillip on trade flows has however brought small welfare gains (few countries have gained more than 1%). Because the initial African flows were small, even a strong increase of trade flows has a weak impact on real income. As a robustness check, we also estimate the conditional and the full general equilibrium responses of removing RTAs using the Anderson and Yotov (2016) procedure. All the results are verified showing in addition that both buyers and sellers have benefited of the enforcement of RTAs.

The remainder of the paper is organized as follows. In Section II, the data and the empirical strategy is presented. Section III discusses the main results regarding trade creation. Section IV presents the counterfactual analysis and the final section outlines the study's conclusion.

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<sup>8</sup>Following Anderson and van Wincoop (2003) only individual fixed effects are introduced and not importer/exporter time effects

## 1.2 Trade and Regional Trade Agreements in Africa

### 1.2.1 Empirical strategy

From neoclassical models of trade with perfect competition to new trade theories with increasing returns to scale, many different models display a gravity equation that takes the following form:

$$X_{od} = \phi_{od} \frac{Y_o}{\Pi_o^{1-\sigma}} \frac{Y_d}{P_d^{1-\sigma}} \quad (1.1)$$

where  $\sigma$  is the elasticity of substitution between varieties ( $\sigma > 1$ ),  $\phi_{od}$  an inversed measure of trade costs  $\tau_{od}$  ( $\phi_{od} = \tau_{od}^{1-\sigma}$  i.e an indicator of trade openness) between  $o$  and  $d$ ,  $Y_d$  and  $Y_o$  the aggregated expenditures/incomes at the destination of exports  $d$  and at origin  $o$ .  $\Pi_o^{1-\sigma}$  represents the market potential in  $o$ . This term is sometimes considered as an indicator of the market access from  $o$  and/or called outward multilateral resistance because it represents a GDP share weighted measure of trade cost resistance that exporters in  $o$  face when shipping their goods to consumers on their own and outward markets. Concerning African RTAs, this term may matter since the recent History of Africa (e.g. slavery, colonialism, preferential trade agreements<sup>9</sup>) has affected bilateral trade costs between African countries *relatively* to trade costs with distant countries. The term  $P_d^{1-\sigma}$  in this gravity equation (1.1) is the accessibility-weighted sum of exporters- $o$  capabilities also called inward multilateral resistance since it is a reversed measure of the openness of a nation to import from the world. Anderson and Yotov (2010) also consider this term as the buyers' incidence because it represents the weighted sum of trade costs paid by buyers.

This gravity equation is estimated using the pseudo-maximum likelihood (PML) esti-

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<sup>9</sup>The first Generalized System of Preferences were non-reciprocal schemes implemented by the European Economic Community and Japan in 1971 and by the USA in 1976, i.e. only a few decades after the wave of independances, to facilitate LDCs access to markets of rich countries. See Candau and Jean (2009) for a detailed analysis on the utilisation of these trade preferences in Africa.



mator as follows:

$$X_{odt} = \exp(\alpha + f_{ot} + f_{dt} + \phi_{odt} + \epsilon_{odt}) \quad (1.2)$$

where  $f_{ot}$  and  $f_{dt}$  are time-varying countries-specific effects approximating exporting and importing capacity,  $Y_{o,s}/\Pi_{o,s}^{1-\sigma_s}$  and  $E_{d,s}/P_{d,s}^{1-\sigma_s}$  in Equation (1.1) at time  $t$ ,  $\alpha$  is a constant.

Subscripts  $o$  and  $d$  represent all countries in the world, and the dummy variable  $RTA_{odt}$  takes 1 at the year  $t$  when a regional agreement between these countries enters into force and zero otherwise.

To control for other bilateral relationships, binary bilateral variables are used i.e. dummies for colonial links, borders, common language and physical distance. Since this strategy raises doubts regarding the possibility of omitted variables, we compare results with estimations including bilateral fixed effects  $f_{od}$  to control for all unobserved time-unvarying bilateral determinants of exports (Baier and Bergstrand, 2007; Magee, 2008).

Consequently trade costs in (1.2) take the following form:

$$\phi_{odt} = \psi_1 RTA_{odt} + \psi_2 RTA_{odt} AFR_{od} + f_{od} \quad (1.3)$$

where the dummy  $AFR_{od}$  taking value 1 for african pairs, in interaction with the dummy of RTAs ( $RTA_{odt}$ ), captures the trade creation effect of African RTAs. In addition to individual-time fixed effects (see, 1.2) that control for several individual variables varying over time (such as change in internal infrastructures or internal conflicts) here we consider bilateral fixed effects that aim to take into account bilateral relationships that are constant over time.

### 1.2.2 Data and estimators

While regional trade agreements have strongly boosted regional trade in Europe or in North America, intra-African trade remains very low despite several agreements, here we consider

six of them: the Economic Community of West African States (ECOWAS) within which eight countries have a deeper integration with the West African Economic and Monetary Union (WAEMU). The Economic and Monetary Community of Central Africa (known as CEMAC from its name in French) which is the other monetary union of our sample. The Common Market for Eastern and Southern Africa (COMESA) which is the largest regional agreement in Africa with a free trade area and a customs union since 2009. We also analyze the Southern African Development Community (SADC) and lastly the East African Community (EAC). Appendix A provides a figure representing each country in the agreements signed. We compute a dummy taking one when these agreements enter in enforcement and zero otherwise.

We lead our analysis of trade flows on the bilateral TRADE HISTorical series, TRADHIST, a database from the CEPII (see Fouquin and Hugot, 2016). This database is to our knowledge the sole to compile bilateral flows at the aggregate level with an historical perspective allowing to analyze the effects of RTA over the period 1965-2014. This period of time enables to consider a dummy of RTA that varies over time, with the entry (and sometimes the exit) of members. Furthermore, even on recent periods (e.g. the 90's), TRADHIST is more complete. Other databases coming exclusively from COMTRADE (e.g. BACI) have many missing data of trade between African countries before 1994 which is very problematic since many significant RTAs have been signed on that period. These databases however have the advantage to provide data at a more desegregated level. The dummy of regional trade agreements,  $RTA_{odt}$ , comes from Jeffrey Bergstrand's homepage<sup>10</sup> and all dummies concerning specific agreements (e.g. "COMESA before 1994") are also built from these data.

To control for bilateral relationship we used bilateral fixed effects or a vector of dummies coming from the database GEODIST of the CEPII, i.e. dummies variables taking one when countries are contiguous ( $contig_{ij}$ ), when one country was the colonizer of the other ( $col_{ij}$ ),

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<sup>10</sup><https://www3.nd.edu/~jbergstr/> 2017

when the two countries were part of the same country ( $smctry_{ij}$ )<sup>11</sup>, and when at least 9% of the population in both countries speak the same language ( $lang_{ij}$ ).

Equation (1.2) is estimated with Poisson Pseudo-Maximum-Likelihood (PPML) which is the most appropriated estimator of the trade gravity equation.<sup>12</sup>

### 1.3 Trade creation

All the results reported in Table (1.1) show that RTAs have significantly promoted trade. Column 1 depicts results of a standard gravity equation with individual fixed effects.

The effect of RTAs in general is high, in particular in Column 1 which presents the results of a standard gravity equation, indicating that this traditional specification with individual fixed effects over-estimates trade creation. The same conclusion comes from individual-time fixed effects, the coefficient may be biased upward due to the lack of control. The most demanding specification (Column 3), where both individual-time fixed effects and bilateral fixed effects are taken into account leads to a strong reduction of the coefficient of RTAs in the general case (divided by 5). The coefficient of the interaction between RTAs and the African dummy is also smaller but to a lesser extent. The trade creation of RTA in Africa is thus strong and even stronger than the average effect of RTAs, boosting trade by around 95% ( $e^{0.668} - 1$ ) between 1965 and 2012. Concerning the traditional variables of the trade gravity equation, standard results are obtained. The average distance elasticity is closed to -0.5 which is smaller than the one reported by studies using log-linear estimation with the OLS estimator<sup>13</sup> but in line with estimates using the PPML estimator.<sup>14</sup> The GDP elasti-

<sup>11</sup>Here, we define same country differently from Anderson and Yotov (2008) where their variable is equal to 1 when the flow is international and 0 when is internal.

<sup>12</sup>see Santos Silva and Tenreyro (2006) for detailed explanations and more recently Fally (2015, Proposition 1) which demonstrates that the estimated fixed effects with PPML are perfectly consistent with the multilateral resistances of the theoretical model

<sup>13</sup>According to the meta-analyzis of Disdier and Head (2008) the mean coefficient is -0.9.

<sup>14</sup>Santos Silva and Tenreyro (2006) find an elasticity around -0.7 with PPML and an elasticity twice as large

Table 1.1: Trade Creation

Period	1965-2012		
	(1)	(2)	(3)
$dep = X_{odt}$			
$RTA_{odt}$	0.505 <sup>a</sup>	0.514 <sup>a</sup>	0.102 <sup>a</sup>
	0.055	0.019	0.026
$RTA_{odt}AFR_{od}$	0.785 <sup>a</sup>	0.802 <sup>a</sup>	0.668 <sup>a</sup>
	0.151	0.051	(0.101)
$\log(d_{od})$	-0.559 <sup>a</sup>	-0.563 <sup>a</sup>	
	0.028	0.008	
$\log(GDP_{ot})$	0.744 <sup>a</sup>		
	0.041		
$\log(GDP_{dt})$	0.736 <sup>a</sup>		
	0.039		
$colony_{od}$	0.267 <sup>a</sup>	0.259 <sup>a</sup>	
	0.086	0.018	
$contig_{od}$	0.507 <sup>a</sup>	0.492 <sup>a</sup>	
	0.080	0.021	
$lang_{od}$	0.111	0.120 <sup>a</sup>	
	0.071	0.018	
$comcol_{od}$	0.295 <sup>b</sup>	0.291 <sup>a</sup>	
	0.150	0.042	
$smctry_{od}$	0.168	0.169 <sup>a</sup>	
	0.181	0.046	
Obs	874163	918852	835315
Pseudo R <sup>2</sup>	0.85	0.87	0.99
log likelihood	-2.852e+13	-2.552e+13	-4.605e+12

Notes: <sup>abc</sup> denote significance at the 1, 5 and 10 percent level respectively. Estimations have been done with the PPML estimator. Robust clustered standard errors are reported under each coefficient. Concerning fixed effects: Column 1:  $f_o$ ,  $f_d$ ,  $f_t$ , Column 2:  $f_{ot}$ ,  $f_{dt}$  and Column 3  $f_{ot}$ ,  $f_{dt}$ ,  $f_{od}$ .

ties as well as contiguity, a common language and a common colonizer have the usual sign and size.

Table (1.2) analyzes different trade agreements in Africa with individual-time fixed effects and bilateral fixed effects. This analysis aims to measure the different enlargements of the different RTAs, we then consider a dummy for the current WAEMU, a dummy that takes one for countries that enforced this agreement in 1993 and another dummy for 1974 (Appendix A provides a brief history of these different agreements). Similar dummies are with OLS.

computed for ECOWAS, CEMAC, SADC, COMESA and EAC. The second aim is to identify agreements that have made a difference when countries have enforced different RTAs. For instance eight countries belong to the WAEMU and to ECOWAS and the spaghetti bowl is even bigger for COMESA, SADC and EAC. Column 1 considers exclusively the WAEMU, the CEMAC, the SADC and their ancestors. Among the current agreements only the CEMAC is not significant. Regression 2 controls for the fact that the positive effect of the WAEMU (SADC) may be driven by the ECOWAS (respectively COMESA). This is indeed the case for WAEMU which is no longer significant after this introduction. At the opposite of this insignificant effect, trade creation obtained thanks to ECOWAS has been strong, increasing trade by a coefficient of 0.9. In Column 3, all the dummies of RTAs are introduced, which shows that three agreements have been particularly efficient to stimulate trade: ECOWAS, SADC and COMESA. It is also noteworthy that some agreements that precede the current RTAs have been useful to stimulate trade (SADC before 1993) while other not. For instance, only the current version of ECOWAS is clearly beneficial to trade.

Table 1.2: Individual Trade Creation

	(1)	(2)	(3)
<i>WAEMU</i>	0.885 <sup>a</sup>	0.149	0.149
	0.287	0.276	0.276
<i>WAEMU (before 1974)</i>	-0.086	-0.050	-0.050
	0.469	0.521	0.522
<i>WAEMU (before 1993)</i>	0.238	0.350	0.351
	0.311	0.267	0.267
<i>ECOWAS</i>		0.906 <sup>a</sup>	0.907 <sup>a</sup>
		0.295	0.295
<i>ECOWAS (before 1993)</i>		-0.171	-0.172
		0.286	0.286
<i>CEMAC</i>	0.091	0.076	0.076
	0.593	0.594	0.594
<i>CEMAC (before 1994)</i>	-0.181	-0.189	-0.189
	0.523	0.524	0.524

Notes: <sup>abc</sup> denote significance at the 1, 5 and 10 percent level respectively. Estimations have been done with PPML. Robust clustered standard errors are reported under each coefficient. Individual and bilateral fixed effects (  $f_{ot}$  ,  $f_{dt}$  ,  $f_{od}$  ) have been introduced in all regressions.

Table 1.3: 1.2 continued

	(1)	(2)	(3)
<i>SADC</i>	1.177 <sup>a</sup>	1.180 <sup>a</sup>	1.178 <sup>a</sup>
	0.192	0.190	0.190
<i>SADC (before 1993)</i>	0.068	0.798 <sup>b</sup>	0.734 <sup>b</sup>
	0.341	0.337	0.331
<i>COMESA</i>		0.648 <sup>b</sup>	0.674 <sup>a</sup>
		0.250	0.258
<i>COMESA (before 1994)</i>		-0.471 <sup>c</sup>	-0.359
		0.271	0.254
<i>EAC</i>			0.337
			0.342
<i>EAC (before 2000)</i>			0.052
			0.228
<i>Other RTA</i>	0.260 <sup>a</sup>	0.258 <sup>a</sup>	0.259 <sup>a</sup>
	0.035	0.035	0.035
Obs	835315	835315	835315
Pseudo R <sup>2</sup>	0.9901	0.9901	0.9901
log likelihood	-4.581e+12	-4.575e+12	-4.59e+12

Notes: <sup>abc</sup> denote significance at the 1, 5 and 10 percent level respectively. Estimations have been done with PPML. Robust clustered standard errors are reported under each coefficient. Individual and bilateral fixed effects (  $f_{ot}$  ,  $f_{dt}$  ,  $f_{od}$  ) have been introduced in all regressions.

## 1.4 General Equilibrium Analysis

To assess the impact of past RTAs in Africa, we use the now standard analysis of trade gravity proposed by Arkolakis, Costinot and Rodriguez-Clare (2012) where the real market potential of exporters in the structural gravity equation (1.1) is defined by:

$$\Pi_o^{1-\sigma} \equiv \sum_{d=1}^n (\tau_{od}/P_d)^{1-\sigma} Y_d \quad (1.4)$$

while the price index of the consumption basket in the destination country is given by:

$$P_d^{1-\sigma} \equiv \sum_{o=1}^n (\tau_{od}/\Pi_o)^{1-\sigma} Y_o \quad (1.5)$$

Considering a Log-differentiation of the gravity equation (1.1) we present, hereafter and step by step, the impact of a change in trade costs due to RTAs.

By focusing our analysis on a change of trade costs  $\phi_{od}$  in the numerator of (1.1), from  $\phi_{od}$  to  $\phi_{od}^c$  then we obtain the direct effect of trade costs. The upper-script  $c$  is used to characterize the counterfactual experiment. Assuming the part of trade costs related to RTAs is a linear function of  $\ln \phi$  with a coefficient  $\psi$ , we can write the *direct* effect of the enforcement of RTA on bilateral trade flows in a very simple form:

$$Direct_{od} \equiv \dot{\phi}_{od} = \frac{\phi_{od}^c}{\phi_{od}} = \exp[\psi(RTA(1)_{od} - RTA(0)_{od})], \quad (1.6)$$

where  $RTA(0)$  means no RTA and  $RTA(1)$  enforcement. The “dot” is used in this paper to represent the proportional change in a variable between its initial value and the counterfactual scenario.<sup>15</sup> As shown in this equation (1.6), the direct effect does not take into account price indices.

Now adding in this analysis how multilateral resistances vary after regional trade liberalization gives the *indirect* impact:

$$Indirect_{od} \equiv \frac{\Pi_o P_d}{\Pi_o^c P_d^c} \exp[\psi(RTA(1)_{od} - RTA(0)_{od})]. \quad (1.7)$$

Table (1.4), (1.5) and (1.6) report these effects considering successively the counterfactual removal of the COMESA, the ECOWAS and the SADC (using the coefficient of these agreements in the first part (column 3, 1.2)), which are the three African RTAs that have

<sup>15</sup>The literature usually work with a “hat”, a notation here preserved to notify the predicted value of coefficients.



significantly promoted bilateral trade according to our previous analysis. The direct impact of these RTAs is a strong reduction of the delivered price of goods exported. For instance, trade frictions under the SADC are 0.30 time smaller than under the counterfactual, implying that without the SADC the value of trade frictions would be 69% higher. The direct impact of the COMESA and the ECOWAS is smaller but however high ( $\phi$  is respectively equals 0.509 and 0.403). To the extent that a significant RTA reduces the average trade barriers faced by an importer and an exporter (multilateral resistances), it dampens the direct impact of this RTA on bilateral trade flows (Anderson and van Wincoop, 2003). As a result the indirect effect of RTAs is positive, indeed by reducing the delivered price, a reduction of tariffs leads to a reduction of price indices, increasing the purchasing power of consumers and then the demand of new goods and finally bilateral exchanges. This indirect effect seems to have been particularly strong and homogeneous for countries of the ECOWAS. In contrast the COMESA and the SADC have brought unequal indirect gains, for instance South Africa is one of the country that gets the most significant reduction in multilateral resistances thanks to the SADC, the indirect effect is equal to 6.3, which may be compared with the ratio of Lesotho which is the smallest in this sample (equal to 2.1). The reduction of bilateral barriers relative to average trade barriers that these two countries face with all their trading partner has been certainly stronger for South Africa than for a small and isolated country like Lesotho.

Table 1.4: General Equilibrium effects of COMESA

Country	Indirect Effect	GETI	Welfare	Inward Multi	Outward Multi	Factory Price	Real GDP
Angola	2.121%	8.965%	0.040%	-0.198%	-0.198%	0.159%	0.359%
Burundi	5.389%	28.886%	5.378%	-0.218 %	-0.209%	0.167%	0.387 %
Djibouti	5.463%	8.793%	0.029%	-0.215 %	-0.206%	0.165 %	0.382%
Egypt	5.526%	8.897%	0.061%	-0.189%	-0.185 %	0.148%	0.338%
Ethiopia	5.754%	1.968%	1.223%	-0.214%	-0.206%	0.165%	0.381 %
Kenya	5.455%	8.588%	0.028%	-0.209 %	-0.200%	0.160%	0.370%
Libya	5.385%	8.766%	0.013%	-0.190 %	-0.195%	0.156%	0.348%
Lesotho	1.992%	8.549%	0.060%	-0.163 %	-0.158%	0.127%	0.290%
Madagascar	2.009%	15.453%	0.765%	-0.217%	-0.210%	0.168%	0.386%
Mozambique	2.116%	2.286%	0.775%	-0.161%	-0.157%	0.126%	0.288 %
Mauritius	3.864%	8.819%	0.032%	-0.149%	-0.138 %	0.111%	0.261%
Malawi	3.001%	8.120%	0.100%	-0.196 %	-0.186 %	0.149%	0.347 %
Rwanda	5.382%	8.805%	0.031%	-0.218 %	-0.209 %	0.167%	0.387 %
Somalia	5.389%	8.718%	0.017%	-0.210%	-0.206 %	0.165%	0.377%
Swaziland	3.654%	8.395%	0.074%	-0.170%	-0.160%	0.128%	0.300%
Uganda	5.608%	8.739%	0.056%	-0.193%	-0.183 %	0.147 %%	0.342%
Zambia	2.024%	8.553%	0.194%	-0.217 %	-0.208 %	0.166 %	0.385%
Zimbabwe	2.030%	2.803%	0.137%	-0.216%	-0.208%	0.166 %	0.384 %

Notes : The benchmark year is 2006. The direct impact of the COMESA is 0.509. Some member's countries of COMESA are not present in our results because of a lack in data (Seychelles, Democratic Republic of Congo, Comoros, Eritrea and Sudan). Indirect and GETI are the country's mean facing all others countries.

Table 1.5: General Equilibrium Effects of ECOWAS

Country	Indirect Effect	GETI	Welfare	Inward Multi	Outward Multi	Factory Price	Real GDP
Benin	7.365%	11.434%	0.037%	-0.115%	-0.109%	0.089%	0.205 %
Burkina Faso	7.361%	11.542%	0.035%	-0.117 %	-0.109%	0.089%	0.207%
Côte d'Ivoire	7.467%	11.558%	0.025%	-0.110%	-0.102 %	0.083%	0.194 %
Cap Verde	7.374%	12.523%	0.140%	-0.110%	-0.103%	0.084%	0.195 %
Ghana	7.750%	11.429%	0.043%	-0.096%	-0.087%	0.071%	0.168 %
Guinee	7.740%	11.595%	0.002%	-0.091%	-0.083%	0.068%	0.159%
Gambia	7.378%	11.511%	0.038%	-0.116%	-0.110 %	0.090%	0.206%
Liberia	7.478%	11.571%	0.061%	-0.106%	-0.098%	0.080 %	0.188 %
Mali	7.371%	11.133%	0.115%	-0.117%	-0.109%	0.089%	0.207%
Niger	7.792%	11.299%	0.021%	-0.090%	-0.082 %	0.067 %	0.159%
Nigeria	7.393%	11.528%	0.007%	-0.102%	-0.107 %	0.087 %	0.190%
Senegal	7.377%	11.294%	0.033%	-0.116%	-0.108 %	0.088%	0.205%
Sierra Leone	8.624%	10.545%	0.100%	-0.117%	-0.110%	0.089 %	0.207%
Togo	7.436%	11.202%	0.076%	-0.113 %	-0.105%	0.086%	0.199 %

Notes : The benchmark year is 2006. The direct effect of ECOWAS is 0.403. Guinee-Bissau not present in our results because of a lack in data. Indirect and GETI are the country's mean facing all others countries.

Table 1.6: General Equilibrium Effects of SADC

Country	Indirect Effect	GETI	Welfare	Inward Multi	Outward Multi	Factory Price	Real GDP
Angola	2.352%	-10.146%	0.522%	-0.197%	-0.197%	0.158%	0.356%
Botswana	5.736%	30.162%	4.219%	-0.213 %	-0.205%	0.164 %	0.379%
Lesotho	2.159%	13.251%	0.078%	-0.216%	-0.206%	0.165 %	0.383%
Madagascar	2.185%	30.386%	1.748%	-0.208%	-0.205%	0.164%	0.374%
Malawi	3.663%	13.065%	0.109%	-0.186 %	-0.182%	0.146 %	0.333 %
Mauritius	4.887%	13.951%	0.042%	-0.139 %	-0.134%	0.107 %	0.247 %
Mozambique	2.347%	5.503%	1.664%	-0.212%	-0.205%	0.164 %	0.378 %
South Africa	6.308%	10.741%	0.228%	-0.156%	-0.153%	0.123 %	0.280 %
Swaziland	4.625%	12.914%	0.075%	-0.160 %	-0.156%	0.125%	0.286%
Tanzania	6.607%	13.446%	0.040%	-0.207 %	-0.204 %	0.164%	0.372 %
Zambia	2.207%	21.577%	1.168%	-0.210 %	-0.204 %	0.163 %	0.375 %
Zimbabwe	2.217%	8.922%	0.832%	-0.210 %	-0.203 %	0.163%	0.374 %

*Notes : The benchmark year is 2006. Seychelles doesn't appear in this table because it was not member of SADC at our benchmark year. The direct effect of SADC is 0.307. Some member's countries of SADC are not present in our results because of a lack in data (Seychelles, Democratic Republic of Congo and Namibia). Indirect and GETI are the country's mean facing all others countries.*

Obviously, these direct and indirect effects neglect one important aspect of trade liberalization: the impact of RTAs on wages and incomes. We take the terminology of Head and Mayer, and call the effects including the change in wages, General Equilibrium Trade Effect (GETI) when there is a change in trade costs. It is defined as following :

$$GETI_{od} = \frac{Y'_o X'_d \Pi_o P_d}{Y_o X_d \Pi_o^c P_d^c} \exp[\psi(RTA(1)_{od} - RTA(0)_{od})]$$

Where  $Y'_o$  and  $X'_d$  denote respectively the production in origin country and the expenditures in destination country after trade costs changes.

Considering the production side with labour as the sole factor of production in each country  $i = (o, d)$ ,  $Y_i = w_i L_i$ , and by considering change in the labour force as constant, then changes in incomes are only determined by changes in wages ( $\dot{w} = \dot{Y}$ ). Since trade deficit are exogeneous and thus constant, change in expenditures equals change in incomes (indeed with  $X_d = w_d L_d (1 + d_d)$ ) where  $d_d$  is the deficit of country  $d$ , gives  $\dot{X}_d = \dot{w}_d = \dot{Y}_d$ ). To determine the equilibrium change in income we use the share of expenditure of consumers in  $o$  spent on goods produced in  $d$ ,  $\pi_{od} = X_{od}/X_o$ . Based on Deckle et al. (2008), we work with the change in expenditure due to a trade shock given by:

$$\dot{\pi}_{od} = \frac{\dot{\phi}_{od} \dot{Y}_o^{1-\sigma}}{\sum_l \pi_{ld} \dot{\phi}_{ld} \dot{Y}_l^{1-\sigma}}. \quad (1.8)$$

Inserting this expression in the market clearing enables us to solve the system and to get the income change due to the enforcement of a RTA:

$$\dot{Y}_d = \frac{1}{Y_d} \sum_{o=1}^n \frac{\pi_{od} \dot{\phi}_{od} \dot{Y}_o^{1-\sigma}}{\sum_l \pi_{ld} \dot{\phi}_{ld} \dot{Y}_l^{1-\sigma}} \dot{Y}_o X_o. \quad (1.9)$$

Using the direct effects calculated earlier, with  $Y_o$  approximated by GDPs, and the trade share  $\pi_{od}$  of each country  $o$ , gives from (1.9) a system of equations defining  $\dot{Y}_o$ , which once inserting in the trade share expenditure (1.8)<sup>16</sup>, gives the General Trade Equilibrium Impact (GETI) of trade shock:  $\dot{\pi}_{od} \dot{Y}_d$ . We also compute the welfare gains of RTAs under this quantitative exercise, given by  $\dot{\pi}_{dd}^{1/(1-\sigma)}$ , since welfare depends only on changes in the trade to GDP ratio.

To assess the removal impact of African RTAs, it is essential to have internal flows to measure domestic expenditures in order to re-calculate multilateral resistances and GDPs

<sup>16</sup>To resolve the system we need an estimate of the constant elasticity of substitution between variety, we use  $\sigma = 4.03$  which is the number obtained in the meta-analysis of Head and Mayer (2014).

after a change in trade costs. As a consequence, we use the Input-Output Tables coming from EORA Database. This database contains the Input-Output tables for 195 countries. We choose the 2006's table as benchmark year and the Uruguay<sup>17</sup> as a reference since this country shares characteristics with some African countries in terms of size and in terms of trade agreements. Alternative years are considered to check the robustness of our results. These tables are in appendix.

Table (1.4), (1.5) and (1.6) witness the impact of RTAs detailing the GETI and the welfare gains at the country level for each agreements.

Concerning the GETI, the most striking result is that RTAs have impacted on the income of all countries with particular strong impact on the exportations of some of them such as Madagascar where exports soar to 30% in comparison with a situation without the SADC. Results are quite similars between members of ECOWAS (varying around an increase of eleven percents), while the trade effects of the COMESA and even more of the SADC are quite heterogeneous with different GETIs between members. For instance, Zambia has an increase of trade flows around 21 percent while Mozambique only an increase of 5.5 percent. Finally, the SADC records the most important value of GETI (around 30%) for two countries (Botswana and Madagascar).

In comparison, effects on welfare are small, for instance the highest gain under the ECOWAS is an increase of 0.1% of the monetary well-being in Mali. In comparison, the COMESA and the SADC have been much more welfare improving, increasing real GDPs by approximately 0.7% to 1% for many countries. In computing the mean of welfare for each agreement analyzed in this paper, the SADC provides the biggest gains (0.89%) while the smallest gains come from the ECOWAS (0.05%).

This relative small impact of RTAs on welfare must be balanced with other findings.

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<sup>17</sup>Reader have to keep in mind that with a General Equilibrium model, the solution should be independent of the normalization by reference country. Then to avoid any doubt about that, we have checked that changing reference country does not modify our results. With Perou, Paraguay and Vietnam which are more closed to Subsaharian Africa in terms of GDP per capita findings still the same. In appendix C we propose different results where we change our benchmark year. Figures of interest are almost unaffected.

Calculating the “cost of Non-Europe”, Mayer et al (2018) for instance find that the Single market has increased trade between EU members by 109% on average with an associated welfare gains around 4.4% for the average European countries. Because the initial African flows were smaller than the European initial trade, it is not surprising that even a strong increase of trade will result in very tiny changes in the share of expenditure that is spent locally in Africa and as a result involves a small welfare gains.

We supplement these results with the analysis of Anderson and Yotov (2016) and Anderson, Larch and Yotov (2018) as a robustness check.<sup>18</sup> These authors also depart from the gravity equation (1.1) but use the model differently to get another insight of the impact of trade costs. While the previous analysis was based on observed data of trade flows, here the incidence of trade costs are based on predicted trade flows. More precisely we estimate Equation (1.2) twice, first with  $\phi_{odt} = \psi RTA_{odt} + f_{od}$  and then with  $\phi_{odt}^c = \beta \bar{\psi} RTA_{odt}^c + \bar{f}_{od}$  where  $RTA_{odt}^c$  takes one for all RTAs enforced in the world excepted the African RTAs studied (e.g. COMESA) and zero otherwise. As previously, the upper-script  $c$  is used to characterize the counterfactual experiment and the “bar” the coefficient estimated in the first estimation, i.e. the second estimation is a constrained version of the first one. Based on the work of Fally (2015), time-varying countries-specific effects  $f_{ot}$  and  $f_{dt}$  estimated from Equation (1.2) with  $\phi_{odt} = \psi RTA_{odt} + f_{od}$  are considered as an exact measure of price indices and then used to construct the outward multilateral resistances:

$$\hat{\Pi}_{ot}^{1-\sigma} \equiv \frac{Y_{o,t}}{\exp(\hat{f}_{ot})} N_{UY,t}, \quad (1.10)$$

where  $N_{UY,t}$  represents aggregate expenditure of the dropped country in the initial estimation which is used as the numeraire, i.e. all other effects are interpreted with respect to that one. Here we choose the Uruguay (denoted UY) as in the previous methodology. This normalization is done without loss of generality, the solution we get is independent of the

<sup>18</sup>Stata code for this analysis and the previous one are provided online.

normalization. Similarly, the inward resistance is given by:

$$\widehat{P}_{dt}^{1-\sigma} \equiv \frac{Y_{d,t}}{\exp(\widehat{f}_{dt}) N_{UY,t}} \quad (1.11)$$

This analysis is in the spirit of the empirical literature in economic geography that used the predicted value of individual fixed effects to compute the market and the supplier market access to explain the cross-country variation in per capita income (Redding and Venables, 2004), the location choices of multinational firms (Candau and Dienesch, 2017), and the concentration of activities in nations's largest metropolis (Candau and Gbandi, 2018).

These multilateral resistances are also computed by using the estimates of time-varying countries-specific effects obtained from the estimation of the constrained Equation (1.2), i.e. with  $\phi_{odt}^c = \beta \bar{\psi} RTA_{odt}^c + \bar{f}_{od}$ . We also used these estimations to determine the change in the factory-gate price defined by:

$$Factory_{od} \equiv \dot{p}_{od} = \frac{p_{ot}^c}{p_{ot}} = \left( \frac{\exp(\widehat{f}_{ot}^c) / N_{UY,t}^c}{\exp(\widehat{f}_{ot}) / N_{UY,t}} \right)^{1/(1-\sigma)} \quad (1.12)$$

Using this factory price in incomes (e.g.  $Y_{ot}^c = Y_{ot} p_{ot}^c / p_{ot}$ ) and then in the theoretical equation (1.1) finally leads to new trade flows in the counterfactual exercises:

$$\dot{X}_{odt} = \dot{\Phi}_{odt} \dot{Y}_{ot} \dot{Y}_{dt} \dot{\Pi}_{ot} \dot{P}_{dt} \quad (1.13)$$

where  $\dot{\Phi}_{odt}$  is given by:

$$\dot{\Phi}_{odt} = \frac{\exp(\bar{\psi} RTA_{odt}^c + \bar{f}_{od})}{\exp(\psi RTA_{odt} + f_{od})} \quad (1.14)$$

Table (1.4), (1.5) and (1.6) report the results of these variables for the different agreements. In each case, RTAs have led to a reduction of buyers and sellers' incidence. They are however interesting difference accross countries that confirms the previous analysis. Madagascar for instance is one of the country with the highest change in the buyers and sellers's



incidence. Among all agreements, the SADC has been the most beneficial for both sellers and buyers. Countries like Botswana, who are not heavily specialized on agricultural goods, are also in this exercise among the biggest winners of RTAs with a significant decrease in the outward and inward multilateral resistances. The effects of RTAs are however modest in term of changes in factory prices (increase by only 0.15% for many sellers) and in term of welfare confirming the previous analysis<sup>19</sup>.

## 1.5 Concluding remarks

The marginalization of Africa in the world trade system is still a reality.<sup>20</sup> Africa's share of world exports has declined from about 6 percent in 1974 to 1.6 percent in 1995, and even if this number has since more than doubled it only reached 3.2 percent in 2014.<sup>21</sup> Despite this poor performance, the current study shows that RTAs cannot be accused of pointlessness. Some agreements have failed to deliver the expected trade gains, this is particularly true for the WAEMU since its early design, but overall RTAs have fostered trade in Africa. Results are even comparable with those obtained elsewhere in the world, for instance the COMESA and the ECOWAS provide similar effects than the NAFTA in term of trade flows<sup>22</sup>. As shown in our counterfactual analysis, these RTAs have contributed to reduce trade frictions and multilateral trade resistances in Africa. Their effects on welfare are obviously still

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<sup>19</sup>There are also some differences between the two analysis. An interesting one is that the dispersion of change in GDP is smaller here, e.g. we do not find the strong increase in welfare for countries like Burundi (4%). Another difference with the GETI results is that some 'remote' countries, such as Lesotho, are those that benefit the most of RTAs. These differences are however minors and may be simply understood by the fact that the second methodology is more an estimation of the general equilibrium effects than a computation of these effects.

<sup>20</sup>Sachs and Warner (1997) and Subramanian and Tamirisa (2001) consider the marginalization of Africa as a consequence of a lack of trade integration while Foroutan and Pritchett (1993) and Rodrik (1998) view this marginalization as a consequence of their low income levels.

<sup>21</sup>Authors' calculation from Comtrade.

<sup>22</sup>Cipollina and Salvatici (2010) find in their meta-analyzis that the mean coefficient for NAFTA is equal to 0.90.

small, but with the increasing integration of African countries in the world trade system, one can expect that the future generation of RTAs in Africa will have more substantial income growth effects.

## 1.6 Appendix A

The following Chart shows the RTAs notified to the WTO and analyzed in this paper, it also illustrates to what extent these agreements are inter-linked.

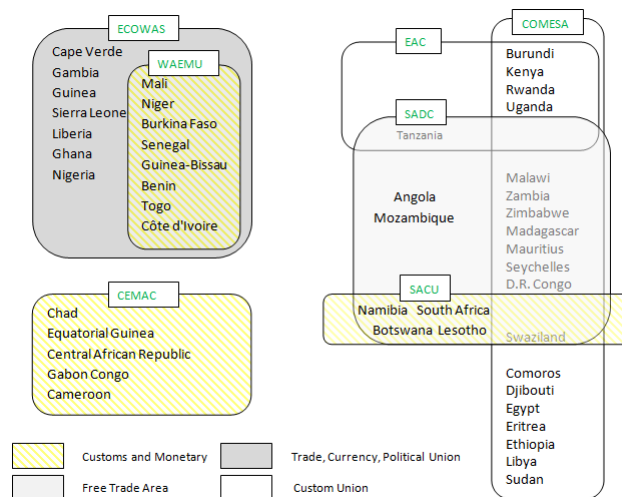


Figure 1.1: Spaghetti bowl of RTAs in Africa

The origin of this Spaghetti bowl, comes from the 1950s. During that period, French and English speaking countries come together to form the first Regional Trade Agreement in Sub-Saharan Africa.

Successive Regional Trade Agreements were created, namely West African Customs Union (WACU) and Customs Union of West African States (CUWAS) for West Africa. Equatorial Customs Union (ECU) and Central African Customs and Economic Union (CACEU) for Central Africa and the last one is East African Community (EAC) for the east of the

continent. Central and West African agreements are better known by their French acronyms which are respectively: UDAO, UDEAO for West Africa and UDE, UDEAC for Central Africa.

Regional agreements in West Africa start in 1959 with seven members engaged in UDAO with his headquarters in Abidjan. These members were Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal and Mauritania. UDAO encounters many difficulties among which the distribution of customs revenues collected on imports. It was replaced by UDEAO conserving the same membership.

Concerning RTAs in Central Africa, Central African Republic, Gabon, Chad and Congo are the founding members of UDE which was established in june 1959 and joined by Cameroun in 1962. This union moves on to UDEAC in 1964 with the same members exepted Chad.

The only English-speaking agreement on that period was the East African Community. Since 1917, EAC was a political union before to become an economic community in june 1967. The treaty was signed between Kenya, Tanzania and Uganda but was quickly dissolved in 1977 in reason of internal opposition and war in Uganda.

## 1.7 Appendix B

In order to measure diversion effects of African countries inpedently of the agreements to which they belong (African or not), we add to our trade costs function, dummies  $RTA_{o-dt}$  and  $RTA_{d-ot}$  as well as african exporters and importers dummies ( $AFR_o$  and  $AFR_d$ ) taking value 1 respectively for african exporters and importers.  $RTA_{o-dt}$  takes 1 when the country  $o$  is a member of any RTA which excludes  $d$ . Similarly,  $RTA_{d-ot}$  takes 1 if importer  $d$  has signed any other RTA with any outside trade partners. Then 1.2 become:

$$X_{odt} = \psi_1 RTA_{odt} + \psi_2 RTA_{odt} AFR_{od} + \psi_3 RTA_{d-ot} + \psi_4 AFR_d RTA_{d-ot} + \psi_5 RTA_{o-dt} \quad (1.15)$$

$$+\psi_6AFR_oRTA_{o-dt} + bZ_{od} + \varepsilon_{odt}$$

In comparison with the analysis of trade creation, studying trade diversion through (1.15) requires to remove importer/exporter-year effects since fixed effects directly capture variation over time at the destination or at the origin of exports. As a result, year-exporter and year-importer fixed effects are used to properly analyze trade creation in the core of the paper but must be omitted to study trade diversion here.

The interaction term between african and diversion dummies variables capture trade diversion of an agreement that one of the african countries has with another country. As explain by Soloaga and Winters (2001) and Carrère (2004) if  $\psi_2 > 0$  and  $\psi_4 < 0$  then the propensity to import from the rest of the world decrease whereas the propensity to trade with others members increase (import diversion). Similary, there is an export diversion when  $\psi_2 > 0$  and  $\psi_6 < 0$ .

Estimates (1.7, column 6) show that the trade diversion has been weak or not significant. In olumn 2-4, the same regressions are done (i.e. considering different agreements succesively and historically). Interpretation of our result in these cases are a little bit different since trade diversion is now induced by only sub saharan RTAs. Above all agreements, the diversion effect is the most clear for WAEMU, considering the imports and the exports as well as past agreements. Export diversion is also found for EAC. Overall, these results show that RTAs in Africa have brought few trade distortions.

## 1.8 Appendix C

The following tables show general equilibrium analysis results for alternative years (2000 and 2010). Result are similar to those obtained in the text.

Table 1.7: Individual Trade Diversion

	(2)	(3)	(4)	(5)	(6)
<i>WAEMU</i>	2.194 <sup>a</sup> (0.389)	1.237 <sup>a</sup> (0.460)	1.240 <sup>a</sup> (0.460)	$RTA_{odt}$	0.458 <sup>a</sup> (0.054)
<i>WAEMU</i> <sub>export</sub>	-0.165 (0.216)	0.035 (0.218)	0.034 (0.217)	$RTA_{odt}AFR_{od}$	0.842 <sup>a</sup> ( 0.154)
<i>WAEMU</i> <sub>import</sub>	-0.453 <sup>a</sup> (0.160)	-0.583 <sup>a</sup> (0.220)	-0.583 <sup>a</sup> (0.220)	$\log(d_{od})$	-0.509 <sup>a</sup> (0.030)
<i>WAEMU</i> (before 1974)	1.980 <sup>a</sup> (0.394)	2.117 <sup>a</sup> (0.421)	2.123 <sup>a</sup> (0.420)	$RTA_{o-dt}$	-0.204 <sup>a</sup> (0.051)
<i>WAEMU</i> <sub>export</sub> (before 1974)	0.446 (0.272)	0.449 (0.294)	0.449 (0.293)	$RTA_{d-ot}$	-0.119 <sup>b</sup> (0.050)
<i>WAEMU</i> <sub>import</sub> (before 1974)	-0.134 (0.240)	-0.008 (0.233)	-0.007 (0.233)	$RTA_{o-dt}AFR_i$	0.162 <sup>c</sup> (0.092)
<i>WAEMU</i> (before 1993)	1.811 <sup>a</sup> (0.383)	1.421 <sup>a</sup> (0.433)	1.425 <sup>a</sup> (0.433)	$RTA_{d-ot}AFR_j$	0.079 (0.093)
<i>WAEMU</i> <sub>export</sub> (before 1993)	0.036 (0.218)	-0.027 (0.209)	-0.027 (0.208)		
<i>WAEMU</i> <sub>import</sub> (before 1993)	-0.361 <sup>b</sup> (0.169)	-0.448 <sup>a</sup> (0.159)	-0.448 <sup>a</sup> (0.159)		
<i>CEMAC</i>	1.293 (0.867)	1.300 (0.867)	1.302 (0.866)		
<i>CEMAC</i> <sub>export</sub>	0.481 (0.416)	0.478 (0.416)	0.477 (0.415)		
<i>CEMAC</i> <sub>import</sub>	0.318 (0.409)	0.326 (0.409)	0.325 (0.408)		
<i>CEMAC</i> (before 1994)	1.585 <sup>c</sup> (0.878)	1.596 <sup>c</sup> (0.878)	1.600 <sup>c</sup> (0.877)		
<i>CEMAC</i> <sub>export</sub> (before 1994)	0.535 (0.393)	0.535 (0.393)	0.533 (0.393)		
<i>CEMAC</i> <sub>import</sub> (before 1994)	1.116 <sup>a</sup> (0.411)	1.116 <sup>a</sup> (0.411)	1.114 <sup>a</sup> (0.411)		
<i>SADC</i>	2.072 <sup>a</sup> (0.303)	2.018 <sup>a</sup> (0.307)	2.044 <sup>a</sup> (0.307)		
<i>SADC</i> <sub>export</sub>	0.169 (0.137)	0.167 (0.137)	0.170 (0.137)		
<i>SADC</i> <sub>import</sub>	0.239 (0.146)	0.251 <sup>c</sup> (0.147)	0.254 <sup>c</sup> (0.146)		
<i>SADC</i> (before 1993)	1.892 <sup>a</sup> (0.384)	1.106 <sup>b</sup> (0.469)	1.171 <sup>b</sup> (0.469)		
<i>SADC</i> <sub>export</sub> (before 1993)	0.041 (0.231)	-0.007 (0.258)	0.014 (0.258)		
<i>SADC</i> <sub>import</sub> (before 1993)	0.268 <sup>c</sup> (0.157)	0.308 <sup>b</sup> (0.157)	0.309 <sup>b</sup> (0.156)		

Notes: <sup>abc</sup> denote significance at the 1, 5 and 10 percent level respectively. Estimations have been done with PPML. Robust clustered standard errors are reported under each coefficient. Individual and bilateral fixed effects (  $f_o$  ,  $f_d$  ,  $f_t$  ) have been introduced in all regressions as well as the usual bilateral variables. The latter have the appropriate signs but we do not report them in this table. <sub>exportimport</sub> denote respectively exporter and importer trade diversion dummies.

## 1.9 Appendix D : The Gain of Tripartite and Continental Free Trade Area (TFTA and CFTA)

Trade between African countries is low in comparison with other regional block, for instance while intra-asian trade is about 60% of its total trade, intra-trade represents only 15% of the total continental trade. For more than forty years, African countries have enforced Regional Trade Agreement such as the Common Market for Eastern and Southern Africa, the East Africa Community, and the Southern African Development Community. In 2015, African leaders have signed the Tripartite Free Trade Area (TFTA) agreement that aims to unite

Table 1.8: 1.7 continued

	(2)	(3)	(4)	(5)	(6)
<i>ECOWAS</i>		1.116 <sup>a</sup> (0.338)	1.117 <sup>a</sup> (0.337)		
<i>ECOWAS</i> <sub>export</sub>		-0.258 (0.212)	-0.258 (0.211)		
<i>ECOWAS</i> <sub>import</sub>		0.201 (0.211)	0.200 (0.211)		
<i>ECOWAS</i> (before 1993)		0.483 (0.323)	0.483 (0.323)		
<i>ECOWAS</i> <sub>export</sub> (before 1993)		0.077 (0.187)	0.076 (0.186)		
<i>ECOWAS</i> <sub>import</sub> (before 1993)		0.207 <sup>b</sup> (0.081)	0.206 <sup>b</sup> (0.081)		
<i>COMESA</i>		0.810 <sup>a</sup> (0.259)	0.688 <sup>a</sup> (0.231)		
<i>COMESA</i> <sub>export</sub>		0.038 (0.098)	0.051 (0.096)		
<i>COMESA</i> <sub>import</sub>		-0.112 <sup>c</sup> (0.064)	-0.100 (0.064)		
<i>COMESA</i> (before 1994)		1.319 <sup>a</sup> (0.323)	1.205 <sup>a</sup> (0.323)		
<i>COMESA</i> <sub>export</sub> (before 1994)		0.201 (0.164)	0.124 (0.171)		
<i>COMESA</i> <sub>import</sub> (before 1994)		-0.134 <sup>c</sup> (0.079)	-0.150 <sup>c</sup> (0.080)		
<i>EAC</i>			2.014 <sup>a</sup> (0.317)		
<i>EAC</i> <sub>export</sub>			-0.594 <sup>a</sup> (0.130)		
<i>EAC</i> <sub>import</sub>			-0.162 (0.103)		
<i>EAC</i> (before 2000)			1.925 <sup>a</sup> (0.403)		
<i>EAC</i> <sub>export</sub> (before 2000)			0.717 <sup>a</sup> (0.159)		
<i>EAC</i> <sub>import</sub> (before 2000)			0.237 (0.146)		
<i>Other RTA</i>	0.374 <sup>a</sup> (0.085)	0.372 <sup>a</sup> (0.085)	0.372 <sup>a</sup> (0.084)		
<i>Other RTA</i> <sub>export</sub>	-0.104 <sup>b</sup> (0.049)	-0.108 <sup>b</sup> (0.049)	-0.108 <sup>b</sup> (0.049)		
<i>Other RTA</i> <sub>import</sub>	-0.028 (0.060)	-0.028 (0.060)	-.028 (0.059)		
Obs			874163		
Pseudo R <sup>2</sup>			0.854		
log likelihood	-2.895e+13	-2.892e+13	-2.890e+13	-	2.823e+13

Notes: <sup>abc</sup> denote significance at the 1, 5 and 10 percent level respectively. Estimations have been done with PPML. Robust clustered standard errors are reported under each coefficient. Individual and bilateral fixed effects (  $f_o$  ,  $f_d$  ,  $f_t$  ) have been introduced in all regressions as well as the usual bilateral variables. The latter have the appropriate signs but we do not report them in this table. <sub>exportimport</sub> denote respectively exporter and importer trade diversion dummies.

these three existing trade blocs and which according to optimistic points of view, is going to create a free-trade zone stretching from Cape Town to Cairo. Pessimistic points of view in contrast raise several doubts about this agreement, considering that RTAs in Africa have always been badly implemented and are not convinced that the TFTA is more promising.

We show with the following table(1.12) that the gain at stake are significant and deserve political efforts. Our assesment is based on Anderson and Yotov (2016) and Anderson, Larch and Yotov (2018) quantitative analysis.This new free trade area is positive in terms

Table 1.9: General Equilibrium effects of COMESA

Country	Welfare 2000	Welfare 2010
Angola	0.055%	-0.003%
Burundi	4.355%	5.095%
Djibouti	0.018%	0.039%
Egypt	0.073%	0.055%
Ethiopia	1.493%	1.315%
Kenya	0.032%	0.025%
Libya	0.000%	0.021%
Lesotho	0.077%	0.062%
Madagascar	0.552%	0.823%
Mozambique	0.740%	0.711%
Mauritius	0.025%	0.033%
Malawi	0.090%	0.096%
Rwanda	0.016%	0.040%
Somalia	0.013%	0.025%
Swaziland	0.064%	0.083%
Uganda	0.038%	0.053%
Zambia	0.173%	0.197%
Zimbabwe	0.075%	0.084%

Notes : Some member's countries of COMESA are not present in our results because of a lack in data (Seychelles, Democratic Republic of Congo, Comoros, Eritrea and Sudan).

Table 1.10: General Equilibrium Effects of ECOWAS

Country	Welfare 2000	Welfare 2010
Benin	0.033%	0.039%
Burkina Faso	0.024%	0.043%
Côte d'Ivoire	0.029%	0.023%
Cap Verde	0.159%	0.147%
Ghana	0.042%	0.045%
Guinee	0.001%	0.002%
Gambia	0.032%	0.048%
Liberia	0.036%	0.064%
Mali	0.108%	0.124%
Niger	0.018%	0.023%
Nigeria	0.008%	0.008%
Senegal	0.025%	0.035%
Sierra Leone	0.173%	0.094%
Togo	0.053%	0.078%

Notes : Guinee-Bissau not present in our results because of a lack in data.

Table 1.11: General Equilibrium Effects of SADC

Country	Welfare 2000	Welfare 2010
Angola	1.099%	0.501%
Botswana	2.645%	5.939%
Lesotho	0.108%	0.089%
Madagascar	NA	1.930%
Malawi	0.099%	0.104 %
Mauritius	0.030%	0.043 %
Mozambique	0.716%	1.897%
South Africa	0.199%	0.258%
Swaziland	0.071%	0.083 %
Tanzania	0.032%	0.038 %
Zambia	1.112%	1.122 %
Zimbabwe	0.565%	0.552 %

*Notes : Some member's countries of SADC are not present in our results because of a lack in data (Seychelles, Democratic Republic of Congo and Namibia). Madagascar was not a member of SADC in 2000.*

of its impact on consumers and producers, even if they are very small (less than 0.5%). Like the results presented in the main text, the effect of the TFTA on individual countries is heterogeneous. Consumers in the Democratic Republic of Congo seem to be by far the biggest winners (-0.201%) followed by South Africa (-0.081%) and Libya (-0.065%). The same holds for producers (see Outward multilateral resistances column). By comparing the real GDP between the TFTA and the smaller agreements (SADC, COMESA), we can see that the creation of the tripartite agreement seems to have a negligible effect. Take the case of Botswana under the TFTA and SADC. The effect of SADC (0.379%) is six times greater than that of TFTA (0.069%). What could explain this? The fact that the TFTA is more an enlargement than a creation of a free trade area per se can explain this. More precisely, most of the countries that make up the TFTA already have a trade cost (tariff) close to zero. Therefore, the countries that join the TFTA do not leave a situation of autarchy for free trade. This situation is highlighted by simulating the gains associated with the Continental Free Trade Area (CFTA). The only difference between the two agreements is related to the size of the CFTA, which includes all existing African agreements (including the TFTA).



Table 1.12: Tripartite Free Trade Areas

country	Inward Multi	Outward Multi	Factory Price	Real GDP
Angola	-0,025%	-0,015%	0,012%	0,038%
Burundi	-0,041%	-0,038%	0,030%	0,071 %
Botswana	-0,035%	-0,033 %	0,027 %	0,063%
Congo	-0,201 %	-0,201 %	0,161%	0,363%
Djibouti	-0,047%	-0,046%	0,036%	0,084%
Egypt	-0,041 %	-0,042%	0,034%	0,075 %
Ethiopia	-0,046%	-0,044%	0,035%	0,082%
Kenya	-0,051%	-0,048 %	0,039 %	0,090 %
Libya	-0,065%	-0,059%	0,047%	0,113%
Lesotho	-0,049%	-0,049%	0,039 %	0,089%
Madagascar	-0,002%	-0,001%	0,0006%	0,003%
Mozambique	-0,054 %	-0,054%	0,043%	0,098%
Mauritius	-0,053 %	-0,051%	0,041%	0,095 %
Malawi	-0,028 %	-0,026%	0,021%	0,050%
Rwanda	-0,042%	-0,040%	0,032%	0,075%
Tanzania	-0,015 %	-0,011%	0,009%	0,024 %
Uganda	-0,064%	-0,063%	0,050%	0,115%
South Africa	-0,083%	-0,083%	0,066%	0,150%
Zambia	-0,004%	-0,002%	0,002%	0,006%
Zimbabwe	-0,005%	-0,003%	0,002%	0,008%

The results in Table (1.13) show that RTAs have a significant effect on well-being (real GDP). More importantly, the effect of the CFTA is about four times greater than that of the TFTA. All of which leads us to argued that the additional effect of such an agreement is proportional to its size.

Table 1.13: CFTA-consolidated text

country	Inward Multi	Outward Multi	Factory Price	Real GDP
Sao Tome and Principe	-0.347%	-0.340%	0.273%	0.623%
Chad	-0.339 %	-0.332%	0.266%	0.607%
Central African Republic	-0.338%	-0.332%	0.266%	0.607%
Gabon	-0.338%	-0.332%	0.266%	0.606%
Mauritania	-0.338 %	-0.330 %	0.265%	0.605%
Congo	-0.336%	-0.332%	0.266%	0.605%
Cameroon	-0.323%	-0.315%	0.253%	0.578%
Algeria	-0.288 %	-0.282%	0.227%	0.516%
Morocco	-0.283%	-0.277%	0.223%	0.507%
Tunisia	-0.265%	-0.267 %	0.215%	0.481 %
Guinea	-0.237%	-0.228%	0.183%	0.422%
Niger	-0.237%	-0.228%	0.183%	0.422 %
Togo	-0.236%	-0.228 %	0.183%	0.421%
Mali	-0.235 %	-0.228 %	0.183%	0.419%
Burkina Faso	-0.235%	-0.228%	0.183%	0.419%
Sierra Leone	-0.235 %	-0.228%	0.183%	0.419%
Liberia	-0.234%	-0.228%	0.183%	0.419%
Senegal	-0.234%	-0.228 %	0.183%	0.419%
Gambia	-0.232%	-0.228 %	0.183%	0.416%
Benin	-0.231%	-0.228 %	0.183%	0.415%
Nigeria	-0.225%	-0.228 %	0.183%	0.409%
Ghana	-0.225%	-0.217%	0.174%	0.400%
Côte d'ivoire	-0.224%	-0.217%	0.174%	0.400%

Table 1.14: Table 1.13 continued

country	Inward Multi	Outward Multi	Factory Price	Real GDP
Cape Verde	-0.222%	-0.216%	0.174 %	0.397%
Somalia	-0.196%	-0.184%	0.148%	0.345%
Mozambique	-0.191%	-0.185%	0.149%	0.341%
Djibouti	-0.190%	-0.181 %	0.145%	0.336%
Ethiopia	-0.188%	-0.181%	0.145 %	0.335%
Uganda	-0.181%	-0.171%	0.138%	0.319%
Rwanda	-0.181%	-0.172%	0.138%	0.320%
South africa	-0.178%	-0.172%	0.138 %	0.317%
Lesotho	-0.178%	-0.172%	0.138%	0.317%
Kenya	-0.179%	-0.170%	0.136%	0.316%
Burundi	-0.179%	-0.170 %	0.137%	0.316%
Libya	-0.173%	-0.165%	0.132 %	0.306%
Botswana	-0.163%	-0.154 %	0.123%	0.287%
Tanzania	-0.151%	-0.142%	0.114%	0.265%
Angola	-0.150%	-0.138%	0.110 %	0.261%
Malawi	-0.148%	-0.140%	0.111 %	0.260%
Mauritius	-0.141 %	-0.132%	0.106%	0.248%
Zimbabwe	-0.140%	-0.131%	0.106%	0.247%
Zambia	-0.141 %	-0.131%	0.105%	0.246%
Seychelles	-0.139%	-0.131%	0.105%	0.246 %
Madagascar	-0.139%	-0.132%	0.105 %	0.245%
Egypt	-0.133 %	-0.126%	0.101 %	0.235%

## 1.10 Appendix E : African RTA and Home market effect

The most original result of the new trade theories is the Home Market Effect (hereafter HME), stating that trade integration will favor the country with the largest market. The interaction of increasing returns and imperfect competition gives birth to a more than proportional relationship between a country's share of regional production of a good and its share of regional demand. In relatively large countries, economies of scale due to the domestic market size may explain why RTAs have fostered the creation of a disproportionate numbers of activities in these countries and not elsewhere. Empirically, it is very difficult to test the HME à la Krugman (1980). This is because data on changes in countries' domestic demand for a given good is very limited. To overcome this problem, some authors have used an extension of the definition of the home market effect that is rather related to the effect of countries' relative production in explaining specializations in international trade (Hanson and Xiang 2005, Crozet and Trionfetti, 2008). Costinot et al, (2017) challenge this difficulty in an interesting way by using variation in disease burdens across countries. By focusing on the pharmaceutical market, they try to show to what extent a country with high exposure to a particular disease tends to export locally produced drugs that treat that disease. This approach is interesting because, as argued by the authors, using predicted disease burdens as observable demand shifters rather than expenditure shares is a significant step forward. To our knowledge, no empirical studies use properly demand shifter to estimate HME. Since Africa is rightly viewed as being highly specialized on a limited number of agricultural goods HME has not yet been tested. However, as Candau, Guepie and Schlick (2019) one can be argued that There are some countries in Africa (Ethiopia, South africa) that may have attracted industrial activities in the way described by Krugman (1980).

To test the HME, we follow Hanson and Xiang (2005) who propose to select pairs of exporting countries that have a similar production technology and face common tariffs at destination. So taking the ratio of country  $o$ 's exports to country  $h$ 's exports toward the

destination market  $d$  for a particular good  $s$  (using Equation, 1.1) gives

$$\ln \frac{X_{od,s}/X_{hd,s}}{X_{od,r}/X_{hd,r}} = \alpha + \beta \ln \left( \frac{Y_{o,s}}{Y_{h,s}} \right) + \vartheta(Z_o - Z_h) + \delta \ln \left( \frac{d_{od}}{d_{hd}} \right) + \varepsilon_{ohd,rs} \quad (1.16)$$

where the sector  $s$  is considered as the “treatment” industry and the sector  $r$  as the “control” group.

The home-market effect is observed whether  $\beta > 0$  i.e. whether larger countries export relatively more of high-markup, high-transport cost goods. To identify the HME, it is necessary to consider pairs of exporting countries that face common trade policy barriers and similar production costs (in order to minimize the risk to mislead the HME with comparative advantage). Thus origin countries,  $\{o, h\}$ , are now exclusively African countries,  $\{i, j\}$ . They extend the methodology of Hanson and Xiang (2004) by considering the following ‘difference-in-difference’ specification by using a panel version of (1.16) and by introducing RTA dummy as follows:

$$\ln \frac{X_{idt,s}/X_{jdt,s}}{X_{idt,r}/X_{jdt,r}} = \alpha + \beta RTA_{ijt} \ln \left( \frac{Y_{it,s}}{Y_{jt,s}} \right) + RTA_{ijt} + \ln \left( \frac{Y_{it,s}}{Y_{jt,s}} \right) + \vartheta(Z_i - Z_j) + f_i + \delta \ln \left( \frac{d_{id}}{d_{jd}} \right) + \varepsilon_{ijd,rs} \quad (1.17)$$

In comparison with Hanson and Xiang (2004), time fixed effects are introduced and our test of the HME is more demanding: the HME due to RTAs between  $i$  and  $j$  is here analyzed on third market  $d$ .

Equation (1.17) is estimated to test the HME for African countries. We found that there are some evidence of the HME, but in the majority of cases, this effect is not significant or ambiguous. For instance for “paper and paperboard” the coefficient is significantly negative when taking as a reference “nonferrous metals”, positive when considering “construction machinery” and not significant when considering “refrigeration machinery”. For “iron and

steel”, results are less ambiguous, but the positive sign of the HME’s coefficient is significant only with three particular references (nonferrous metals, medical instruments and construction machinery). The same comments can be done for products like “steel wire”, “glassware and glass” or “clay”.

## **Chapter 2**

# **Gains and Losses in a Trade Bloc: The Case of the East African Community**

### **2.1 Introduction**

The current Chapter analyzes the East African Community (EAC). Founded in 1967 by the three countries of Kenya, Tanzania and Uganda, the first EAC collapsed in 1977 on the grounds that Kenya was taking the lion's share of the benefits of the EAC. The new EAC enforced in 2000 by Kenya, Tanzania and Uganda and then by Rwanda and Burundi in 2007, which became a fully-fledged Customs Union in 2009, adopts a more optimistic point of view by considering this regional integration as mutually beneficial. To our knowledge these successively negative and positive opinions have never been analyzed until now, at least not in the way we proceed.

Using fifty years of trade data over the period 1964-2014, we undertake a within identification strategy with dummies of the EAC that varies over time enabling us to control for the various variables explaining trade by using importer-year, exporter-year and country pair fixed effects. We find that the former EAC (1967-1977) has not been significant to foster trade while the recent EAC has strongly increased bilateral exports over the period 2000-2012. Beyond this statistical analysis, we use a multi-country and multi-sector Ricardian model to quantify and to decompose the gains/losses of the current EAC between

countries and across sectors. The model is based on Caliendo and Parro (2015) and takes into account the international trade of intermediate goods and the impact of input-output linkages on trade. It is a well known fact that countries exchange intermediate goods along the global supply chain, however since African countries are highly specialized and often viewed as marginalized to the world trade network, counterfactual analysis with such a model has never been done for RTAs in Africa. Still, at the beginning of the EAC in 2000, trade in intermediate goods represented half of the total importation of the members of this agreement.<sup>1</sup> Then, it seems crucial to take into account these data to assess the impact of the EAC.

Regarding the literature on gravity equations, only a handful of studies has been undertaken with the aim to better control for bilateral and individual-time unobserved characteristics in Africa. Carrère (2004) provides convincing evidence of the positive effect of RTAs on African trade using a panel specification with random bilateral effects. In comparison we use here bilateral fixed effects, and country-year effects to control for institutional and cultural determinants of trade that vary over the period analyzed. This analysis is in the vein of the seminal paper of Magee (2008) and follows in particular Mayer and Thoenig (2016) who analyze how trade has pacified Eastern Africa.

Regarding the counterfactual analysis, many Computable General Equilibrium models (CGE) have been used to analyze the EAC (Willenbockel, 2012; Balistreri et al., 2016), and have concluded that this agreement has successfully promoted growth and reduced poverty in the trade bloc. Mayer and Thoenig (2016) and Candau, Guepie and Schlick (2019) use a middle size model without intermediate trade (Arkolakis et al. 2012) to study RTAs and find that these agreements have been beneficial to promote trade. Here, using a richer model than the Arkolakis et al. (2012) model, but however more transparent than classical CGE, our conclusion is less positive. We find strong trade diversion in many countries (in particular

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<sup>1</sup>Based on the Comtrade database, the import share of intermediate goods in Kenya was equal to 56%, 55% in Burundi, 41% in Rwanda, 54% in Tanzania, 50% in Uganda. Intermediate goods refer to UNCTAD-SoP2 and UNCTAD-SoP4 HS6 groups



in Rwanda) and a deterioration of the term of trade in all members (with the exception of Kenya). Considering the overall impact, including trade creation, we find that the EAC has been beneficial but gains remains small, i.e. close to zero for Burundi, Uganda and Tanzania and close to 1% for Kenya and Rwanda. Our analysis also shows that not taking trade in intermediate goods into account leads to the overestimation of the effect of the EAC.

The remainder of the paper is organized as follows. In Section II, the data and the empirical strategy are presented. Section III discusses the main results regarding trade creation. Section IV presents the counterfactual analysis and the final section outlines the study's conclusion.

## 2.2 Preliminary results

### 2.2.1 The model

Our analysis is based on Caliendo and Parro (2015) who propose a multi-country and multi-sector Ricardian model (i.e. an extension of Eaton and Kortum, 2002). There are  $N$  countries and  $J$  sectors. Subscripts  $k$  and  $j$  are used for sectors,  $o$  and  $d$  for countries. Labour and intermediate goods are the inputs of production. Labour is paid  $w_d$  and is mobile between sectors but not between countries. This economy is composed of  $L$  representative households that maximize a Cobb-Douglas utility function of final goods denoted  $C_d^j$ , with  $\alpha_d^j$  the preference parameter for these goods. A continuum of intermediate goods  $\omega^j$ , also called materials, is produced in each sector. Producers of intermediate goods differ in their efficiency to produce by a factor  $z_d^j(\omega^j)$  drawn from a Fréchet distribution with a location parameter  $\lambda_d^j$  that varies by country and sector, and a shape parameter  $\theta^j$  that varies by sector  $j$ . The production function takes the form of Cobb-Douglas function with  $\gamma_d^{kj}$  the share of materials from sector  $k$  used in the production of intermediate good  $j$ , and  $\gamma_d^j$  the

share of labour in this production function. Intermediate goods are produced under constant return to scale and firms evolve under perfect competition and set the price at the unit cost  $c_d^j/z_d^j(\omega^j)$  with  $c_d^j$  the cost of an input given by:

$$c_d^j = A_d^j w_d^j \prod_{k=1}^J (P_d^k)^{\gamma_d^{k,j}} \quad (2.1)$$

with

$$P_d^k = \left[ \int p_d^k(\omega^k)^{1-\sigma^k} d\omega^k \right]^{1/(1-\sigma^k)} \quad (2.2)$$

where  $p_d^k(\omega^k)$  is the lowest price of intermediate good  $\omega^k$  across all location  $d$ ,  $\sigma^k$  is the elasticity of substitution between intermediate goods within sector  $j$ ,  $A_d^j$  is a constant and  $P_d^k$  the price index of intermediate goods. This equation clearly describes the sectoral linkages, where change in a price of one intermediate goods affects the costs of other products.

Producers in sector  $j$  in country  $d$  supply a composite intermediate good by purchasing intermediate goods  $\omega^j$  from the lowest cost suppliers across countries. The production function of the composite goods takes the classical form proposed by Ethier (1982). These composite goods are used for the production of intermediate and final goods. The consumption price index is given by:

$$P_d = \prod_{k=1}^J (P_d^k / \alpha_d^k)^{\alpha_d^k} \quad (2.3)$$

Trade costs,  $\kappa$ , are iceberg costs and depend on tariffs and distance:

$$\kappa_{do}^j = \tilde{\tau}_{do}^j d_{do}^j \quad (2.4)$$

with  $\tilde{\tau}_{do}^j = (1 + \tau_{do}^j)$  where  $\tau_{do}^j$  is the ad-valorem tariff and  $d_{do}$  the distance between  $o$  and  $d$ .

Using the properties of the Fréchet distribution, the expenditure shares, denoted  $\pi_{do}^j$ ,

takes the following form:

$$\pi_{do}^j = \frac{\lambda_o^j [c_o^j \kappa_{do}^j]^{-\theta^j}}{\sum_{h=1}^N \lambda_h^j [c_h^j \kappa_{dh}^j]^{-\theta^j}} \quad (2.5)$$

This share is thus just a function of prices, technologies and trade costs. Total expenditure on goods  $j$ ,  $X_d^j$ , is the sum of the expenditures such as:

$$X_d^j = \sum_{k=1}^j \gamma_d^{j,k} \sum_{o=1}^N X_o^k \frac{\pi_{od}^k}{1 + \tau_{od}^k} + Y_d \alpha_d^j \quad (2.6)$$

where the income  $I_d$  depends on wages  $w_d$ , tariff revenues  $R_d$ , and trade deficit  $D_d$ :

$$I_d = w_d L_d + R_d + D_d$$

### 2.2.2 The gravity equation

From the previous subsection, the total expenditure of country  $d$  on goods from  $o$  is given by:

$$X_{od}^j = \pi_{do}^j X_d^j$$

which observing (2.5), (2.6), adding time  $t$  and summing on sectors  $j$  takes the form of a general gravity equation:

$$X_{odt} = \frac{f_{ot} f_{dt}}{d_{odt}} \quad (2.7)$$

where  $f_{ot}$  and  $f_{dt}$  represent the comparative advantage of countries (productivity, costs) and the purchasing power of consumers (prices indices and incomes).  $f_{ot}$  is often considered as an indicator of the market access from  $o$  and/or called outward multilateral resistance be-

cause it represents a GDP share weighted measure of trade cost resistance that exporters in  $o$  face when shipping their goods to consumers on their own and outward markets. Concerning African RTAs, this term matter since different significant historical events (e.g. slavery, colonialism, preferential trade agreements<sup>2</sup>) have affected bilateral trade costs between African countries *relatively* to trade costs with distant countries. The term  $f_{dt}$  in this gravity equation is the accessibility-weighted sum of exporters- $o$  capabilities also called inward multilateral resistance since it is a reversed measure of the openness of a nation to import from the world.

This gravity equation is estimated using the Poisson Pseudo-Maximum Likelihood (PPML) estimator<sup>3</sup> as follows:

$$X_{odt} = \exp(\alpha + f_{ot} + f_{dt} + f_{od} + \psi_1 EAC_{odt} + \psi_2 RTA_{odt} + \varepsilon_{odt}) \quad (2.8)$$

where  $f_{ot}$  and  $f_{dt}$  are time-varying countries-specific effects approximating exporting and importing capacity at time  $t$ ,  $\alpha$  is a constant. Trade flows  $X_{odt}$  come from the bilateral TRADE HISTORICAL series, TRADHIST, a database from the CEPII (see Fouquin and Hugot, 2016) over the period 1965-2012. Respectively the dummy  $EAC_{odt}$  ( $RTA_{odt}$ ) takes one at year  $t$  when the EAC (another RTA) enters into force and zero otherwise. These dummies come from Jeffrey Bergstrand's homepage<sup>4</sup>.

To control for bilateral determinant of trade,  $f_{od}$ , we use a vector of dummies coming from the database GEODIST of the CEPII. These binary variables take one when countries are contiguous (called *Contiguity*), when a country was the colonizer of its trade partner

<sup>2</sup>The first Generalized System of Preferences were non-reciprocal schemes implemented by the European Economic Community and Japan in 1971 and by the USA in 1976, i.e. only a few decades after the wave of Independence, to facilitate LDCs access to markets of rich countries. See Candau and Jean (2009) for a detailed analysis on the utilisation of these trade preferences in Africa.

<sup>3</sup>To take into account that many countries do not trade bilaterally (leading to consider an estimator dealing with zeroes and heteroskedasticity), the trade literature has adopted the PPML approach proposed by Santos Silva and Tenreyro (2006). See Head and Mayer (2014) for a discussion and a comparison with the generalized Tobit proposed by Eaton and Kortum (2001).

<sup>4</sup><https://www3.nd.edu/~jbergstr/> 2017

(called *Colony*), when two countries had the same colonizer (called *Common Colony*), when the two countries were part of the same country (*Same Country*), when at least 9% of the population in both countries speak the same language (*Official Language*) and when two countries share a least one ethnic language (*Ethnic Language*). Since this strategy to add arbitrarily variables may raise doubt regarding the possibility of endogenous bias due to omitted variables, we compare with estimations including bilateral fixed effects  $f_{od}$  to control for all unobserved time-unvarying bilateral determinants of export (Baier and Bergstrand, 2007; Magee, 2008).

As explained in the introduction, the first EAC agreement entered into force between 1967 and 1977 and the second one started in 2000. In order to quantify the distinct effect of these two waves of regionalization, we consider a binary variable, called ‘EAC (1967-77)’, taking one for members during the period 1967-1977 and zero otherwise, and another dummy, called ‘EAC (2000-12)’, taking 1 between 2000 and 2012.

Table (2.1, Column 1) presents a standard gravity equation with GDPs, distance and bilateral controls (dummies for contiguity, past colonial links, common language, common history such as the fact that countries have belong to the same country in the past). This specification is typically the one used in past studies and leads to conclude that the EAC (1967-77) has fostered trade while the most recent agreement has not been significant. However, from a theoretical point of view, this estimation is not reliable since many omitted terms that are country specifics (e.g. price indices) are correlated with trade cost terms (e.g. distance and RTAs). Then in Table (1, Column 2), fixed effects by exporter and importer are introduced. Fally (2015) demonstrates that estimating a gravity equations using the PPML estimator with these fixed effects is equivalent to introduce the ‘multilateral resistance’ presented in theoretical models (*à la* Anderson and Van Wincoop, 2004). According to this estimation, the EAC promotes trade but in too strong way to be credible ( $(e^{2.99} - 1) * 100 = 1800\%$ ). The introduction of time-varying individual effects in Column

4 does not resolve this problem of overestimation of the RTAs' coefficient. The set of binary dummies (such as common language, colonial ties, etc) *imperfectly* control for all the bilateral links between countries that explain trade flows. Countries that have enforced the EAC are certainly also characterized by other unobserved bilateral factors and thus the endogenous bias of omitted variables is still problematic to consider seriously the coefficient of RTAs in this specification. The last Column 4 is thus our preferred estimation since bilateral fixed effects are introduced resolving all the aforementioned problems. The conclusion of this last regression is exactly the reverse of the naïve estimation done in Column 1, the current EAC (2000-12) has been a significant factor of trade growth, whereas the historical EAC (1967-77) was inefficient. The impact of the new EAC (2000-12) that increase trade by 75% ( $e^{0.564} - 1$ ) is very close to the estimation of the trade effect obtained in Europe (68%) and smaller than the coefficient obtained for the NAFTA (145%) according to the meta-analysis of Cipollina and Salvatici (2010).

Table 2.1: Gravity results

	(1)	(2)	(3)	(4)
<i>EAC(1967 – 77)</i>	1.348*** (0.469)	3.286*** (0.348)	1.767*** (0.499)	0.045 (0.175)
<i>EAC(2000 – 12)</i>	-0.250 (0.466)	2.710*** (0.388)	2.998*** (0.403)	0.564** (0.256)
<i>Other RTA</i>	0.062 (0.077)	0.523*** (0.056)	0.521*** (0.059)	0.107*** (0.026)
<i>Exporters GDP</i>	0.773*** (0.015)	0.603*** (0.034)		
<i>Importers GDP</i>	0.788*** (0.019)	0.560*** (0.034)		
<i>Distance</i>	-0.519*** (0.038)	-0.550*** (0.027)	-0.558*** (0.028)	
<i>Contiguity</i>	0.513*** (0.100)	0.469*** (0.074)	0.446*** (0.076)	
<i>Official language</i>	-0.081 (0.158)	-0.149 (0.111)	-0.158 (0.111)	
<i>Ethnic language</i>	0.420*** (0.141)	0.330*** (0.112)	0.355*** (0.112)	

Note: robust dyad Clustered Standard errors are reported in parentheses with \*\*\*, \*\* and \* respectively denoting significance at the 1%, 5% and 10% levels. Estimations have been done with PPML estimator.

Table 2.2: 2.1 continued

	(1)	(2)	(3)	(4)
<i>Colony</i>	-0.034 (0.113)	0.264*** (0.087)	0.246*** (0.086)	
<i>Comon Colony</i>	0.531** (0.266)	0.333** (0.149)	0.326** (0.149)	
<i>Same country</i>	0.807*** 0.314	0.163 (0.174)	0.168 (0.179)	
Observations	874,163	874,163	918,852	835,315
Pseudo R-square	0.88	0.93	0.94	0.99
Pseudolikelihood	-5.27455e+13	-2.88938e+13	-2.52816e+13	-4.610e+12
Importers FE	No	Yes	No	No
Exporters FE	No	Yes	No	No
Importer × time FE	No	No	yes	Yes
Exporters × time FE	No	No	yes	Yes

Note: robust dyad Clustered Standard errors are reported in parentheses with \*\*\*, \*\* and \* respectively denoting significance at the 1%, 5% and 10% levels. Estimations have been done with PPML estimator.

To paraphrase Allen, Arkolakis and Takahashi (2019) many trade models lead to the “universal gravity” described by Equation (2.7), which makes the results of this section particularly general. However to run a credible counterfactual analysis, we need to scratch beneath the surface of this gravity equation and to come back on the theoretical model. In particular in order to assess trade diversion. Indeed, the EAC by impacting on the relative prices of goods and on multilateral resistances, leads to a reallocation of the demand, diverting trade from outside; but importer-year and exporter-year effects typically capture these diversion effects in our gravity equation. In other words, the coefficient of the EAC presented here is conditioned to trade diversion, it only represents the *pure* trade creation effect. On the contrary, resolving the model leads to take into account multilateral resistances and thus trade diversion.



## 2.3 Quantitative analysis

### 2.3.1 How to resolve the model

Following a long tradition in international trade, the model is solved for changes in prices and wages after a discrete change in tariff from  $\tau$  to  $\tau'$ . All the variables that are affected by this new tariff are analyzed in relative change and denoted with a “hat” (i.e.  $\hat{x} = x'/x$ ). Then the equilibrium is get from the following equations with the cost of the input:

$$\hat{c}_d^j = \hat{w}_d^{\gamma_d^j} \prod_{k=1}^J (P_d^k)^{\gamma_d^{k,j}}, \quad (2.9)$$

the price index:

$$\hat{P}_d^j = \left[ \sum_{o=1}^N \pi_{do}^j [\hat{\kappa}_{do}^j \hat{c}_0^j]^{-\theta^j} \right]^{\frac{-1}{\theta^j}} \quad (2.10)$$

the trade share:

$$\hat{\pi}_{do}^j = \left[ \frac{\hat{\kappa}_{do}^j \hat{c}_0^j}{\hat{P}_d^j} \right]^{-\theta^j} \quad (2.11)$$

These equations (with the total expenditures and the trade balance equation) give the equilibrium in relative changes. As it well known now, the great advantage of this system is that it can be resolved with few data and estimations. Only tariffs, trade shares, value added and their share and the sectoral dispersion of productivity are necessary. The trade elasticities are here directly determined by the dispersion of productivity  $\theta^j$  which are the only parameters that need to be estimated for the quantitative trade policy evaluation of the EAC.

## 2.3.2 Taking the Model to the Data

### 2.3.2.1 Elasticities

Evaluation of trade policy welfare gains depend crucially on trade elasticities. With a high  $\theta^j$ , the productivity is concentrated and goods are not substitute. As a result a change in tariff will not have a strong effect on the share of traded goods because producers of the composite aggregate are less likely to change their suppliers. This means that our results depend on the values of these elasticities. Following Mejean and Imbs (2017) we propose to use two different estimates of  $\theta^j$ :

First, we use the sectoral elasticities of Caliendo and Parro (2015). These authors use the expenditure share (2.5) and a triple differentiation to estimate only from tariffs these elasticities, reported in Table (2.3).

Secondly, we estimate these elasticities from the method of Feenstra (1994), Broda and Weinstein (2006) and Soderbery (2018).

Formally, following Feenstra (1994), demand and supply trade elasticities are estimated from a single equation that takes the following form:

$$(\Delta^i \ln P_{dkt})^2 = \alpha_k (\Delta^i \ln S_{dkt})^2 + \beta_k (\Delta^i \ln S_{dkt}) (\Delta^i \ln P_{dkt}) + \varepsilon_{dkt} \quad (2.12)$$

where  $S_{dkt}$  and  $P_{dkt}$  are respectively country  $d$  trade share and price of product  $k$  at time  $t$ . In order to eliminate time specific effect, all variables are first differentiating ( $\Delta$ ). We estimate this equation with the Limited Information Maximum Likelihood (LIML) hybrid estimator proposed by Soderbery (2018). This estimator corrects for small sample bias and outliers observations effects. Its constrained non linear routine corrects grid search inefficiencies introduced by Broda and Weinstein (2006). The estimation of this equation gives trade price elasticity relative to a reference country  $i$  (here Zambia). The coefficient of interest here is the elasticity of the trade share  $\alpha_k$ .

Table 2.3 presents these trade elasticities, the range is from 1.32 to 22.63 showing strong heterogeneity across sectors. Since these two methods provide different results, they represent an interesting way to lead sensitivity analysis of the model and to test the robustness of our findings.

Table 2.3: Sectoral trade elasticities

Eora sectors	Feenstra	Caliendo&Parro
Agriculture	3.584	9.11
Fishing	2.037	9.11
Mining and Quarrying	2.832	13.53
Food & Beverages,	3.268	2.62
Textiles and Wearing Apparel	3.844	8.1
Wood and Paper	6.742	14.846
Petroleum, Chemical, Non-Metallic Mineral Prod	4.944	18.015
Metal Products	22.638	5.135
Electrical and Machinery	3.991	7.994
Transport Equipment	1.324	1.115
Other Manufacturing	3.271	1.98

Note: Caliendo and Parro ISIC Rev 3 are converted in EORA classification through the classification proposed by Manfred et al (2013)

### 2.3.2.2 Data

Value added ( $V_d^j$ ) and gross production ( $Y_d^j$ ) come from the EORA global supply chain database. This database consists of a multi-region input-output time series (1990-2015) for 26 sectors and 190 countries. Bilateral trade flows come from United Nation statistical division Commodity Trade (COMTRADE) database using The Harmonized Commodity

Description and Coding System (HS) 1996 at 6 digit level of aggregation. In order to maintain a single classification, trade flows are converted to EORA classification. This is done in two steps. First, by using the World Integrated Trade Solutions (WITS) correspondence table, we move from the HS nomenclature to the 4-digit ISIC Rev 3 nomenclature. Then, the transition from ISIC to EORA classification is made through the classification proposed by Manfred et al (2013). Bilateral tariff data at the sectoral level come from United Nation Conference on Trade And Development Trade Analysis Information System (UNCTAD-TRAINS) for the year 1999 and 2009. Our counterfactual exercise covers 11 tradable sectors as well as 48 countries<sup>5</sup>, including an aggregated rest of the world. These countries and sectors are the same as those used to estimate trade elasticities. Finally concerning trade data we used the BACI database provided by CEPII.

### 2.3.3 Tariff, real wage and welfare

To understand the result of the quantitative model, it is useful to decompose the effect of tariffs on real wage and welfare.

Using the cost function (2.9) with trade share (2.11), the counterfactual change in real wages is solved in each sector  $j$  as a function of the share of expenditure on domestic goods and sectoral prices. Using this expression in the consumption expenditure shares, gives the following expression:

$$\ln \frac{\hat{w}_d}{\hat{P}_d} = - \sum_{j=1}^J \frac{\alpha_d^j}{\theta^j} \ln \hat{\pi}_{dd}^j - \sum_{j=1}^J \frac{\alpha_d^j}{\theta^j} \frac{1 - \gamma_d^j}{\gamma_d^j} \ln \hat{\pi}_{dd}^j - \sum_{j=1}^J \frac{\alpha_d^j}{\gamma_d^j} \ln \prod_{k=1}^J \left( \frac{\hat{P}_d^k}{\hat{P}_d^j} \right)^{\gamma_d^{k,j}} \quad (2.13)$$

Changes in real wages depend on three components. The economic conditions in the

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<sup>5</sup>Appendix A, gives the list of countries used in this study.

final sector,  $-\sum_{j=1}^J \frac{\alpha_d^j}{\theta^j} \ln \hat{\pi}_{dd}^j$ , and in the intermediate good,  $-\sum_{j=1}^J \frac{\alpha_d^j}{\theta^j} \frac{1-\gamma_d^j}{\gamma_d^j} \ln \hat{\pi}_{dd}^j$  and finally of changes in sectoral and consumer prices,  $-\sum_{j=1}^J \frac{\alpha_d^j}{\gamma_d^j} \ln \prod_{k=1}^J \left( \hat{P}_d^k / \hat{P}_d^j \right)^{\gamma_d^{k,j}}$ . Then, changes in wages depends on sectoral elasticities and on the share of the final demand. The higher the ratio between sectoral elasticities and the share of final demand growth, the greater the effects on real wages, even if there are small variations in domestic spending. In a similar way, the share of value added of intermediate goods in the production matters. The higher this parameter increases, the less significant the impact on real wages is. In the model without intermediate goods (we make this assumption in the last part of the paper), the aggregate effect of tariff reduction on producers of these goods does not play any role on the welfare. Indeed, there are no reduction in the price of intermediate goods and so the gain coming from the decrease in the cost of production is simply not taken into account. Lastly, sectoral linkages are impacted by the ratio between the share spent on final goods and the share of value added in production. As this ratio increases, the effect of sectoral linkages on real wages increases.

Totally differentiating the welfare function of the representative consumer in country  $d$  yields:

$$d \ln W_d = \frac{1}{I_d} \sum_{j=1}^J \sum_{o=1}^N \left( E_{do}^j d \ln c_d^j - M_{do}^j d \ln c_o^j \right) + \frac{1}{I_d} \sum_{j=1}^J \sum_{o=1}^N \tau_{do}^j M_{do}^j \left( d \ln M_{do}^j - d \ln c_o^j \right) \quad (2.14)$$

This expression enables to decompose the welfare impact of tariffs into terms of trade and volume of trade effects across countries and sectors. The terms of trade given by the first part of equation (2.14) measure the gains of an increase in exporter prices relative to a change in importer prices from tariff reduction. This component impacts the welfare through the sectoral deficit and sectoral prices. The second part represents the volume of trade and measures the gain of an increase in the volumes of trade from tariff reduction.

At the national level, the change in bilateral Terms of Trade (hereafter denoted  $ToT_{do}$ ) and the change in the bilateral Volume of Trade ( $VoT_{do}$ ) are respectively given by:

$$ToT_{do} \equiv \sum_{j=1}^J \left( E_{do}^j \Delta \ln c_d^j - M_{do}^j \Delta \ln c_o^j \right), \quad (2.15)$$

$$VoT_{do} \equiv \sum_{j=1}^J \tau_{do}^j M_{do}^j \left( \Delta \ln M_{do}^j - \Delta \ln c_o^j \right). \quad (2.16)$$

The change in the sectoral terms of trade and volume of trade are similarly given by:

$$ToT_d^j \equiv \sum_{i=1}^N \left( E_{do}^j \Delta \ln c_d^j - M_{do}^j \Delta \ln c_o^j \right), \quad (2.17)$$

$$VoT_d^j \equiv \sum_{i=1}^N \tau_{do}^j M_{do}^j \left( \Delta \ln M_{do}^j - \Delta \ln c_o^j \right). \quad (2.18)$$

Then the welfare change takes the following form:

$$\Delta \ln W_d = \frac{1}{I_d} \sum_{j=1}^J \left( VoT_d^j + ToT_d^j \right) \quad (2.19)$$

Using data from I-O tables, trade flows ( $M_{do}^j$ ), value added ( $V_d^j$ ) and gross production ( $Y_d^j$ ) we get  $\pi_{do}^j$ ,  $\gamma_d^j$ ,  $\gamma_d^{j,k}$  and  $\alpha_d^j$ , and with the estimates of sectoral productivity dispersion  $\theta^j$ , we can solve the model for tariff changes in order to study how real wages (2.13) and welfare (2.14, 2.15, 2.16, 2.17, 2.18) have been affected by the EAC and by trade liberalization in general.

## 2.4 Main results

With the model, data and estimations in hand, we now turn to simulations of the EAC trade integration. We also propose additional results by modifying important assumptions (number of sectors, sectoral linkages, trade deficit).

### 2.4.1 Ceteris Paribus: the EAC

#### 2.4.1.1 Country analysis

To compute the effect of the EAC, we make two different shocks and our analysis of the EAC is based on the difference between these shocks. This methodology is typically the one proposed by Caliendo and Parro (2015) to study the impact of the NAFTA given world tariff changes or by Mayer et al. (2019) to revisit the cost of Non-Europe. In each cases we calibrate the model on the year 1999 when the EAC has been signed, i.e. before its implementation, and we take into account trade deficits. In the first shock, we introduce the observed change in world tariff structure from 1999 to the year 2009 including changes due to the EAC. In the second shock, we still consider the observed change in world tariff structure from 1999 to the year 2009 but holding EAC tariffs fixed. The difference between these two simulations allows to isolate the effect of the EAC from other changes in the world.

In all tables, we present the simulations done with the elasticities of  $\theta^j$  obtained from the two methodologies presented previously.

In Table (2.4, Column 1), we provide results concerning welfare change (Equation 2.14) and in Column 2 and 3 we decompose the effect of the EAC by analyzing changes in the terms of trade and in the volume of trade (Equations 2.15, 2.16). Finally Column 4 provides

Counterfactuals based on elasticities computed from Caliendo and Parro's Methodology				
Welfare				
Country	Total	Term of Trade	Volume of Trade	Real wage
Burundi	0,10%	-0,35%	0,45%	-1,30%
Kenya	0,89%	0,59%	0,30%	2,40%
Rwanda	1,10%	-0,30%	1,40%	-1,20%
Tanzania	0,31%	-0,09%	0,40%	-0,28%
Uganda	0,03%	-0,39%	0,42%	-1,70%

Counterfactuals based on elasticities computed from Feenstra's Methodology				
Welfare				
Country	Total	Term of Trade	Volume of Trade	Real wage
Burundi	-0,42%	-0,76%	0,22%	-3,40%
Kenya	1,10%	0,83%	0,22%	3,20%
Rwanda	0,43%	-0,48%	0,92%	-3,20%
Tanzania	0,08%	-0,18%	0,26%	-0,93%
Uganda	-0,30%	-0,51%	0,21%	-2,50%

Table 2.4: Welfare Effects of EAC's tariff reductions

the impact of the EAC on real wages (Equation 2.13). The main result of this analysis is that the EAC increases the welfare of individuals in the five countries of the trade bloc. These gains are however small for some countries. Kenya and Rwanda benefits of an increase of well-being of approximately 1% but gains in Tanzania, Burundi and Uganda are negligible. For the latter two countries, the counterfactual done with the Feenstra's elasticities (at the bottom of Table 2.4), shows that the impact of the EAC is even detrimental. In fact for these two countries, and to a lesser extent for Tanzania, this customs union has fostered the volume of trade but has also generated an equivalent deterioration of the terms of trade. In other words, while we can be confident about the welfare improvement in Kenya and Rwanda, the consequence of the EAC for Tanzania, Burundi and Uganda is less clear. The case of Kenya is particularly interesting since this country is the sole to improve its term of trade thanks to the EAC. To understand this result, first note that the material prices decrease between 0.07% and 2.51% in all countries excepted in Kenya where these prices increase by 2.58%. Furthermore, wage increases by 6.26% in Kenya while in all other members this



Counterfactuals based on elasticities computed from Caliendo and Parro's Methodology				
Country	Terms of Trade		Volume of Trade	
	EAC	Rest of the World	EAC	Rest of the World
Burundi	0,00%	-0,35%	1,10%	-0,64%
Kenya	0,05%	0,55%	0,06%	0,24%
Rwanda	-0,03%	-0,27%	3,20%	-1,80%
Tanzania	-0,02%	-0,08%	0,76%	-0,36%
Uganda	-0,07%	-0,32%	0,90%	-0,48%

Counterfactuals based on elasticities computed from Feenstra's Methodology				
Country	Terms of Trade		Volume of Trade	
	EAC	Rest of the World	EAC	Rest of the World
Burundi	0,00%	-0,76%	0,75%	-0,41%
Kenya	0,06%	0,77%	0,02%	0,21%
Rwanda	-0,04%	-0,44%	1,90%	-0,98%
Tanzania	-0,02%	-0,15%	0,63%	-0,38%
Uganda	-0,09%	-0,42%	0,55%	-0,34%

Table 2.5: Bilateral welfare effects from EAC's tariff reductions

variable decreases strongly (a reduction between 2,50% and 13.02%). As a result, because export prices increase when change in wages is higher than the change in material prices, Kenya benefits of an appreciation of its terms of trade. The fact that the EAC leads to strong decrease in wages and to a small decrease in prices in Rwanda, Tanzania, Burundi and Uganda also explains the negative impact of the EAC on real wages in these countries (Column 4).

So far, trade diversion has not been caught, to tackle it, Table (2.5) decomposes the terms of trade and the volume of trade by considering exchanges between countries of the EAC and with the rest-of-the world. In Column 1 and 2, we verify that the previous results about the deterioration of the terms of trade mainly comes from a deterioration with the rest-of-the world. Column 3 displays the trade creation effect of the EAC, already found in a different way in our section concerning the gravity equation. Finally Column 4 presents clear evidence of trade diversion. This trade diversion has been particularly significant in Rwanda and in Burundi. These countries are also the ones where the trade creation has been

the strongest. These results are robust to change in trade elasticities (Table at the bottom of 2.5).

#### 2.4.1.2 Sectoral analysis

The table (2.6) presents the sectoral contribution on welfare (still with the elasticities obtained from Caliendo and Parro (2015) and computed from Feenstra (1994), Broda and Weinstein (2006) and Soderbery (2018)).

The agricultural sector is the sector which explains the bulk of our results concerning the deterioration of the terms of trade in Burundi, Uganda, Rwanda and Tanzania and the appreciation of them in Kenya. Petroleum and Chemicals also have a significant contribution in almost all countries (excepted in Burundi). For instance in Uganda the deterioration is mainly explained by two sectors, Agriculture and Petroleum/Chemicals which contribute to 90% of the reduction in the terms of trade. This result, that most of the aggregate change in terms of trade is explained by few sectors is also found by Caliendo and Parro (2015). In their analysis of the NAFTA, this result comes from the strong input-output feedback in three sectors (Electrical Machinery, Communication Equipment, and Autos). In the EAC, such a possibility is credible for Chemicals and Agriculture (think to fertilizers), but the main explanation lies in the strong reduction of tariffs in the sectors that stand out from the rest. For instance the agricultural sector has recorded the most significant reduction in tariffs (see Appendix A, Table 2.1). This reduction is magnified by the share of materials used in the production. Indeed large shares of materials and strong reductions in tariffs have large impact on sectoral export prices and then on the sectoral contribution on welfare. Three of five countries had in 1999 very high tariffs (above the mean and median), for instance, Burundi applied a tariff of 26% (while the mean and the median across sectors were of 24% and 20%). Consequently, the reduction of tariffs in the agricultural sector (from 26% to 5%

Counterfactuals based on elasticities computed from Caliendo and Parro's Methodology										
Sectors	Burundi		Kenya		Rwanda		Tanzania		Uganda	
	Terms of Trade	Volume of Trade	Terms of Trade	Volume of Trade	Terms of Trade	Volume of Trade	Terms of Trade	Volume of Trade	Terms of Trade	Volume of Trade
Agriculture	95,60%	3,80%	82,30%	18,80%	85,80%	3,09%	66,10%	-0,44%	81%	-0,77%
Fishing	0,60%	0,40%	0,15%	0,01%	0,03%	-0,58%	0,71%	0,00%	0,53%	0,02%
Mining & Quarrying	0,88%	5,03%	1,87%	4,68%	5,15%	2,12%	10,70%	0,26%	0,89%	2,15%
Food & Beverages	-0,16%	13,60%	3,39%	4,16%	-0,29%	24,00%	5,40%	5,63%	3,64%	6,61%
Textiles & Wearing	0,78%	18,10%	1,99%	2,89%	0,29%	6,24%	1,12%	1,22%	0,54%	5,84%
Wood & Paper	-0,02%	16,60%	0,80%	5,73%	0,28%	16,40%	1,00%	23,00%	0,70%	20,20%
Petroleum, Chemicals*	1,82%	47,90%	7,46%	43,30%	7,48%	48,30%	9,32%	68,40%	10,60%	74,10%
Metal Products	0,18%	5,44%	0,84%	4,40%	0,95%	2,05%	2,70%	3,57%	1,53%	2,26%
Electrical & Machinery	0,09%	-5,46%	0,74%	10,30%	0,13%	-1,70%	1,70%	-0,67%	0,65%	-7,64%
Transport Equipment	0,10%	-5,74%	0,31%	4,81%	0,15%	-0,62%	0,65%	-1,02%	0,35%	-2,61%
Other Manufacturing	0,09%	0,35%	0,15%	0,85%	0,05%	0,72%	0,68%	0,03%	0,08%	0,20%

Counterfactuals based on elasticities computed from Feenstra's Methodology										
Sectors	Burundi		Kenya		Rwanda		Tanzania		Uganda	
	Terms of Trade	Volume of Trade	Terms of Trade	Volume of Trade	Terms of Trade	Volume of Trade	Terms of Trade	Volume of Trade	Terms of Trade	Volume of Trade
Agriculture	98,00%	3,91%	82,00%	9,70%	88,60%	0,99%	69,20%	-1,49%	79%	-1,92%
Fishing	0,40%	0,03%	0,11%	0,03%	0,02%	-0,91%	0,57%	0,00%	0,31%	0,00%
Mining & Quarrying	0,58%	0,36%	1,18%	3,39%	2,90%	0,25%	6,02%	-0,75%	0,91%	0,31%
Food & Beverages	-0,03%	21,50%	4,42%	7,08%	-0,25%	43,30%	6,81%	9,93%	5,14%	19,60%
Textiles & Wearing	0,53%	7,16%	2,07%	3,13%	0,26%	3,24%	1,11%	0,11%	0,57%	2,04%
Wood & Paper	0,03%	2,49%	0,86%	5,09%	0,28%	4,22%	0,89%	6,53%	0,76%	9,66%
Petroleum, Chemicals*	1,22%	-12,90%	6,84%	31,70%	7,01%	23,30%	7,10%	14,40%	10,60%	18,40%
Metal Products	-0,94%	104,00%	1,19%	14,40%	0,87%	29,00%	5,64%	80,80%	1,72%	74,30%
Electrical & Machinery	0,07%	-12,20%	0,79%	15,40%	0,14%	-3,63%	1,42%	-6,32%	0,69%	-15,60%
Transport Equipment	0,12%	-15,20%	0,33%	8,62%	0,12%	-1,63%	0,51%	-3,28%	0,38%	-6,75%
Other Manufacturing	0,05%	0,65%	0,17%	1,50%	0,05%	1,83%	0,75%	0,04%	0,08%	-0,05%

Table 2.6: Sectoral contribution to welfare effects from EAC's tariff reductions (with elasticities from Caliendo and Parro's Methodology)

in 2009) explains the strong contribution of this sector to change in price and volume.

The impact on the volume of trade has been more balanced. But there are some sectors with strong contribution such as Textile and Wearing in Burundi, Electrical and Machinery in Kenya, Food and Beverages in Rwanda and Wood and Paper in Uganda and Tanzania. In each cases, the strong decreases in the degree of protection linked to the concentration of productivity explains these results. Finally in all countries, the Petroleum and Chemicals sector matter to explain the volume of trade. This sector is a relatively homogeneous sector and then even a small change in tariffs has a strong impact on trade since it is easy to find substitute suppliers (i.e this sector is characterized by a relatively high elasticity,  $\theta^j \simeq 5$  in our analysis based on Feenstra and four time higher according to Caliendo and Parro (Table 1,  $\theta^j \simeq 18$ )).

To study how the EAC has affected sectoral specialization, Table (2.7) presents export shares by industry before and after the EAC trade integration. The interesting result is that the customs union has succeeded to slightly diversify these economies. In all countries, the export share of agricultural product has decreased leaving place mainly to the Petroleum and Chemicals sector but also to other sectors. For instance in Kenya, the agricultural sector account for 66% of the total export before the EAC, while after this trade integration shock, the concentration of exports in this sector is halved (33%). Rwanda exports more Wood and Paper, Metal Products and other Manufacturing goods. In Tanzania and Uganda, the decrease in the share of the agricultural sector seems to have been compensated by the increase in the share of export coming from the Petroleum and Chemicals sector. The Herfindhal Index at the bottom of Table (2.7) confirms this diversification of economies.

Counterfactuals based on elasticities computed from Caliendo and Parro's Methodology										
Sectors	Burundi		Kenya		Rwanda		Tanzania		Uganda	
	Before	After	Before	After	Before	After	Before	After	Before	After
Agriculture	95,00%	94,00%	66,00%	33,00%	84,00%	81,00%	70,00%	61,00%	92%	82,00%
Fishing	0,51%	0,51%	0,11%	0,11%	0,00%	0,00%	0,74%	0,64%	0,56%	0,51%
Mining & Quarrying	2,90%	2,60%	2,40%	1,90%	12,00%	10,00%	13,00%	12,00%	0,24%	0,23%
Food & Beverages	0,43%	0,50%	9,40%	7,00%	0,45%	0,34%	7,50%	8,30%	5,80%	5,50%
Textiles & Wearing	0,08%	0,10%	3,40%	3,00%	0,10%	0,13%	1,50%	1,70%	0,16%	0,53%
Wood & Paper	0,11%	0,40%	1,50%	6,70%	0,22%	1,10%	0,54%	1,80%	0,08%	3,00%
Petroleum, Chemicals*	0,11%	1,30%	13,00%	44,00%	1,60%	5,60%	3,10%	11,00%	0,61%	7,20%
Metal Products	0,01%	0,01%	1,70%	2,40%	0,58%	1,00%	1,40%	1,20%	0,21%	0,30%
Electrical & Machinery	0,06%	0,12%	2,00%	0,18%	0,62%	0,72%	1,40%	0,36%	0,57%	2,44%
Transport Equipment	0,28%	0,32%	0,61%	0,44%	0,03%	0,09%	0,09%	0,17%	0,18%	2,79%
Other Manufacturing	0,00%	0,00%	0,20%	0,16%	0,02%	2,20%	1,10%	0,98%	0,01%	0,02%
Normalized Herfindahl	0,91	0,88	0,44	0,28	0,72	0,65	0,49	0,38	0,84	0,67

Counterfactuals based on elasticities computed from Feenstra's Methodology										
Sectors	Burundi		Kenya		Rwanda		Tanzania		Uganda	
	Before	After	Before	After	Before	After	Before	After	Before	After
Agriculture	96,00%	96,00%	65,00%	41,00%	90,00%	85,00%	69,00%	64,00%	89%	85,00%
Fishing	0,34%	0,32%	0,08%	0,06%	0,00%	0,00%	0,55%	0,50%	0,32%	0,30%
Mining & Quarrying	2,10%	2,00%	1,50%	1,10%	6,00%	5,00%	7,00%	6,40%	0,16%	0,15%
Food & Beverages	0,57%	0,73%	12,00%	10,00%	0,75%	0,64%	10,00%	12,00%	8,40%	9,20%
Textiles & Wearing	0,10%	0,10%	3,50%	2,80%	0,13%	0,13%	1,60%	1,60%	0,17%	0,26%
Wood & Paper	0,12%	0,16%	1,60%	2,20%	0,26%	0,44%	0,57%	0,68%	0,07%	0,37%
Petroleum, Chemicals*	0,09%	0,19%	12,00%	13,00%	1,30%	1,50%	2,50%	3,20%	0,49%	1,00%
Metal Products	0,03%	0,04%	2,40%	27,00%	1,40%	6,70%	7,00%	9,70%	0,72%	3,30%
Electrical & Machinery	0,07%	0,10%	1,50%	1,50%	0,23%	0,40%	0,77%	0,99%	0,38%	0,44%
Transport Equipment	0,30%	0,35%	0,63%	0,53%	0,04%	0,04%	0,10%	0,10%	0,17%	0,21%
Other Manufacturing	0,00%	0,00%	0,23%	0,23%	0,03%	0,05%	1,20%	1,20%	0,01%	0,04%
Normalized Herfindahl	0,92	0,92	0,42	0,24	0,80	0,72	0,47	0,41	0,79	0,72

Table 2.7: Sectoral export shares

### 2.4.2 Trade in intermediate goods matters

We now analyze how results are modified by some important changes in the model assumptions, especially when we remove the presence of Input-Output, when we consider only one sector and when we drop intermediate goods. The model without I/O and without materials are multi-sector models, thus comparing the results of these model (Column 1 and 3) with the one sector model (Column 2) shows that both intermediate goods and input-output linkages amplify the welfare effects of the EAC. We can also note that there are few differences between the model without I/O and the model without materials. Only the gains in Kenya and in Uganda slightly increase from respectively 1.54% to 1.55% and from 0.23% to 0.24% when we compare the two models. Similar small changes are also found for the NAFTA concerning the U.S. and Canada (the welfare varies by respectively 0.01% and -0.01%), but with a noticeable difference concerning Mexico where the model with intermediate goods leads to predict a 0.16% increases in the welfare gain (see Caliendo and Parro (2015, Table 11)). Clearly members of the EAC are similar developed countries not characterized by the kind of vertical specialization in the manufacturing sector that the NAFTA has fostered in Mexico. In fact the introduction of intermediate goods and I/O feedback leads to reduce the welfare gains obtained thanks to the EAC for all countries excepted for Kenya (compare our benchmark result in (2.4) with the Table (2.8) below). Models that do not take into account intermediate goods and the heterogeneity of sectors leads to overestimate the positive impact of the EAC in Burundi, Rwanda, Tanzania and Uganda. Furthermore, this table also shows that the main result of our baseline (see Table, 2.4) are robust to significant change in assumptions: welfare gains are small and the main winners are Kenya and Rwanda.

Counterfactuals based on elasticities computed from Caliendo and Parro's Methodology			
Country	Welfare		
	Without I/O	One sector	No materials
Burundi	0,33%	0,23%	0,33%
Kenya	0,65%	0,85%	0,65%
Rwanda	1,55%	1,48%	1,54%
Tanzania	0,40%	0,43%	0,40%
Uganda	0,24%	0,04%	0,23%

Counterfactuals based on elasticities computed from Feenstra's Methodology			
Country	Welfare		
	Without I/O	One sector	No materials
Burundi	0,03%	0,23%	0,03%
Kenya	0,70%	0,85%	0,70%
Rwanda	0,83%	1,48%	0,82%
Tanzania	0,31%	0,43%	0,31%
Uganda	-0,05%	0,04%	-0,04%

Table 2.8: Welfare gains and trade effects from EAC tariff changes 1999 - 2009 (%)

### 2.4.3 About Trade Deficit

The previous analysis was not based on the raw observed data but on the counterfactual equilibrium that eliminates aggregate deficits in all countries. The trade balance assumption is commonly used in many general equilibrium models despite its highly unrealistic nature. However, in most cases, the introduction of a trade imbalance does not affect the outcome (see Dekle et al., 2007). This is also the case for the EAC.

Table (2.9) shows that when we take into account trade deficits, there are small welfare gains for all members. Countries that benefit the most are still Kenya and Rwanda.

Impact of real wages is less negative which is quite logical since the trade balance assumption leads to strong adjustment of nominal wages. The current analysis thus leads to have a more optimistic point of view regarding the impact of the EAC on real wages in

particular in Rwanda (in Kenya the effect was already positive with a percentage of 2.4% compare to 2.3% now, and in Tanzania the percentage is now positive but however small).

Counterfactuals based on elasticities computed from Caliendo and Parro's Methodology				
Welfare				
Country	Total	Terms of Trade	Volume of Trade	Real Wages
Burundi	0,04%	-0,01%	0,05%	-0,66%
Kenya	0,34%	0,09%	0,25%	2,30%
Rwanda	0,16%	-0,03%	0,18%	1,00%
Tanzania	0,06%	0,00%	0,07%	0,26%
Uganda	0,03%	-0,03%	0,06%	-0,33%

Counterfactuals based on elasticities computed from Feenstra's Methodology				
Welfare				
Country	Total	Terms of Trade	Volume of Trade	Real Wages
Burundi	0,03%	-0,01%	0,04%	-0,46%
Kenya	0,23%	0,08%	0,15%	1,70%
Rwanda	0,07%	-0,03%	0,10%	-1,30%
Tanzania	0,06%	0,00%	0,06%	0,22%
Uganda	0,02%	-0,03%	0,05%	-0,31%

Table 2.9: Welfare effects from EAC tariff reductions, with trade deficit

Table (2.10) shows the evolution of the terms of trade and the volume of trade with EAC members and the rest of the world. Trade diversion is lower than previously found in a situation without a deficit (compare with Table, 2.5). The overall picture is however similar to what has been obtained with trade balance.



Counterfactuals based on elasticities computed from Caliendo and Parro's Methodology				
Country	Terms Of Trade		Volume of Trade	
	EAC	Rest of the World	EAC	Rest of the World
Burundi	-0,01%	0,00%	0,39%	-0,34%
Kenya	0,02%	0,07%	0,01%	0,24%
Rwanda	-0,02%	0,00%	1,20%	-1,00%
Tanzania	-0,01%	0,00%	0,18%	-0,12%
Uganda	-0,03%	-0,01%	0,36%	-0,30%

Counterfactuals based on elasticities computed from Feenstra's Methodology				
Country	Terms Of Trade		Volume of Trade	
	EAC	Rest of the World	EAC	Rest of the World
Burundi	-0,01%	-0,01%	0,26%	-0,22%
Kenya	0,02%	0,06%	0,01%	0,14%
Rwanda	-0,02%	-0,01%	1,00%	-0,91%
Tanzania	-0,01%	0,00%	0,11%	-0,05%
Uganda	-0,02%	-0,01%	0,24%	-0,19%

Table 2.10: Bilateral welfare effects from EAC tariff reductions, with trade deficit

## 2.5 Conclusion

The debate about the benefit of RTAs has a long history. With regard to African countries, the consensus in the 1990s was based on little hope of trade creation and a high risk of trade diversion (Foroutan and Pritchett, 1993; Rodrik, 1998). However, the statistical tools and the data available at the time, prevented researchers from going beyond mere speculation. Using a structural gravity equation we provide consistent estimates of the trade creation effect of the EAC agreement. The flip side of this analysis is that by controlling for multilateral resistances, we cannot study trade diversion. Then we rely on the general equilibrium model proposed by Caliendo and Parro (2015) to assess the whole impact of the EAC. We find that this agreement deteriorates the terms of trade, diverts trade from the rest-of-the world and negatively affects real wages. Only Kenya and Rwanda record significant welfare gains. The

good news for other countries, however, is in the sector analysis. Indeed, in all countries, the share of agricultural exports has declined, leaving room for other sectors. This structural change is welcome in countries where demographic profiles require job creation. In other words, although the static trade model presented here projects small welfare gains, it is possible that the structural change observed may be much more beneficial in the long term.<sup>6</sup>

## 2.6 Appendix A

Imports (Millions of dollar)			
Country	Value	Country	Value
Argentina	89300	Ireland	76500
Australia	48200	Italia	254000
Austria	51200	Japan	330000
Burundi	413	Kenya	4520
Brazil	76400	Madagascar	782
Central African Rep.	157	Mexico	135000
Canada	119000	Mali	1460
Chili	25000	Mauritius	3940
China	122000	Malawi	1140
Côte d'Ivoire	10100	Nigeria	7760
Cameroon	2340	Norway	29200
Germany	480000	New Zealand	24300
Denmark	55000	Portugal	55600
Egypt	25700	Rwanda	387
Spain	110000	Sweden	51300
Ethiopia	2300	Togo	1060
Finland	34700	Tunisia	15000
France	338000	Turkey	47500
Gabon	1670	Tanzania	2650
United Kingdom	336000	Uganda	1760
Guinea	938	United States	1020000
Greece	72400	South Africa	25200
Indonesia	36500	Zambia	1420
India	66700	Rest of the World	1620000

Table 2.11: Flows by importers in 1999

<sup>6</sup>However, we observed an increasing share of oil and chemical exports that certainly represents development opportunities, but also, potential resource curses.

Sector	Imports Tariffs (%)									
	Burundi		Kenya		Rwanda		Tanzania		Uganda	
	1999	2009	1999	2009	1999	2009	1999	2009	1999	2009
Agriculture	27,44	4,69	15,39	5,15	41,03	5,15	29,45	5,15	22,96	5,15
Fishing	40,00	20,00	15,97	20,00	60,56	20,00	39,51	20,00	29,02	20,00
Mining & Quarrying	10,86	3,73	14,18	3,73	13,13	3,73	22,97	3,73	10,86	3,73
Food & Beverages	38,09	24,63	19,80	24,95	78,32	24,95	33,66	24,95	43,61	24,95
Textiles & Wearing	34,75	21,07	19,51	21,09	49,81	21,09	18,85	21,09	23,33	21,09
Wood & Paper	20,56	14,90	18,19	14,90	39,67	14,90	29,98	14,90	18,34	14,90
Petroleum, Chemicals*	16,42	9,86	15,48	9,86	29,33	9,86	21,93	9,86	13,95	9,86
Metal Products	16,96	11,22	16,07	11,22	27,99	11,22	26,32	11,22	15,39	11,22
Electrical & Machinery	18,78	8,57	13,26	8,57	33,86	8,57	22,05	8,57	16,22	8,57
Transport Equipment	19,67	7,21	12,14	7,21	24,08	7,21	17,17	7,21	14,37	7,21
Other Manufacturing	34,90	22,05	20,55	22,05	64,86	22,05	26,92	22,05	26,01	22,05

Table 2.12: Tariff changes between 1999 and 2009

## **Part III**

### **Trade and Conflicts**

# Chapter 3

## On the Economic Geography of Trade and Ethnic War

### 3.1 Introduction

“The old new economic geography gains a new lease on life once you shift your focus to the developing countries” P. Krugman (2011)

Economic geography is an important factor of development as illustrated by the fact that the market access accounts for a huge share of global GDP per capita (Redding and Venables, 2004; Mayer and Head, 2011). As a result, the Old New Economic Geography (to paraphrase Krugman, 2011), referred to as ONEG, which focuses on the effect of transport and commuting costs that are so high in many developing countries, provides useful tools to understand the unequal development of many regions in Africa, Asia or Latin America.

However, in analysing developing countries, authors have often focused their studies on standard variables such as wages in Brazil (Fally et al. 2010), labour mobility in China (Bosker et al. 2012) or firm relocation in corrupted countries (Candau and Dienesch, 2017) and have partially omitted how the spatial economy can influence public policies in emerg-

ing markets. This contrasts sharply with studies devoted to developed countries where regional policies, tax competition and welfare have been analysed in depth through the ONEG's theoretical lens (Baldwin and Krugman, 2004; Charlot et al. 2006; Candau and Dienesch, 2015; Redding, 2016).

Central events that are endemic to developing countries and that have deep spatial roots have never been analyzed. We propose here to study one of these topics: civil wars in developing countries. Civil wars are extremely frequent in developing countries and many of the variables that explain these wars, such as ethnic segregation, unequal development of different groups or the dependence of certain regions, can be challenged by ONEG's concepts.

We propose a model, with two regions and a rest of the world that enables to characterize how local and international trade integration affect the location of capital and the welfare of individuals. We then extend this model to analyse how these changes in welfare can affect the escalation in conflicts between the two regions. Technically, we add to the Footloose Capital model, hereafter FC, of Martin and Rogers (1995), the function of escalation in wars used by Martin, Mayer and Thoenig (2008a). We consider that civil wars reduce the supply of all factors, which affect the number of varieties produced by the manufacturing sector as well as the demand of goods by reducing incomes and the number of consumers. In comparison with the FC model, where dispersion is always stable until free trade, the simple introduction of war destructions and of a rest-of-the world made the agglomeration of capital in one region sustainable for an intermediate level of trade integration. Both local and trade integration improves welfare whatever the spatial configuration. However, the model shows that what matter is not the absolute change in welfare but the change in the opportunity costs of war due to trade integration under the different equilibrium. Under asymmetrical dependency, i.e. when one region hosts all the capital while the other region is peripheral depending on importation from the Core and the rest-of-the world, trade integration first

reduces the probability of conflicts but after a critical level, this integration is also a way to get income under war and consequently the risk of war is increasing.

In contrast under the symmetrical equilibrium, the probability of civil wars always increase with international trade integration, but is reduced when countries have a good internal integration.

In a first part, this article presents the theoretical model used, then in a second part details its implications in terms of well-being and in particular analyses the impact of local and international integration on real wages. The third part analyses the consequences of this trade integration on the probability of conflicts. A fourth part discusses the robustness of the results and proposes some extensions.

## **3.2 On the theoretical impact of regional and international trade on wars**

### **3.2.1 On the agglomeration of capital**

Our analysis is based on a regional economics model (Martin and Roger, 1995; Baldwin et al. 2003) extended to consider international trade and regional escalation to war. There are two regions in this economy, called A and B that belong to the same country, and the rest-of-the world (superscript  $\circ$ ). There are two kind of factor, labour ( $L_r$  with  $r = \{A, B\}$ ) and capital ( $K_r$ ), two sectors, a Constant Returns to Scale (CRS) activity, agriculture, that produces a homogeneous good under perfect competition and an Increasing Returns to Scale (IRS) activity that produces differentiated manufactured goods. We assume that the possible economic effect of a war is a decrease of  $\gamma$  percent in the effective factor used in each region, i.e. under war the supply of labour and capital is  $\gamma L_r$  and  $\gamma K_r$ . What we called “peace” in

this model is the particular case where  $\gamma = 1$ . Variables under peace are thus denoted  $x_r|_{\gamma=1}$  when we need to specify.

Workers are employed in the CRS activity as well as in the IRS and are immobile geographically. Capital is mobile between region but not at the global level. Capital restriction may be a cause of this limited mobility.

The preference of the representative consumer is represented by the standard Dixit-Stiglitz utility function:

$$U_r = M_r^\mu A_r^{1-\mu} \text{ with } M_r = \left[ \sum_n c_i^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}},$$

where  $M$  is the consumption of the manufactures aggregate,  $A$  of the agricultural product,  $n$  the number of varieties and  $\sigma > 1$  the elasticity of substitution among these varieties. The budget constraint is given by  $P_r M_r + pA = Y_r$ , where  $p$  is the price of the agricultural product and  $P_r = (\sum_n p_i^{1-\sigma} di)^{\frac{1}{1-\sigma}}$  the price index of industrial varieties with  $p_i$  the price of a typical variety  $i$ . The impact of  $n$  on the price index depends on the elasticity of substitution.

Concerning the cost function in the industrial sector, the fixed cost involves  $f$  units of capital while the variable cost requires  $v$  units of workers. Thus the total cost of producing  $q_r$  units of a typical manufactured variety is:

$$TC_r = fr_r + vwq_r, \quad (3.1)$$

where  $r$  denotes the rental rate of capital and  $w$  workers' wage. Because each firm produces a distinct variety, the number of firms is also the number of varieties consumed. Thus each firm is a monopolist on the production of its variety. We retain the classical feature of the Dixit-Stiglitz monopolistic competition that firms ignore the effects of their action on income  $Y_r$  and on the price index  $P_r$  which is well adapted to the informal sector. Accordingly, when maximizing its profit, a typical firm sets  $p_r = vw\rho/(\rho - 1)$ . Because there is free entry



and exit, profits are always equal to zero, which, using (3.1) with the previous expression of price gives the level of output  $q_r = (\rho - 1)fr_r/vw$ . In equilibrium, a typical firm employs  $f$  units of capital, so the total demand is  $fn_r$ . As the supply of capital is  $K_r$  in case of peace, and  $\gamma K_r$  with civil conflicts. The equalization gives the number of varieties produced under peace and war (respectively  $K_r/f$  and  $\gamma K_r/f$ ).

These varieties are exchanged between countries under transaction costs which take the form of iceberg costs: if an industrial variety produced in one region is sold at price  $p_r$  on it, then the delivered price of that variety in the other region is going to be  $\tau p_r$  with  $\tau > 1$ . The assumption of iceberg costs implies that firms charge the same producer price in both regions, there is no spatial discrimination and “mill pricing” is optimal. In what follow we often speak about trade integration, which is a reversed measure of these transportation costs, i.e.  $\phi = \tau^{1-\sigma}$ .

Wages in the agricultural sector,  $w$ , are taken as the numeraire and normalized to one. Furthermore we assume that the total stock of capital is normalized to one ( $K_A + K_B = 1$ ). Finally the welfare of individuals is given by the indirect utility denoted  $V_r$ . The sum of real incomes of these individuals in each regions is:

$$V_r^K = \frac{K_r \gamma r_r}{P_r^\mu}, \quad V_r^L = \frac{L_r \gamma w}{P_r^\mu},$$

The relocation of capital stops when nominal rewards are equalized in case of dispersion,  $r_A = r_B$ , or when agglomeration in one location generates a higher relative profit  $r_A > r_B$ .

Wars by affecting the labour force as well as the supply of capital affects simultaneously the local competition (i.e. the number of firms  $n_r$ ) and the market size (i.e. the number of people  $L_r$ ). Usually in large market, the agglomeration of capital and thus of firms, exacerbates local competition, triggering a slump in the price index, and thereby in operating profits too. Here wars, by destroying firms, directly affect this “market crowding effect”. The second effect that usually arises in period of peace with an agglomeration of activities,

is that large markets generate more profits and attract plants because firms find significant outlets there. Wars directly reduce nominal income and thus this “market-size effect”. Trade integration with the rest-of-the world plays in the opposite direction by providing new opportunities of sales to domestic firms but also more competition. Indeed the varieties produced by foreigner firms also enter in the consumption basket of consumers, and thus competition is fiercer reducing the returns of the domestic capital.

In comparison with the literature, under autarky with the rest of the world  $\phi^\circ = 0$ , this model is the footloose capital model of Martin and Roger (1995). Here the introduction of an additional demand provides an incentive to agglomerate capital in one region in order to benefit of increasing returns by serving the external market. On the contrary regional wars, by weakening agglomeration forces, delay the development of a rich region. From this model, we retain the following result.

(Endogeneous Agglomeration): The agglomeration of capital is positively influenced by regional integration. Civil wars require a deeper level of regional integration to make agglomeration profitable.

The market clearing condition on the good market gives:

$$fr_A = \frac{Y_A}{\Delta_A} + \phi \frac{Y_B}{\Delta_B} + \frac{\phi^\circ Y^\circ}{\Delta^\circ} \quad (3.2)$$

with

$$\phi \equiv \tau^{1-\sigma}, \quad \phi_r^\circ \equiv (\tau_r^\circ)^{1-\sigma}$$

$$\Delta_A \equiv (\gamma K_A + \phi \gamma K_B + \phi^\circ K^\circ) / f \quad (3.3)$$

$$\Delta_B \equiv (\phi \gamma K_A + \gamma K_B + \phi^\circ K^\circ) / f$$

$$\Delta^\circ \equiv (\phi^\circ \gamma K_A + \phi^\circ \gamma K_B + K^\circ) / f$$

and a similar expression in the South:

$$fr_B = \phi \frac{Y_A}{\Delta_A} + \frac{Y_B}{\Delta_B} + \frac{\phi^\circ Y^\circ}{\Delta^\circ} \quad (3.4)$$

Income in the rest-of-the world is taken as given  $Y_r^\circ = K_r^\circ r_r^\circ + L^\circ w^\circ$ , while incomes in the two regions depend on the location of capital:

$$Y_r = \gamma K_r r_r + \gamma L w \quad (3.5)$$

Using the equation of income (3.5), we resolve the system (3.2) and (3.4) to get the capital rewards  $r_r$ . In addition to the normalization already presented in the text, we make additional simplification:  $L = 1$ ,  $f = 1$ . We then resolve  $r_A = r_B$  with respect to  $\phi$  under agglomeration in region A, i.e  $K_A = 1$  which yields:

$$\phi^s = \frac{\gamma(1-b) - \Pi^\circ K^\circ}{(1 + \Pi^\circ + b)\gamma}$$

where  $\Pi^\circ$  is the market access to the rest-of-the world, i.e.  $\Pi^\circ = \phi^\circ Y^\circ / \Delta^\circ$  and  $b = \mu / \sigma$ . This critical point is the level of regional trade integration at which the agglomerated equilibria is sustainable. From this expression we get  $\partial \phi^s / \partial \gamma > 0$ , which proves the last part of Proposition 1.

### 3.2.2 Escalation to war

The timing of the game is borrowed to MMT: a dispute leads to chose a negotiation protocol based on welfare, information is privately revealed and negotiations take place. Depending of the outcome of these negotiations, the situation evolves toward war or peace. Then the activities of production, trade and consumption take place as described in the previous section.

Leaders are utilitarians and maximize the sum of welfares during the period of peace,  $W_A|_{\gamma=1} = K_A V_A^K|_{\gamma=1} + L_A V_A^L|_{\gamma=1}$  and  $W_B|_{\gamma=1} = L_B V_B^L|_{\gamma=1}$  and get a stochastic outside option  $(\tilde{W}_A, \tilde{W}_B)$ .

Because peace is a Pareto improvement with respect to war, we always have  $W_A|_{\gamma=1} + W_B|_{\gamma=1} > \tilde{W}_A + \tilde{W}_B$ . An agreement under this condition allows to avoid escalation to war. With MMT we consider that the stochastic outside options  $(\tilde{W}_A, \tilde{W}_B)$  are equal on average to the equilibrium values  $(W_A, W_B)$  such as  $\tilde{W}_A = (1 - \tilde{u}_A)W_A$  and  $\tilde{W}_B = (1 - \tilde{u}_B)W_B$  where  $\tilde{u}_A$  and  $\tilde{u}_B$  are private informations (e.g the military strength), with unconditional mean and variance such as  $E(\tilde{u}_A) = E(\tilde{u}_B) = 0$  and  $var(\tilde{u}_A) = var(\tilde{u}_B) = v^2/8$  where  $v$  the degree of informational asymmetry between the regions.

In comparison with the classical model of Myerson and Satherwaite (1983), the class of protocols considered is smaller since mechanism design is without commitment. Leaders can quit the negotiation table to enter war. Furthermore, in this game the disagreement payoffs are negatively correlated. MMT show that the bargaining protocol chosen optimally by the two countries corresponds to a Nash Bargaining protocol. They propose the Figure (3.1) to explain the bargaining problem simply. Private informations  $\tilde{u}_A$  and  $\tilde{u}_B$  are distributed with a uniform law in the triangle CAF. Wars occur for every outside option  $\tilde{W}_A, \tilde{W}_B$  represented in the dashed area BCFG with  $AG=3/4AE$  and  $AB=3/4AD$ . The probability of escalation is thus represented by this dashed area conditioned on the distribution of private informations CAF,  $Pr(war_{AB}) = 1 - \frac{BCFG}{CAF}$  which gives:

$$Pr(war_{AB}) = 1 - \frac{1}{4v^2} \frac{[(W_A|_{\gamma=1} - W_A) + (W_B|_{\gamma=1} - W_B)]^2}{W_A W_B}. \quad (3.6)$$

This expression reflects the rationalist view of the current paper, since the probability of escalation to war only depends on the the opportunity cost of war, i.e. the differential between the surplus under peace and war.

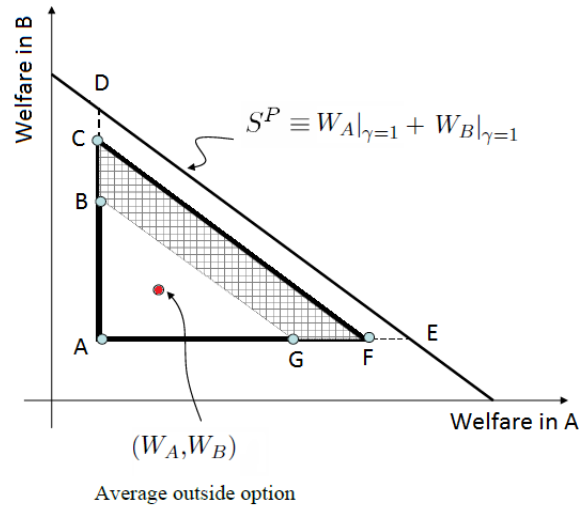


Figure 3.1: Regional Trade Integration and Wars  
*Numerical simulations done with  $\sigma = 4$ ,  $\mu = 0.6$ ,  $Y^\circ = 2$ ,  $h^\circ = 2$ ,  $\gamma = 0.9$ .*

### 3.3 Welfare

As reflected by the equation of escalation into wars (3.6), the impact of local and international trade on the probability of conflicts is mainly based on the impact of trade integration on welfares. Then this section analyzes this impact under the Core-Periphery equilibrium and the dispersive one, before to analyze how the probability of conflicts evolves. Comparisons between changes under wars and peace are also proposed.

#### 3.3.0.1 Welfare under the concentration of capital

Here we focus our analysis on the case where the agglomeration of capital in one region is stable (region A is chosen as the Core). Such a spatial configuration where one region is richer than the other seems the most appropriated to study internal conflicts that often oppose a peripheral etnies to a central region. We start our analysis by workers in the Core who are indifferent about local trade, because all the varities they consume are produced at the

Core. Formally:

$$\frac{\partial V_A^L}{\partial \phi} = -a\gamma L\Delta_A^{-a-1} \frac{\partial \Delta_A}{\partial \phi} = 0$$

because under the Core-Periphery equilibrium  $\frac{\partial \Delta_A}{\partial \phi} = 0$  thus  $\frac{\partial V_A^L}{\partial \phi} = 0$ .

We can now turn our attention on the real gains of capital owners in the Core:

$$\frac{\partial V_A^K}{\partial \phi} = \gamma\Delta_A^{-a} \frac{\partial r_A^K}{\partial \phi} \quad (3.7)$$

Clearly the market size effect due to local trade integration is the central factor affecting sales, and thus the capital rewards in this equation. Trade integration raise the capital rent ( $\sigma > \mu$ ),

$$\frac{\partial r_A^K}{\partial \phi} = -\frac{K_0 L \mu \phi (1 + \frac{K_0 \phi_0}{\gamma})}{\gamma (\phi + \frac{K_0 \phi_0}{\gamma})^2 (\mu - \sigma - \sigma \frac{K_0 \phi_0}{\gamma})} > 0, \quad (3.8)$$

which positively affects the real gain,  $\frac{\partial V_A^K}{\partial \phi} > 0$  (see 3.7).

Local trade integration is also beneficial at the periphery, but obviously for a different reason: in that case, individuals wins in terms of purchasing power which enables them to have an access to a wider range of variety. Indeed:

$$\frac{\partial V_B^L}{\partial \phi} = -\gamma^{-a+1} a L (\phi + \frac{K^\circ \phi^\circ}{\gamma})^{-a-1} > 0 \quad (3.9)$$

Since  $a = \frac{\mu}{1-\sigma} < 0$ . We now have to analyse the impact of  $\phi^\circ$ . The welfare of workers in A is positively impacted by the international trade integration:

$$\frac{\partial V_A^L}{\partial \phi^\circ} = -a K^\circ L \mu \gamma^{-a} (1 + \frac{K^\circ \phi^\circ}{\gamma})^{-a-1} > 0 \quad (3.10)$$

The welfare change of capital owner in A,  $\frac{\partial V_A^K}{\partial \phi^\circ}$ , is given by:

$$\frac{\partial V_A^K}{\partial \phi^\circ} = \gamma\Delta_A^{-a} \frac{\partial r_A^K}{\partial \phi^\circ} - a\Delta_A^{-a} r_A^K \frac{\partial \Delta_A}{\partial \phi^\circ} \quad (3.11)$$

Indeed  $\frac{\partial r_A^K}{\partial \phi^\circ} > 0$ . Coming back to (3.11), with  $\frac{\partial \Delta_A}{\partial \phi^\circ} = K^\circ$  and  $a < 0$  yields that the real gains of capital owners increase with  $\phi^\circ$ :

$$\frac{\partial V_A^K}{\partial \phi^\circ} > 0$$

Concerning the real wage at the periphery, the price index decreases with respect to trade integration ( $\frac{\partial \Delta_B}{\partial \phi} = K^\circ$ ) which raises the indirect utility:

$$\frac{\partial V_B^L}{\partial \phi^\circ} = -a\gamma^{-a}LK^\circ \left( \phi + \phi^\circ \frac{K^\circ}{\gamma} \right)^{-a-1} > 0 \quad (3.12)$$

### 3.3.0.2 Comparison of welfare between war and peace under the agglomerated equilibrium

In this section, we compare how welfares vary with trade integration under peace and war, because these changes matter to explain escalation in war.

To show simply these effects, we start with an additional assumption considering that war destructions are negligible with respect to the stock of capital in the rest of the world, such as  $\frac{K_0}{\gamma} \simeq K_0$  when we analyse change in trade integration. In that case, we find from (3.8) that  $\frac{\partial r_A^K}{\partial \phi} = \frac{1}{\gamma} \frac{\partial r_A^K}{\partial \phi} \Big|_{\gamma=1}$ . From (3.7) and (3.3), we get  $\frac{\partial V_A^K}{\partial \phi} = \gamma^{-a} \frac{\partial V_A^K}{\partial \phi} \Big|_{\gamma=1}$ , and because  $\gamma < 1$  and  $a < 0$ , then  $\gamma^{-a} < 1$ , this leads to find that the difference between the welfare gains under peace and war increase with local trade.

$$\frac{\partial V_A^K}{\partial \phi} < \frac{\partial V_A^K}{\partial \phi} \Big|_{\gamma=1}$$

This effect decreases the probability of wars.

In a similar way, from (3.9), we have  $\frac{\partial V_B^L}{\partial \phi} = \gamma^{-a+1} \frac{\partial V_B^L}{\partial \phi} \Big|_{\gamma=1}$  which yields that the welfare gap between peace and war at the periphery increase with local trade:

$$\frac{\partial V_B^L}{\partial \phi} < \frac{\partial V_B^L}{\partial \phi} \Big|_{\gamma=1}$$

Local trade has thus the same effect at the Periphery and at the Core: it reduces the probability of civil war.

Results are similar with international trade integration. Indeed, with  $\frac{K_0}{\gamma} \simeq K_0$ , we find that  $\frac{\partial r_A^K}{\partial \phi^\circ} = \gamma \frac{\partial r_A^K}{\partial \phi^\circ} \Big|_{\gamma=1}$ , thus  $\frac{\partial r_A^K}{\partial \phi^\circ} < \frac{\partial r_A^K}{\partial \phi^\circ} \Big|_{\gamma=1}$  as previously. Furthermore the second term in (3.11), which was not present in the local trade case is smaller under war than under peace (by a factor  $\gamma^{-a}$ ). Thus

$$\frac{\partial V_A^K}{\partial \phi^\circ} < \frac{\partial V_A^K}{\partial \phi^\circ} \Big|_{\gamma=1}$$

The difference between the welfare gains under peace and war increases for capital owners with international trade liberalization. This effect reduces the probability of wars.

Exactly the same relationships is found for workers at the periphery:

$$\frac{\partial V_B^L}{\partial \phi^\circ} < \frac{\partial V_B^L}{\partial \phi^\circ} \Big|_{\gamma=1}$$

### 3.3.0.3 Welfare under dispersion

Workers benefits of trade integration thanks to a reduction of their price index:

$$\frac{\partial \Delta_r}{\partial \phi} = \frac{\gamma}{2} > 0, \quad (3.13)$$

which raises their well-being ( $a < 0$ ):

$$\frac{\partial V_r^L}{\partial \phi} = -a \frac{1}{2} \gamma \Delta_r^{-a-1} \frac{\partial \Delta_r}{\partial \phi} > 0, \quad \text{with } r = A, B \quad (3.14)$$

In comparison with the Core-Periphery model, this positive impact concerns all the workers whatever their location.



Considering the indirect utility of capital owners,  $\frac{\partial V_r^K}{\partial \phi}$  gives:

$$\frac{\partial V_r^K}{\partial \phi} = \frac{\gamma}{2} \left( \Delta_r^{-a} \frac{\partial r_r^K}{\partial \phi} - a \Delta_r^{-a-1} \frac{\partial \Delta_r}{\partial \phi} r_r^K \right) \quad (3.15)$$

where the impact of trade on the capital rent is positive and given by:

$$\frac{\partial r_r^K}{\partial \phi} = \frac{1}{\gamma} \frac{2K^\circ \mu \sigma \phi^\circ (2\frac{K^\circ}{\gamma} L + (\frac{K^\circ r^\circ}{\gamma} + 2L) \phi^\circ)}{(\frac{K^\circ}{\gamma} + \phi^\circ) \left[ (\mu - \sigma)(1 + \phi) - 2\frac{K^\circ}{\gamma} \sigma \phi^\circ \right]^2} > 0 \quad (3.16)$$

Then local trade integration has two complementary and positive effects on this welfare,  $\frac{\partial V_r^K}{\partial \phi} > 0$ , indeed from in eq. (3.15) local trade integration reduces the cost of living (see the second term in (3.15) with  $a < 0$  and (3.13)) and increases operating profit.

Concerning international trade, the price index of goods consumed by workers clearly decrease,

$$\frac{\partial \Delta_r}{\partial \phi^\circ} = K^\circ > 0, \quad (3.17)$$

which improves real wage ( $a < 0$ ):

$$\frac{\partial V_r^L}{\partial \phi^\circ} = -a \frac{\gamma}{2} \Delta_r^{-a-1} \frac{\partial \Delta_r}{\partial \phi^\circ} > 0. \quad (3.18)$$

Concerning capital owners:

$$\frac{\partial V_r^K}{\partial \phi^\circ} = \frac{\gamma}{2} \left( \Delta_r^{-a} \frac{\partial r_r^K}{\partial \phi^\circ} - a \Delta_r^{-a-1} \frac{\partial \Delta_r}{\partial \phi^\circ} r_r^K \right) \quad (3.19)$$

Firms benefit of an increase of the demand with international trade integration, which boosts sales and the capital return such as  $\frac{\partial r_r^K}{\partial \phi^\circ} > 0$ , and since the cost of living is also reduced by the process of international trade liberalization  $\frac{\partial \Delta_r}{\partial \phi^\circ} > 0$  (see 3.17), the welfare of capital owners increase,  $\frac{\partial V_r^K}{\partial \phi^\circ} > 0$ . Local and international trade liberalization are Pareto improvements under this equilibrium.

### 3.3.0.4 Comparison of welfare between war and peace under dispersion

In that case, we find from (3.8) that  $\frac{\partial r_A^K}{\partial \phi} = \frac{1}{\gamma} \frac{\partial r_A^K|_{\gamma=1}}{\partial \phi}$ . From (3.7) and (3.3), we get  $\frac{\partial V_A^K}{\partial \phi} < \gamma^{-a} \frac{\partial V_A^K|_{\gamma=1}}{\partial \phi}$ , and because  $\gamma < 1$  and  $a < 0$ , then  $\gamma^{-a} < 1$ , this leads to conclude that:

$$\frac{\partial V_A^K}{\partial \phi} < \frac{\partial V_A^K|_{\gamma=1}}{\partial \phi}$$

In a similar way, from (3.9), we have  $\frac{\partial V_B^L}{\partial \phi} = \gamma^{-a+1} \frac{\partial V_B^L|_{\gamma=1}}{\partial \phi}$  which yields:

$$\frac{\partial V_B^L}{\partial \phi} < \frac{\partial V_B^L|_{\gamma=1}}{\partial \phi}$$

Concerning international integration  $\phi^\circ$ , we have  $\frac{\partial V_B^L}{\partial \phi^\circ} = \gamma^{-a} \frac{\partial V_B^L|_{\gamma=1}}{\partial \phi^\circ}$  and for capital owners  $\frac{\partial V_A^K}{\partial \phi^\circ} = \gamma^{-a} \frac{\partial V_A^K|_{\gamma=1}}{\partial \phi^\circ}$ ,<sup>1</sup> which gives:

$$\frac{\partial V_A^K}{\partial \phi^\circ} < \frac{\partial V_A^K|_{\gamma=1}}{\partial \phi^\circ}; \frac{\partial V_B^L}{\partial \phi^\circ} < \frac{\partial V_B^L|_{\gamma=1}}{\partial \phi^\circ}$$

All the findings of this section (under the dispersed and the agglomerative equilibria) are summarized by:

Whatever the spatial equilibrium, real gains of workers and of capital owners are fostered by local and international trade integration, both under war and under peace. Furthermore, whatever the scale of trade integration (local or international), the gains of welfare due to trade are higher under peace than under war

<sup>1</sup>In comparison with  $\phi$ , we now have a strict equality because in (3.19) we have  $\frac{\partial \Delta_r}{\partial \phi^\circ}$  that does not depends on  $\gamma$ , and thus we can factorize by  $\gamma^{-a-1}$  which gives  $\frac{\partial V_A^K}{\partial \phi} < \gamma^{-a} \frac{\partial V_A^K|_{\gamma=1}}{\partial \phi}$  while in (3.15) we have  $\frac{\partial \Delta_r}{\partial \phi} = \frac{\gamma}{2}$  which implies that  $\frac{\partial V_A^K}{\partial \phi} < \gamma^{-a} \frac{\partial V_A^K|_{\gamma=1}}{\partial \phi}$ . This means that the positive impact of local trade integration is smaller than the positive impact of international trade integration.

## 3.4 Results

### 3.4.1 Civil war in the Core-Periphery configuration

We first analyse the probability of escalation under the Core-Periphery equilibrium. This equilibrium is legitimated by the fact that it introduce a notion of dependency that is often used to explain conflict. Indeed in our model, in that case of total agglomeration, the Periphery is dependant of the Core to consume all the varieties produced by the nation. This is, from the point of view of many authors (sometimes qualified “neo-marxists”) the typical case where conflicts are the most likely, because trade integration by fostering agglomeration impedes the development process of the periphery. Hirschman (1980) for instance argued that dependent states are subject to the manipulation and coercion of the more powerful region regarding different policies. Then, we successively analyze  $\partial W_A/\partial\phi$  and  $\partial W_B/\partial\phi$  under the Core-Periphery equilibrium. At the periphery, the welfare of workers drives the governmental choice about peace:

$$\partial W_B/\partial\phi = \gamma L_B \frac{\partial V_B^L}{\partial\phi} > 0 \quad (3.20)$$

In contrast, the government in A focus its objective function on capital reward, since workers are unaffected by local trade ( $\frac{\partial V_A^L}{\partial\phi} = 0$ , see the previous section), the governmental argument  $W_A$  only depends on the welfare of capital owners:

$$\partial W_A/\partial\phi = \gamma \frac{\partial V_A^K}{\partial\phi} \quad (3.21)$$

and we already know from (3.15) that the welfare of capital owners is positively affected by trade,  $\frac{\partial V_A^K}{\partial\phi} > 0$ , thus  $\partial W_A/\partial\phi > 0$ . Furthermore, because trade integration brings a bigger improvement under peace than under war ( $\frac{\partial V_r^k}{\partial\phi} < \frac{\partial V_r^k}{\partial\phi}|_{\gamma=1}$  for all factors  $k = K, L$ , and

regions  $r = A, B$ ), the opportunity costs of war ( $W_r|_{\gamma=1} - W_r$ ) increase with  $\phi$  which reduces the probability of escalation in wars both at the Periphery and at the Core. Formally the numerator of (3.6) is increasing in  $\phi$ . Since all these relationships are also verified for  $\phi^\circ$ , the probability of war is also influenced negatively by international trade integration.

There is however a second effect coming from the fact that trade integration reduces, in absolute term, the effect of wars. Indeed at the Periphery, the costs of living is smaller and at the Core the market is larger with these integrations (see Result 2). *Ceteris Paribus*, the outside option “war” is thus more attractive. Putting differently, it is really because the welfare under war is affected (positively) by trade integration that the war is more likely: in Equation (3.6), the denominator is increasing in  $\phi$  and  $\phi^\circ$ , which raises the probability of escalation in wars. These two opposing forces imply that the probability of escalation in war follows a U-curve shape. Around autarky the welfare gains of trade are high, and trade integration by increasing the opportunity costs of wars reduced the likelihood of this event, but after a critical threshold the absolute gain of trade under war is the strongest force which increases the probability of escalation.

Under asymmetrical dependency (Core-Periphery equilibrium), the probability of civil wars first fall and then rise with local and international trade integration.

To illustrate this result, Figure (3.2) plots a numerical simulation of Equation (3.6) with respect to regional trade integration for two different levels of international trade costs. In each case, a U-curve is clearly observed.

Comparing the regular and the dashed line, an increase in the market access of the rest-of-the world reduces the probability of war. However, as discussed at length previously, the effect of the international integration has also a non linear effect on the probability of wars as illustrated by Figure (3.3). In that numerical exercise, the increase of the internal integration exacerbates the probability of escalations (compare the regular and the dashed line), but the impact is stronger when the country is weakly integrated to the rest of the world than under

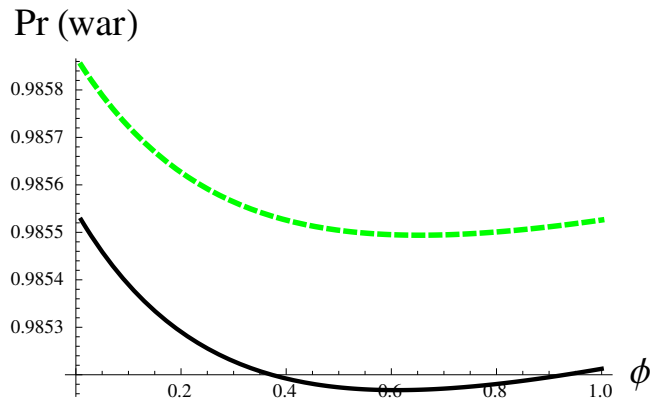


Figure 3.2: Regional Trade Integration and Wars

Numerical simulations done with  $\sigma = 4$ ,  $\mu = 0.6$ ,  $L^\circ = 3$ ,  $v = 1$ ,  $h^\circ = 1$ ,  $r^\circ = 2$ ,  $\gamma = 0.9$ . Black line  $\phi^\circ = 0.9$ , dashed line  $\phi^\circ = 0.95$ . Numerical parameters have been chosen such as the agglomerated equilibrium is always stable (i.e. for these parameters  $\phi^s < 0$ )

a a situation of free trade where the probability of war reaches its maximum.

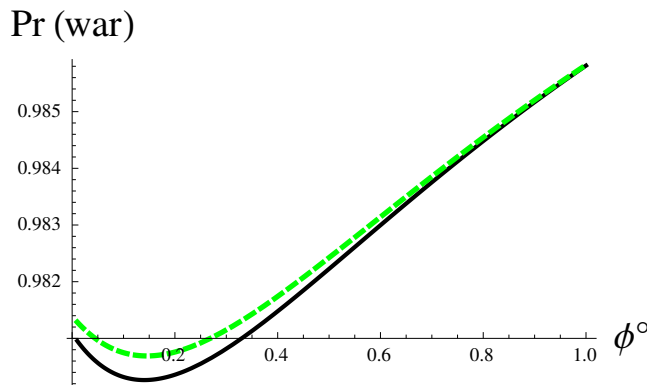


Figure 3.3: International Trade Integration and Wars

Numerical simulations done with  $\sigma = 4$ ,  $\mu = 0.6$ ,  $L^\circ = 3$ ,  $v = 1$ ,  $h^\circ = 1$ ,  $r^\circ = 2$ ,  $\gamma = 0.9$ . Black line  $\phi = 0.6$ , dashed line  $\phi = 0.95$ . Numerical parameters have been chosen such as the agglomerated equilibrium is always stable (i.e. for these parameters  $\phi^s < 0$ )

This result has an interesting corollary, indeed, we have assumed until now that trade integration was possible under war, if we now change this assumption by considering that  $\phi$  and  $\phi^\circ$  cannot be modified, then only the welfare under peace is improved and thus the opportunity costs of war increases, reducing unambiguously the probability of escalation to war. Such a result can even be magnified if we extent this model to consider that civil war can destroy local and international infrastructures (i.e. assuming that trade costs are a

function of war destruction,  $\phi(\gamma)$  and  $\phi^\circ(\gamma)$ ). In that case all the findings found until now demonstrates that welfare will decrease with an increase of trade costs, reducing welfare under wars ( $W_r$ ), implying that the probability of escalation is now reduced first in reason of the comparison with the situation under peace but also in reason of absolute disastrous effect of wars on welfare (the denominator of (3.6) is going to decrease). Trade is a way to buy peace.

### 3.4.2 The dispersed equilibrium

Models in Economic Geography are notorious known to exhibit non linearities, but the one observed here directly comes from the equation of escalation in wars. But with more symmetries between countries in terms of trade dependency, many of the non linearities presented until now vanished. To see this, first consider that under the symmetric equilibrium  $W_A|_{\gamma=1} = W_B|_{\gamma=1}$  and  $W_A = W_B$ , the probability of wars becomes:

$$Pr(war_{AB}) = 1 - \frac{1}{v^2} \left( \frac{W_r|_{\gamma=1} - W_r}{W_r} \right)^2. \quad (3.22)$$

We start by the impact of international trade which is the simplest case. From this expression we know that the probability of escalation decrease under the following condition:

$$\frac{\partial W_r|_{\gamma=1}}{\partial \phi^\circ} > 2 \frac{\partial W_r}{\partial \phi^\circ} \quad (3.23)$$

and from the analysis of welfare we know that  $\frac{\partial W_r|_{\gamma=1}}{\partial \phi^\circ} = \gamma^a \frac{\partial W_r}{\partial \phi^\circ}$  implying that the condition (3.23) is never verified since  $\gamma^a \in ]1, 2[$ . Thus the likelihood of war increase in  $\phi^\circ$ .

Things are quite different regarding internal trade indeed we have  $\frac{\partial V_A^K}{\partial \phi} < \gamma^{-a} \frac{\partial V_A^K|_{\gamma=1}}{\partial \phi}$

(see Footnote 2) implying that the condition

$$\frac{\partial W_r|_{\gamma=1}}{\partial \phi} > 2 \frac{\partial W_r}{\partial \phi} \quad (3.24)$$

can be verified.

In the numerical simulations presented below we find that local and international trade integration indeed have a clear different impact : International trade integration increase the probability of war. On the contrary, a better local integration between regions reduces it.

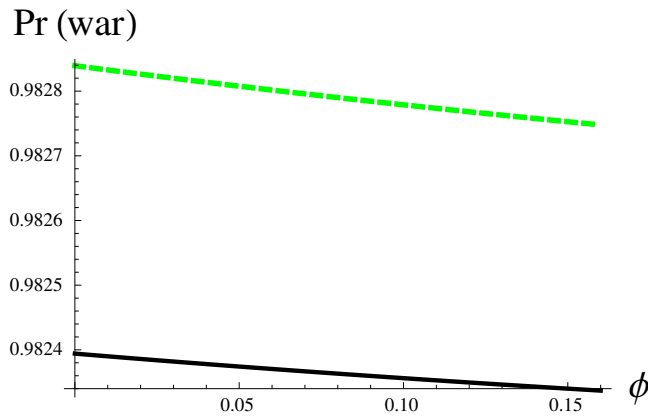


Figure 3.4: Regional Trade Integration and Wars

Numerical simulations done with  $\rho = 4$ ,  $\mu = 0.6$ ,  $L^\circ = 1$ ,  $v = 1$ ,  $h^\circ = 1$ ,  $r^\circ = 1$ ,  $\gamma = 0.9$ . Black line  $\phi^\circ = 0.1$ , dashed line  $\phi^\circ = 0.15$ . We have verified that under these parameter values the dispersed equilibrium is always stable (i.e. for these parameters  $\phi^s \approx 0.19$ ).

We retain the following result:

Under symmetrical dependency, the probability of civil wars always increase with international trade integration, but can be reduced by local trade integration.

We can made the same comment here than before for the Core-Periphery equilibrium, i.e. the increasing part of the escalation in war comes from the beneficial impact that international trade has even under a situation of war. If we cut this channel, then trade liberalization  $\phi^\circ$  only increases welfare under peace and thus reduces the probability of war.

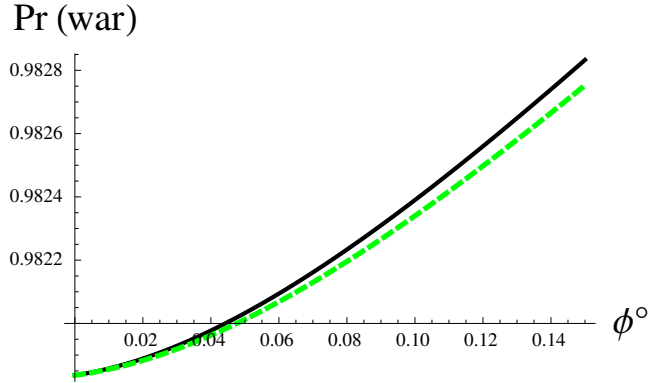


Figure 3.5: International Trade Integration and Wars

Numerical simulations done with  $\rho = 4$ ,  $\mu = 0.6$ ,  $L^\circ = 1$ ,  $v = 1$ ,  $h^\circ = 1$ ,  $r^\circ = 1$ ,  $\gamma = 0.9$ . Black line  $\phi = 0.1$ , dashed line  $\phi = 0.15$ . We have verified that under these parameter values the dispersed equilibrium is always stable (i.e. for these parameters  $\phi^s \approx 0.19$ ).

## 3.5 A (not so) simple empirical test

### 3.5.1 Empirical strategy

Both the results obtained under the Core-Periphery and under the dispersed equilibria shows that the impact of trade on wars crucially depends on its effect on the sum of real wages during the period of wars (we add the subscript  $i$  to describe the situation of an ethny  $r$  in country  $i$ , such as  $W_{ri}$ ). Indeed the U-curve under the agglomerated equilibrium and the increasing impact of international trade integration on conflicts depends on that effect. For instance if trade integration foster real wages under peace  $W_{ri}|_{\gamma=1}$  but have no impact (or have a negative impact) on real wages under wars  $W_r$ , then the odds of war are strictly decreasing in  $\phi^\circ$ . We thus regress these two variables,  $W_r$  and  $W_r|_{\gamma=1}$  with respect to trade:

$$W_{rit}|_{\gamma=1} = a\phi_{rit}^\circ + Z_{rit} + f_t + f_i + e_{rit} \quad (3.25)$$

$$W_{rit} = a\phi_{rit}^\circ + Z_{rit} + f_t + e_{rit} \quad (3.26)$$



where  $Z_{rit}$  is a vector of controls that vary at the ethnic level,  $f_i$  are country fixed effects and  $f_t$  time effects. Since there not so many civil wars (less than fifty) over the period considered, the sample is much smaller when we consider the Equation (3.26) than in the case of Equation (3.25), and thus individual fixed effects are not introduced in this last regression. These two equations are estimated using the OLS estimator as well as the Pseudo-Poisson Maximum Likelihood (PPML) estimator. The PPML estimator is justified here by the fact that there is a significant number of ethnies whose incomes are approximated by zero. The next sector presents our proxy of income which justified the use of this estimator.

### 3.5.2 Data

We need at least two variables that are not easily available at the ethnic level: the incomes of ethnies under war and peace and the level of integration of these ethnies with the rest of the world. This section presents our work on the data to obtain proxies of these variables.

#### 3.5.2.1 Wars and incomes

We first need incomes under period of war and peace. To approximate income at the ethny level we use the night lights pictures provided by satellites from outer space. These data are usefull to approximate income at subnational level in developping countries where no other reliable data is available (Henderson et al., 2012).

More precisely, we use ESRI African countries shapefile that we merge with Murdock (1959) ethnic groups' boundaries shapefile. Night lights rasters come from National Oceanic and Atmospheric Administration (NOAA) and are available between 1992 and 2013. These rasters contain pixels of approximatively 1km square. Every pixel is associated to a number that goes from 0 to 63 indicating the brightness of the light. These rasters are matched with the shapefile obtained earlier and the mean night lights density is com-

puted within each ethnic group-country boundaries for every year. Since satellites' pictures do not distinguish gas flaring activities from real lights, we exclude spatial areas concerned from the result map. The fact that there is no detected night light pictures for some ethnies, explain that the income of these ethnies are considered as null in this database.

We separate period of war and peace by using the Ethnic Power Relation (EPR) database compiled by Wimmer, Cederman and Min (2009) that presents the onset of a new ethnic civil war, taking one for each new ethnic conflict in country  $i$  at a time of year  $t$ . As most civil conflicts only last a few months (only four exceed one year according to the UCDP-GED database), we can safely assume that when this dummy takes one, the GDP approximated by the night light pictures represent incomes during a period of open conflict, while when this dummy takes zero, there are no open conflicts.

### 3.5.2.2 International Trade

As a proxy of international trade integration between ethnies and their partners, the value of trade in specific sectors representing the largest part of exportation in developing countries, namely agricultural goods and mineral products, is used. Formally the sum of exports in the agricultural sector, denoted  $a$ , and the mining sector<sup>2</sup>,  $m$ , are taken into account as follows:

$$\phi^{\circ}_{rit} = \sum_{a=1}^A (p_{ria} * X_{ita}) + \sum_{m=1}^M (p_{rim} * X_{itm})$$

$X_{kit}$  represents country  $i$  exportations at year  $t$  for a sector  $k = a, m$ . The weight  $p_{ria}$  is the ratio of the ethnic group production on the national output concerning this sector, such as  $p_{ria} = \frac{E_{ra}}{E_{ia}}$  where  $E_{ra}$  is the sum of the mean production of crop  $a$  at the ethnic  $r$  (or country  $i$ ) level over the period 1997-2003. The average production is based on Monfreda et al. (2008). This research presents the geographical distribution of 175 crops in the world on

<sup>2</sup>These two sectors are chosen since they represent the lion's share of exportation in the developing countries of our sample.

a 10 km by 10km cell grid. Regarding the mining sector, we approximate the output of each ethnic group by its area. The spatial distribution of mineral resources are taken from U.S. Geological Survey mineral databases which describe metallic and non metallic mineral resources in the world (location, deposit name, geologic characteristics ...).<sup>3</sup> Using natural resources location, we construct ethnic miner weight as  $p_{rim} = \frac{S_{rm}}{\sum_k S_{i,m}^k}$ , where  $S_{rm}$  is the area of the ethnic group where mines,  $m$ , are localised and  $S_{im}^k$  represents the surface of all other ethnic groups  $k$  which share the same natural resources  $m$  in the country  $i$ .

### 3.5.2.3 Controls

Finally we use different controls at the ethnic group level, some vary over time while other are constant denoted by vectors  $Z_{et}$  and  $Z_e$ . Among these variables, we consider etnies that are excluded from regional or national governance (called *excluded*, source: EPR), a binary variable that takes 1 when a diamond mine is in the historical homeland of the ethny (*diamondd*, source: Map of Diamond Resources, Peace Research Institute of Oslo), a dummy variable taking 1 when an on-shore oil field and gas deposit is in the historical homeland of an ethny (called *petroleum*, source: the Petroleum Dataset v.1.1). A binary variable taking 1 when a city with a population larger than 20 000 in 1400 was in the historical homeland (called *old city*, Chandler, 1987). . The average value of malaria stability index for each historical homeland of an ethnic group (called *malariasuit*, source: Kiszewski et al. 2004) and a dummy taking 1 when the ethnic group is partitioned between countries (called *Split*, source: Michapoulos and Papaioannou, 2016).

Geographical variables such as the Log of surface area of the historical homeland of each ethnic group (*surface area*, source: Global Mapping International/Colorado Springs), a dummy variable that takes 1 for historical homelands with a major lake/river (source: Michapoulos and Papaioannou, 2016), a dummy variable for historical homelands of an

<sup>3</sup>see <https://mrdata.usgs.gov/mrds/> for more detail concerning this datasets. Africa shapfile can be download from : <https://mrdata.usgs.gov/mrds/geo-inventory.php>

ethny that are adjacent to the coast (*coastal*, source: Michapoulos and Papaioannou, 2016) and a measure of the average value of elevation in kilometers (elevation, source: National Oceanic and Atmospheric Administration (NOAA) and U.S. National Geophysical Data Center). The Average value of soil quality for cultivation based on two components reflecting the climatic and soil suitability for cultivation (called *mean\_suit*, source: Michalopoulos, 2012).

We also control for variables defined at the country level that varies over time,  $Z_{it}$ , such as the Log of country Gross Domestic Products (*lgdp*, source: World Bank WDI ), an indicator of democracy (called *democracy*, source: PolicyIV project, variable: *Polity2*) and the Log of population in the first post-independence census (UNESCO, 1987).

### 3.5.3 Results

Table (3.1) presents the result of equation (3.25), and shows that the increase in ethnic trade significantly increases incomes. The supplier and/or market access to the rest of the world thus improves the situation of ethnies during peacetime.

Table (3.2) presents the result of equation (3.26), and shows a very different result: trade with the rest of the world has no impact on incomes. More precisely a positive impact is detected only in simple specifications without control (Column 1 and 2), but once additional variables are introduced a simple estimation in OLS (Column 3) and in PPML (Column 4) show that exportations no longer explain local incomes. This result is not surprising, there is many reason to consider that the channel for improving trade revenues no longer works during a period of conflict, but interesting because according to our theoretical model, once this effect is cancelled out, the nonlinearity obtained no longer hold. The probability of

Table 3.1: Trade impact on income under peace

	(1)	(2)	(3)	(4)	(5)
	OLS	Poisson	OLS	Poisson	Poisson
<i>International trade</i> ( $\phi_{rit}^{\circ}$ )	0.161*** (0.031)	0.113*** (0.028)	0.074** (0.030)	0.047*** (0.041)	0.072*** (0.025)
<i>elevation</i>			-0.261* (0.156)	-0.098 (0.325)	-0.437 (0.331)
<i>old city</i>			0.741** (0.320)	-0.539 (0.673)	-0.755* (0.421)
<i>petroleum</i>			1.271*** (0.290)	0.797 (0.558)	0.394* (0.221)
<i>capital</i>			1.746*** (0.264)	1.502** (0.593)	1.454*** (0.204)
<i>Distance from border</i>			2.118*** (0.663)	2.101* (1.102)	-1.627* (0.856)
<i>Distance from sea</i>			-1.292*** (0.256)	-2.512*** (0.390)	-1.734** (0.732)
<i>population 1960</i>			0.605*** (0.095)	0.552*** (0.153)	0.707*** (0.111)
<i>Surface area</i>			-0.822*** (0.087)	-0.707*** (0.177)	-0.860*** (0.112)
<i>Lake</i>			0.419** (0.186)	-0.164 (0.3682)	-0.003 (0.319)
<i>River</i>			0.031 (0.156)	0.071 (0.278)	0.601*** (0.204)
<i>Distance from capital</i>			0.4851 (0.398)	0.627 (0.469)	-1.129 (0.723)
<i>constant</i>	-3.914*** (0.205)	-1.728*** (0.334)	-8.434*** (1.027)	-6.486*** (1.569)	-6.657*** (1.272735)
Observations	6,010	7,832	6,010	7,832	7,813
Pseudo/R-squared	0.045	0.003	0.478	0.279	0.60

Notes: This table estimate trade effect on income under peace. The dependent variable (ethnic income) is proxied by night lights pictures provided by satellites from outer space. Column 1 and 3 are estimated using ordinary least square. Columns 2, 4 and 5 are done with pseudo poisson maximum likelihood estimator. All specification include a set of covariate. This set of covariates include the Log of surface area of the historical homeland of each ethnic group, the log of population in 1960 ,river and lake indicators, distance of each ethnic group homeland from sea coast, from the border and from the capital. Other controls described in the data section are dropped from this specification. They are not significant. Except for column 5 which includes country and year's fixed effects, all others are estimated without any fixed effects. Ethnic group-country clustered robust standard errors are reported in parenthesis. \*\*\* (\*\*) (\*) denote significance at the 1, 5 and 10 percent level respectively.

conflict is always reduced by the international trade integration.

## 3.6 Discussions

### 3.6.1 Footloose Entrepreneurs

Table 3.2: Trade impact on income under war

	(1)	(2)	(3)	(4)
	OLS	Poisson	OLS	Poisson
<i>International trade</i> ( $\phi^{\circ}_{rit}$ )	0.285 (0.174)	0.273** (0.120)	0.040 (0.077)	0.191 (0.135)
<i>elevation</i>			2.877** (1.019)	2.163*** (0.598)
<i>old city</i>			0.500 (0.756)	1.004 (0.885)
<i>petroleum</i>			-0.969 (0.843)	0.903 (0.979)
<i>capital</i>			-3.481* (1.875)	-6.472*** (2.273)
<i>Distance from border</i>			10.244*** (3.523)	8.370*** (2.831)
<i>Distance from sea</i>			1.200 (0.806)	2.868*** (1.098)
<i>population 1960</i>			0.251 (0.204)	0.488 (0.431)
<i>Surface area</i>			-0.948*** (0.215)	-1.429*** (0.362)
<i>Lake</i>			1.709* (0.976)	2.826*** (0.687)
<i>River</i>			0.410 (1.132)	-0.647 (0.628)
<i>Distance from capital</i>			-1.581 (1.419)	-4.508*** (1.702)
<i>constant</i>	-7.007*** (1.309)	-5.716*** (0.907)	-8.149*** (2.639)	-9.159* (5.143)
Observations	21	35	21	35
Pseudo/R-squared	0.128	0.167	0.913	0.963

Notes: This table estimate trade effect on income under conflicts period. The dependent variable (ethnic income) is proxied by night lights pictures provided by satellites from outer space. Column 1 and 3 are estimated using ordinary least square while columns 2 and 4 are done with pseudo poisson maximum likelihood estimator. All specification include a set of covariate. This set of covariates include the Log of surface area of the historical homeland of each ethnic group, the log of population in 1960 ,river and lake indicators, distance of each ethnic group homeland from sea coast, from the border and from the capital. Other controls described in the data section are dropped from this specification. They are not significant. All column include year's fixed effects. Ethnic group-country clustered robust standard errors are reported in parenthesis. \*\*\* (\*\*) (\*) denote significance at the 1, 5 and 10 percent level respectively.

such as the footloose entrepreneurs model (hereafter FE). The main difference is that entrepreneurs mobility depends on real wages (instead of nominal rewards), which brings

different characteristics that we briefly discuss here. First, the FE model presents multiple equilibria, i.e. for intermediate values of trade freeness, both the dispersed and the agglomerative equilibria are stable. As a result, governments can have a real incentive under dispersion to launch a war to win all the activities. In contrast under the Core-Periphery equilibrium, the Core has certainly an objective to keep mobile firms on its territory. Many authors have been critical about these multiple equilibrium and reluctant to use them to analyze public policies (at the exception of Baldwin and Krugman (2004) and other followers in tax competition). It is usually recognized that these multiple equilibria come from the homogeneity of the mobile factor and since this homogeneity is unrealistic the literature has logically neglected the interaction between multiple equilibria and governmental interventions. But multiple equilibria are not so unrealistic in case of wars which are motivated by predatory behavior aiming to steal activities in one place in order to concentrate them elsewhere. In comparison with the FC model, it is thus possible to obtain new interesting results because the possibility of governments to act strategically in order to win activities is an invitation to consider war destruction as endogeneously determined by a deadly game.

The second interesting result of the FE model, is that the agglomeration of entrepreneurs produces an agglomeration rent which is bell-shaped with trade integration. Then, depending on trade costs and on the amount of destruction,  $\gamma$ , it might be possible to get particular situation where peace is not a Pareto improvement, in the sense that entrepreneurs earns more under war than under peace. This case can be interesting to study particular kind of entrepreneurs that indeed become rich during wartime.

### **3.6.2 How to win a war**

The analysis presented here was mainly based on the determinants of the risk of wars. There is however a large literature that analyzes the odds to win a war according to investment in arming. The workhorse model in that case is the contest model where participants

expend resources on arming in order to increase their probability of winning. In the most simple case there are two competing parties, a rebel group and a government, who chose strategically how to allocate their inputs between production and appropriation of resource of the competing group. A key ingredient of conflict is what Hirshleifer (1989) called the “technologies of conflict”, i.e. the quantity of weapons, denoted  $G_r$ , chosen by the two ethnies  $r = A, B$ . Different modellings using this technologie function, denoted  $f(G_r)$ , has been proposed to explain the probability to win, and the following equation generalized these approaches:

$$p_A(G_A, G_B) = \begin{cases} \frac{f(G_A)}{f(G_A)+f(G_B)} & \text{if } f(G_A) + f(G_B) > 0 \\ \frac{1}{2} & \text{otherwise} \end{cases}$$

where  $f(G_r)$  has taken many forms among which the “power form”,  $f(G_r) = G_r^m$  with  $m > 0$ . Before the analyzis of conflits, this form was used to study rent-seeking behaviors (Tullok, 1980) and advertising (Schmalensee (1972)). This function gives a very simple result, the odds to win a war directly depends on the relative advantage in the technology of weapons  $\frac{f(G_A)}{f(G_B)}$ . As remarked by Blattman and Miguel (2010): “technology is defined broadly in this literature, including any factor that influences effectiveness, from skillful revolutionary leaders, to access to firearms and training, rugged terrain, or bases on foreign soil”. While a formal analysis is necessary to understand how the financing of weapons affects the spatial economy and how in response the economic geography affect the probability to win a war, we can make some conjonctures on what could happen in the current model. If the production of weapons is financed by a tax, it is possible that this tax will have the same effect than war destruction  $\gamma$  on the spatial economy, and thus the Result 1 might be still verified, leading to conclude that trade integration in such a framework leads to an agglomeration all the capital in one region. This means that inevitably, more integration improves the probability of the Core to win the war.



## 3.7 Conclusion

The beneficial impact of international trade on peace is an old idea that has been at the heart and soul of many regional trade agreements in Europe, in Latin America and in Africa. Integration in the world economy has been conceived as a way that promotes peace. This conventional wisdom of trade, well documented in political science as well as in economic literature seems however to be a complex one. The main message of the current model is that the spatial configuration as well as the impact of trade during the period of war are important variables to understand theoretically how the escalation in wars emerges with local integration and/or with globalization. Under the Core-Periphery equilibrium, the relationship follows a U-curve, trade first decrease the probability of wars, but after a critical value of integration, the opportunity costs of wars decrease, and then civil wars are more likely. Under the dispersed equilibrium, local integration is always beneficial but the international trade integration fosters conflicts. However, if trade integration does not affect significantly real wages under war (a fact which seems verified), the probability of war decrease whatever the spatial configuration and whatever the kind of trade integration (local or global). Under that condition, Montesquieu was right about the peaceful virtue of trade.

## 3.8 Appendix A: Unequal market access to the rest-of-the world

Market access to the rest-of-the world is not equal between different regions of a same country, in particular in developing countries. Some regions, in particular regions hosting large cities, may benefit of a good access to international market, while peripheral/distant region may be isolated. The opposite situation is also possible, i.e. peripheral regions may have a good market access to the rest of the world thanks to their geographical/historical

proximity with foreigners market. Typically, etnies that have been arbitrarily separated, share the same platform of import/export. We thus consider in this section the Core-Periphery equilibrium presented previously but where region have a different access to the rest of the world. Varieties traded between a region  $r$  and the rest-of-the world bear a transportation costs  $\tau_r^\circ$  with  $r = \{A, B\}$ , which allows to analyse these different cases (i.e.  $\tau_A^\circ > \tau_B^\circ$  or  $\tau_A^\circ < \tau_B^\circ$ ). This new assumption yields the following system:

$$r_A = \frac{Y_A}{\Delta_A} + \phi \frac{Y_B}{\Delta_B} + \frac{\phi_A^\circ Y^\circ}{\Delta^\circ} \quad (3.27)$$

with

$$\Delta_A \equiv \gamma K_A + \phi \gamma K_B + \phi_A^\circ K^\circ$$

$$\Delta_B \equiv \phi \gamma K_A + \gamma K_B + \phi_B^\circ K^\circ$$

$$\Delta^\circ \equiv \phi_A^\circ \gamma K_A + \phi_B^\circ \gamma K_B + K^\circ$$

$$\phi \equiv \left( \tau_r^\circ \right)^{1-\rho},$$

$$Y_A = \gamma K_A r_A + \gamma L_A w_A$$

$$Y^\circ = K^\circ r^\circ + L^\circ w^\circ$$

$$Y_B = \gamma L_B w_B$$

and in region B:

$$r_B = \phi \frac{Y_A}{\Delta_A} + \frac{Y_B}{\Delta_B} + \frac{\phi_B^\circ Y^\circ}{\Delta^\circ} \quad (3.28)$$

This unequal market access to the rest-of-the world influences the degree of regional trade

integration at which agglomeration is sustainable, however for a wide range of international trade costs difference between regions, the agglomeration in region A is still sustainable.<sup>4</sup> Under this spatial configuration, we plot the probability of escalation to war (3.6) with respect to regional trade costs by considering unequal market access with the rest-of-the world (Figure (3.6)).

More precisely, the regular black line represents the case of symmetrical trade costs already discussed ( $\phi_A^\circ = \phi_B^\circ = 0.6$ ), the gray line a situation where region B has a market access advantage to the rest-of-the world ( $\phi_A^\circ = 0.6 < \phi_B^\circ = 0.85$ ) and the dashed line the opposite case ( $\phi_A^\circ = 0.85 > \phi_B^\circ = 0.6$ ). Results are similar to those presented in Figure (3.2).

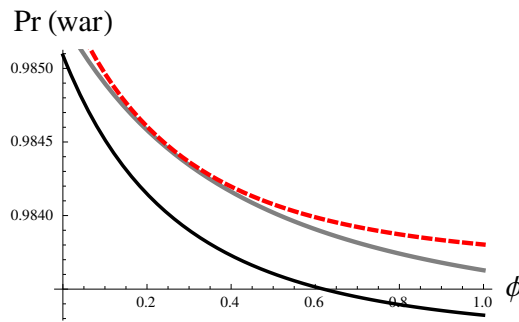


Figure 3.6: Unequal Market Access and Wars

*Numerical simulations done with  $\rho = 4$ ,  $\mu = 0.6$ ,  $L^\circ = 3$ ,  $v = 1$ ,  $h^\circ = 1$ ,  $r^\circ = 2$ ,  $\gamma = 0.9$ . Black line  $\phi_A^\circ = 0.6$ ,  $\phi_B^\circ = 0.6$ ; gray line:  $\phi_A^\circ = 0.6$ ,  $\phi_B^\circ = 0.85$ ; dashed line  $\phi_A^\circ = 0.85$ ,  $\phi_B^\circ = 0.6$ .*

<sup>4</sup>To save space, we do not report here the modified sustain point (the proof is identical to the one presented in Proposition 1), but we take care in our numerical exercises to parametrize our model in order to always work with a stable agglomeration in region A.

# Chapter 4

## Global Change in Local Places: Trade Integration and Ethnic Wars

### 4.1 Introduction

More than half of the world's nations have been affected by civil wars in the past fifty years.<sup>1</sup> As a result, economists, social and political scientists have made great efforts to better understand the causes of these conflicts. Economic factors such as the ability to finance a rebellion, political instability and a rich endowment of resources significantly explain civil wars (Fearon and Laitin, 2003; Collier and Hoeffler, 2004; Hegre et al., 2001). Other determinants such as ethnic fragmentation, political grievances, and income inequality are also common causes of these conflicts (Hegre and Sambanis 2006; Laitin 2007; Michalopoulos and Papaioannou, 2016).

While there is no doubt that many conflicts are rooted in the long term of a national history, it is also true that transnational links and interactions beyond the borders of States have fueled some civil wars. However, while newspaper articles and historical studies often present transnational interactions as factors favoring ethnic wars, serious empirical analyses that go beyond correlations are rare, and research on the consequences of international trade

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<sup>1</sup>According to Blattman and Miguel (2010) who consider civil war as a conflict that leads to at least twenty five battle deaths per year.

even more so. The objective of this paper is to deepen our understanding of the impact of trade on ethnic conflicts in Africa<sup>2</sup> by two different ways.

The first innovation is to analyze the effect of three different kinds of trade (domestic, regional and international trade) *at the level of ethnic groups* to better understand whether there are any opposite effects according to the spatial scale of trade on the risk of conflicts. The ambiguous effect of international trade on conflicts have been emphasized by Martin, Mayer and Thoenig (2008.a) both theoretically and empirically. In opposition to the classical beneficial effect of international trade, they show that a deeper international integration can play as a substitute of regional trade and then fosters wars between neighboring countries by reducing the degree of dependency between them. While this model explains international conflicts, its mechanism can be extending to civil wars. International or regional trade integration by weakening the national integration might foster conflicts between groups. Martin, Mayer and Thoenig (2008.b) analyze such a question, however they only consider the effect of international trade (or more precisely a ratio of multilateral trade flows on income).

In comparison, using the geographical distribution of 175 crops on a 10 km by 10 km cell grid (Monfreda et al., 2008) and the spatial distribution of mineral resources in Africa, we build a proxy of the international trade of ethnic groups concerning agricultural and mineral products (which represent the bulk of export in many African countries). In addition, considering the total value of trade (and not only agricultural and mineral products), we also compute a indicator of regional trade between countries that share at least one ethny. This kind of regional integration can be a stronger substitute of domestic trade than long distance

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<sup>2</sup>Our analysis is based on the database concerning African ethnic groups provided by Michapoulos and Papaioannou (2016). The great advantage of this database is that ethnic groups that have been partitioned among different states by Europeans during the “Scramble for Africa” that starts with the Berlin Conference of 1884-1885 are clearly identified. This database is particularly interesting enabling to analyze ethnic groups that are both geographically and politically peripheral. Since the likelihood to trade is related to historical links, the interest of this dataset is also that we can control for important factors that explain conflicts. We focus on ethnic wars because they represent an important part of civil conflicts (see Fearon, 2006) and are more easily classify than other conflicts reducing the problem of measurement errors.

trade in reason of strong ethnical relationships that go beyond the border. Finally, we analyze the effect of domestic trade on conflicts. We find that the international trade integration of ethnic groups and the domestic integration reduce the likelihood of war. The regional trade integration between countries that share at least one ethny is not significant to explain civil conflicts.

The second contribution of this paper is to present a two-stage approach to decompose the impact of international trade (considering in that case the total export of countries). Indeed globalization has a direct effect on income and then on conflicts but it also has many other impacts. For instance, economists have analyzed how the process of globalization erodes local cultures and individual identities (e.g. Maystre, Olivier, Thoenig and Verdier, 2014) but to our knowledge the impact of this erosion on civil conflicts has not yet been investigated. In a similar way, export may foster resource curse, deforestation, pollution haven, in short the environment of ethnic groups may be affected, and then can be at the source of conflicts. Our two-steps approach, does not identify these effects individually, but enables to capture the net effect of all the variables that affect conflicts via international trade once the ethnic level income effect is purged.

The first stage of the regression allows to assess the importance of the variation of income at the ethnic level against other variations occurring at the national level as a source of conflict. The source of identification is based on the fact that the same ethny can be found in different countries.<sup>3</sup> Formally, we regress the likelihood of civil conflicts on national time-varying characteristics (captured with country-year fixed effects), incomes at the ethnic level (that vary over time), ethny and time fixed effects. The income indicator at the ethnic group level is approximated by exploiting night light pictures provided by satellites from outer space (Henderson et al., 2012). The main result of this first stage, is that income growth at the ethnic level strongly reduces the likelihood of war. This finding suggests that

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<sup>3</sup>Indeed, in many African countries a significant fraction of the population belongs to ethnic groups that are partitioned among different states, see Michalopoulos and Papaioannou. (2016) for a deep analysis of the long-run consequences of ethnic partitioning in Africa.

if trade increases income, then it reduces conflicts, on the contrary an impoverishing trade triggers it. Not controlling for ethny heterogeneity leads to biased estimates of the impact of incomes which is largely underestimated.

The second stage uses the country time varying effects estimated in the first stage and regress them on the total exports of countries and a set of time dummies and controls. Instrumental variables are used to deal with estimation bias. The main finding is that export significantly reduces conflicts via other channel of diffusion than the income gain.

We are not aware of any work using proxies of income and trade data at ethnic groups level, or that develops a similar two-stage approach to study civil wars<sup>4</sup>. However this article has been influenced and is related to the studies of Gleditsch (2007) and Martin et al. (2008.b). Gleditsch (2007) analyzes trade between neighborhood countries (approximated by a ratio of import on GDP of countries that share a border). He finds that the likelihood of peace is much more higher for countries which are highly trade-integrated with their neighboring countries than for countries with no trade (the risk of conflict is divided by 2). This important result is obtained with a simple empirical strategy where the endogeneity bias of trade due to reverse causality is not addressed. Moreover, the panel dimension of the data is not fully exploited by the pooled model used<sup>5</sup>. We extend this analysis by using fixed effects in a baseline estimation in order to treat the problem of endogeneity due to omitted time-invariant characteristics, and an IV strategy to account for the fact that regional trade is also a function of conflicts. On the contrary to Gleditsch (2007), we find that international trade between countries that *share the same ethnic groups* has no impact on the probability of a civil war.

Martin et al. (2008b) consider a different dimension of trade, instead of analyzing regional trade, they take into account the total amount of trade (more precisely a ratio of

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<sup>4</sup>This two-stage regression is now a standard method in urban economics to analyze agglomeration economies (Combes, Duranton and Gobillon, 2008) and in labor economics (Abowd et al., 1999).

<sup>5</sup>With Bosker and Ree (2014) one can be critical on that methodology since “it is unlikely that one fully captures all crucial causes of conflict ignition by including a limited set of regressors in a pooled model.”

multilateral trade flows on income). They use fixed effects and develop an IV strategy and find a non linear effect of trade integration on conflicts depending on the intensity of conflicts. For low-intensity civil wars, trade openness increases the probability of a conflict while the reverse holds for high-intensity wars. In comparison with Martin et al. (2008b), we also analyze domestic and regional trade and we propose a two-stage analysis enabling to infer the impact of trade on all specific characteristics of countries that vary over time and that impact on ethnical wars conditioned on incomes (approximated by satellite data).

There is also research that partly overlaps with what we do, but with a very different objectives and with different methodologies. A good example is Bazzi and Blattman (2014) who analyze how income affects the risk of political instability using data on export price shocks. Their objective is to study how these shocks, by catastrophically impacting on income, influence conflicts. However, in their own words, “this paper uses trade shocks as an *example*”, and quite logically the authors do not dig into the detail of who trade with who or about the different effects of trade as we do here. Moreover, we are not interested by trade shocks. On the opposite, our analysis is more in the spirit of Montesquieu (1758) who writes about the virtue of the international trade of everyday. Finally, our work differs from this study according to the data used, the theory tested and the empirical strategy used.

The rest of the paper is structured as follow. Section 2 and 3 present respectively the empirical strategy and the results concerning the direct impact of the three different types of trade integration on conflicts. Section 4 discusses our two-step approach and present results concerning the impact of trade on time-varying characteristics of countries (e.g. cultural changes) that affect wars.



## 4.2 Empirical strategy

### 4.2.1 Baseline

In this section we analyze three types of trade :

- The international trade of ethnic groups, which is the sum of export that an ethny  $r$  in country  $i$  has exported during the year  $t$  to the rest-of-the world.

International trade can be a way to finance a civil war and can also weaken economic ties and dependence between groups/regions inside a country. In that case this trade is substituted to domestic trade and increases the risk of conflict. Lastly, international trade has distributive effects on incomes; the gains and the losses of trade liberalization might be concentrated on different ethnic groups. In brief inequalities that are triggered by the globalization process may be at the origin of some conflicts.

However as argued by a literature dating back to Montesquieu (1758), international trade can also have the opposite effect since by improving the income of different groups, it increases the opportunity cost of war. From that point of view, trade openness may act as a deterrent to escalation towards civil conflicts.

- The regional trade of countries where ethnic groups have been partitioned between nations, i.e. the sum of bilateral import of countries that share at least one ethny.

Regional trade between countries where ethnic groups have been partitioned can also display two opposite effects. The most obvious is that sharing the same culture with the neighboring

country can facilitate the financing of war. Mariani, Mercier and Verdier (2018) for instance present the conditions under which a diaspora can be actively involved in a conflict by transferring financial resources to its origin country. In the case of neighboring countries with similar ethnic groups such a channel for fueling the conflict is even more likely.

However, more regional trade integration also means less dependency for the peripheral group and a better market access to the neighboring country for all the nation.

- The local trade of ethnic groups, which is an approximation of trade inside the country  $i$ .

In contrast with these two variables, local trade integration may reduce the probability of war unambiguously.

These three variables are analyzed in turn to identify their impact of the likelihood of civil wars, we thus use the same notation  $\phi_{rit}$  to present these three different levels of trade integration in the following baseline estimation:

$$\Pr(\text{war}_{rit}) = \gamma_0 + \gamma_1 \phi_{rit} + \gamma_3 Y_{rit} + Z_{rit} + f_r + F_i + F_t + \varepsilon_{rit} \quad (4.1)$$

where  $Y_{rit}$  represents the income of every ethnic homeland  $e$  in country  $i$  at time  $t$ .  $Z_{rit}$  is a vector of variables that takes into account country-year specific variables and time invariant ethnic characteristics. and ethnic fixed effects.  $F_t$  allowed to get rid of time specific shocks that can drive the relation between ethnic wars and the interest variables.

Due to the fact that the dependent variable is a dummy, we logically used a Logit model with fixed effects. However, the advantage of fixed effect comes at a cost, some homelands fixed effect may perfectly explain civil conflicts leading to a drastic loss of the number of observations. This problem becomes even worst when we turn toward our IV strategy.

We thus use the Linear Probability Model using time-demean variables within each unique ethnic group-country combination. This time-demean transformation of a variable  $X_{rit}$  are denoted  $\Delta X_{rit}$  such as  $\Delta X_{rit} \equiv X_{rit} - \bar{X}_{ri}$  where  $\bar{X}_{ri}$  is the mean of the variable  $X_{rit}$  over time by ethny and country. Then we apply the ordinary least square (OLS) estimator on these transformations (which correspond to a within FE estimation with a Frich-Waugh transformation). More precisely, we also estimate the following equation:

$$\Pr(\Delta war_{rit}) = \gamma_1 \cdot \Delta \phi_{rit} + \gamma_2 \cdot \Delta Y_{rit} + \Delta Z_{it} + \Delta \epsilon_{eit} \quad (4.2)$$

In this equation, the “ethnic group-country” level heterogeneities are then weeded out (as well as time invariant factors).

## 4.2.2 IVs

Due to potential reverse causality between trade, conflicts and income, we implement an instrumental variable (IV) strategy. To instrument trade we consider an economic geographical variable, called by Harris (1954) the Market Potential (MP):

$$MP_{it} = \ln \left( \sum_{j \neq i} \frac{GDP_{jt}}{d_{ij}} \right) \quad (4.3)$$

We consider this nominal market potential as a good candidate to explain trade because it contains two important factors of a gravity equation: distance and GDPs of partners. This MP is defined theoretically (see Redding and Venables, 2004), however at the difference with the theory the price indices of goods produced in  $j$  are not taken into account, it is thus a *nominal* market access that is considered here.<sup>6</sup> In the New Economic Geography’s

<sup>6</sup>In the words of Head and Mayer (2006) the “real market potential” presented in Redding and Venables (2004) “incorporates the notion that a large market that is extremely well-served by existing firms might offer considerably less potential for profits than a smaller market with fewer competitors in the vicinity”. Finally

jargon, this means that the competition effect (or market crowding effect) which theoretically influences price indices is not analyzed.<sup>7</sup> This might be considered as a lacuna since African exporters encounter strong competition in large markets but they also benefit from preferential access to these markets<sup>8</sup> facilitating exports which are not analyzed either, so we can expect that these effects will cancel out each other partially. This variable is also used as an instrument in the trade literature, with minor changes, under the name of a remoteness measure for importers (with a negative sign in Equation (4.3) and a sum based on importers). A country with low remoteness has more alternative sources of imports and is therefore more open to trade. We also use this remoteness variable when considering the regional trade of countries which is based on import.

The first step of our IV approach consist in estimating the following equation:

$$\Delta\phi_{rit} = \Delta MP_{rit} + \Delta Z_{it} + \Delta\epsilon_{eit} \quad (4.4)$$

when the IV strategy is done without the time-demean transformation, a time effect is introduced (e.g.  $\phi_{rit} = MP_{rit} + Z_{it} + f_t + \epsilon_{eit}$ ). The same instrumentation is computed for the regional trade of countries but with the indicator of remoteness  $\Delta Remoteness_{rit}$ .

To solve the potential endogeneity of income in (4.2), weather conditions (temperature and rainfall) are used because a large part of the African population depends on agriculture activities. Nevertheless, these weather indicators are available just at the country-year level for the period considered here. To make this instrument ( $clim_{rit}$ ) related to ethnic groups and year specific, we interact it with the surface of each group homeland. These indicators predict conflicts via the income channel, for instance natural disasters such as floods, by

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Head and Mayer (2004) conclude that the Harris's assumption is a rough but reasonable approximation of the theory.

<sup>7</sup>Candau and Dienesch (2015) develop a theoretical model that presents the different impacts of trade integration on different price indices in these types of model.

<sup>8</sup>See Candau and Jean (2009). According to Gasiorek et al. 2010 the impact of the GSP on aggregate trade is of the order of between 10%-30%.

destroying inputs, production and housing, indirectly explain civil wars (Nel et Marjolein, 2008). We estimate the following relationship:

$$\Delta Y_{rit} = \Delta clim_{rit} + \Delta Z_{it} + \Delta \varepsilon_{cit1} \quad (4.5)$$

### 4.2.3 Data

#### 4.2.3.1 Trade

Trade variables come from BACI, a database developed by the CEPII, and are combined with other sources, hereafter described, to measure three different type of variables concerning the trade integration of ethnic groups.

- The international trade of ethnic groups,  $\phi^{\circ}_{rit}$ .

International trade data at the subnational level in Africa, and even more data at the ethnic level, are not available, we thus use weighting strategy based on trade in particular goods (agricultural goods and natural resources). Formally the sum of exports in the agricultural sector, denoted  $a$ , and the mining sector,  $m$ , are taken into account as follows:

$$\phi^{\circ}_{rit} = \sum_{a=1}^{175} (p_{ria} * X_{ita}) + \sum_{m=1}^{51} (p_{rim} * X_{itm}) \quad (4.6)$$

$X_{kit}$  represents country  $i$  exportation at year  $t$  for a sector  $k = a, m$ . The weight  $p_{ria}$  is the ratio of the ethnic group production on the national output concerning this sector, such as  $p_{ria} = \frac{E_{ria}}{E_{ia}}$  where  $E_{ria}$  is the sum of the mean production of crop  $a$  by the ethnic  $r$  (in country  $i$ ) over the period 1997-2003. Using natural resources location, we construct ethnic miner weight as  $p_{rim} = \frac{S_{rim}}{\sum_k S_{i,m}^k}$ , where  $S_{rim}$  is the area of the ethnic group where mines,  $m$ , are

localized and  $S_{im}^g$  represents the surface of all other ethnic groups  $g$  which share the same natural resources  $m$  in the country  $i$ .

We also compute an indicator with only agricultural goods and another with only mineral products, such as :

$$\phi^{\circ} rita = \sum_{a=1}^{175} (p_{ria} * X_{ita}) \quad (4.7)$$

and

$$\phi^{\circ} ritm = \sum_{m=1}^{51} (p_{rim} * X_{itm}) \quad (4.8)$$

We chose exportation of agricultural goods and mineral products because these two sectors represent the lion's share of exportation in our sample.

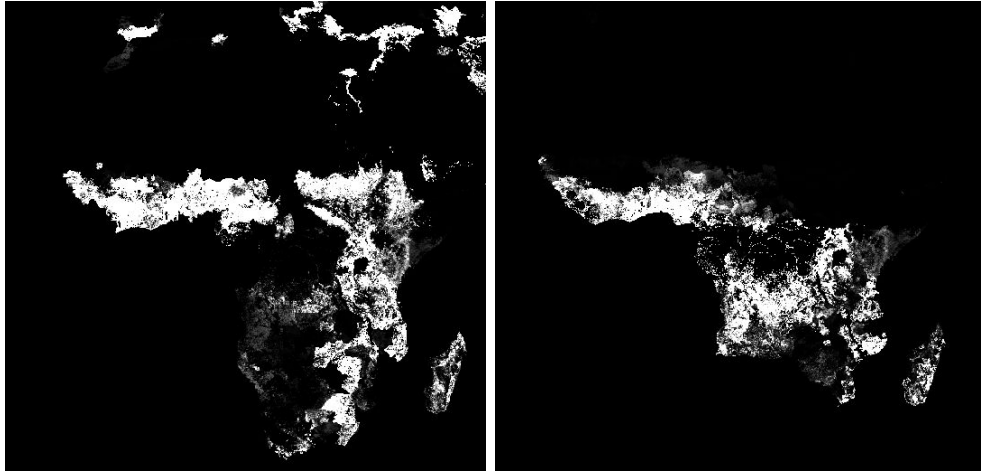
Since the weighting scheme is based on the production of agricultural and mineral goods at the ethnical level, we have to geolocalise these productions and then to match them with the geographical boundary of ethnic groups.

Concerning the agricultural sector, we rely on satellite's pictures extracted from EarthStat<sup>9</sup> that provides information on land use concerning "Harvested Area and Yield" (see Monfreda et al., 2008). This database contains raster on 175 agricultural products with four raters per crop comprising pixels of 10 times 10 km square over the period 1997-2003. As a result, we have information on (i) the average proportion harvested for a given agricultural product; (ii) the average number of hectares harvested per pixel; (iii) the total production of the crops in tons over each pixel; and (iv) the quality of the data according to their sources. We mainly use raster about the production of crop (in tons) in order to take into account that some agricultural products are harvested more than once a year. Figure (4.1) shows the coverage of cotton and cassava in Africa. The more a pixel is bright, the higher the production within the area covered.

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<sup>9</sup><http://www.earthstat.org/>

Figure 4.1: Crops production imagery: cotton and cassava



Source: Author's map based on the data of Monfreda et al. (2008).

These data are then merged with the spatial coverage of ethnic group reported by Murdock (1959) and digitized by Nathan Nunn.<sup>10</sup> Finally we calculate the production of each ethnic groups for the different crops identified (175 different crops) which gives  $E_{ra}$ . Once divided by the national production  $E_{ia}$ , we get our weight of the national export  $p_{ria}$ .

Concerning resources, we use the U.S. Geological Survey<sup>11</sup> enabling to locate mining resources. This survey provides data on the spatial location of a large panel of mineral resources all around the world (Mineral Resources Data System / MRDS) with the names of the deposit, the deposit description, the geological features, the data sources and references.<sup>12</sup> Then, we merge the Murdock (1959) map of ethnographic regions shape file, with countries boundaries<sup>13</sup> and finally with the resources locations shapefile in order to identify in which ethnic group and country the natural resources are located in order to get  $S_{im}^g$ ,  $p_{rim}$

<sup>10</sup>[https://worldmap.harvard.edu/data/geonode:murdock\\_ea\\_2010\\_3](https://worldmap.harvard.edu/data/geonode:murdock_ea_2010_3)

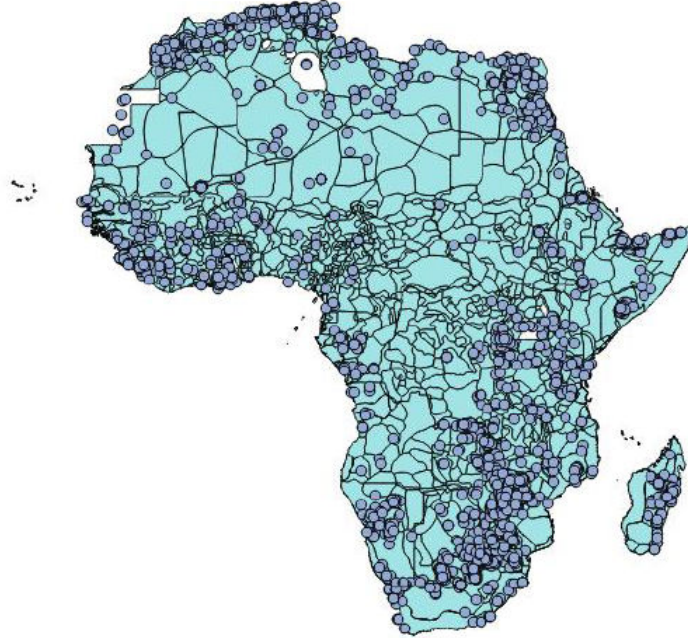
<sup>11</sup><https://mrdata.usgs.gov/mrds/>

<sup>12</sup><https://mrdata.usgs.gov/mrds/package.php>

<sup>13</sup>ESRI Shape file format: <http://www.maplibrary.org/library/stacks/Africa/index.htm>

and  $\phi^\circ$ . Figure (4) illustrates the result of this computation.

Figure 4.2: Mineral resources location in Africa at the Ethny/country level



Source: Authors's map based on Murdock (1959) and the Mineral Resources Data System.

- The regional trade of countries where ethnic groups have been partitioned between nations,  $\phi_{rit}^{split}$ .

We compute the sum of bilateral import of countries that share at least one ethny:

$$\phi_{rit}^{split} = \sum_j M_{ij} \quad (4.9)$$

where  $M_{ij}$  represents trade between two countries  $i$  and  $j$  that shares at least one ethny. We focus here on importations to change the point of view (previously our analysis was based on export) and to understand whether the value of goods that enters in a country affect conflicts. We consider neighboring trade because the likelihood of civil wars for countries



where ethnic groups have been partitioned seems strong (Michapoulos and Papaioannou, 2016). To identify countries that shares the same ethnic groups, we use the database of Michapoulos and Papaioannou (2016) where an ethny is considered as partitioned when at least 5 percent of its ancestral area belongs to more than one country.

- The local trade of ethnic groups,  $\phi_{rit}$ .

Internal flows come from EORA Database Input-Output Tables<sup>14</sup>. This database contains the Input-Output tables for 195 countries and allows to compute an indicator of internal trade (the sum of the final demand and of trade between sectors).

#### 4.2.3.2 Incomes and conflicts

We draw income at the ethnic group level by exploiting night light pictures provided by satellites from outer space. These data are useful to approximate income at sub and supra-national level in developing countries where no other reliable data are available (Henderson et al., 2012).

In order to get night lights intensity at ethnic group level, we use ESRI African countries shapefile that we merge with Murdock (1959) ethnic group's boundaries shapefile. Night lights raster come from the National Oceanic and Atmospheric Administration (NOAA) and are available between 1992 and 2013. A raster contain pixels of approximately 1km square. Every pixel is associated to a number that goes from 0 to 63 indicating the brightness of the light. These data are matched with the shapefile obtained earlier and the mean night lights density is computed within each ethnic group-country boundaries for every year. Since

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<sup>14</sup>Data can be download at <https://worldmrio.com/countrywise/>

satellite pictures do not distinguish gaze flaring activities from real lights, we exclude the corresponding spatial areas.

The onset of a new ethnic civil war comes from the Ethnic Power Relation (EPR) database compiled by Wimmer, Cederman and Min, 2009. This data define “political relevant group”, measure the participation of member’s on state level decision and also disentangle pure civil war from ethnic war<sup>15</sup> based on PRIO/UCDP conflicts database.

### 4.2.3.3 Controls

Finally we use different controls at the ethnic group level, some vary over time while other are constant denoted by vectors  $Z_{et}$  and  $Z_e$ . Among these variables, we consider ethnic groups that are excluded from regional or national governance (called *excluded*, source: EPR), a binary variable that takes 1 when a diamond mine is in the historical homeland of the ethny (*diamond*, source: Map of Diamond Resources, Peace Research Institute of Oslo), a dummy variable taking 1 when an on-shore oil field and gas deposit is in the historical homeland of an ethny (called *petroleum*, source: the Petroleum Dataset v.1.1). A binary variable taking 1 when a city with a population larger than 20 000 in 1400 was in the historical homeland (called *old city*, Chandler, 1987). The average value of malaria stability index for each historical homeland of an ethnic group (called *malariasuit*, source: Kiszewski et al. 2004) and a dummy taking 1 when the ethnic group is partitioned between countries (called *Split*, source: Michapoulos and Papaioannou, 2016).

Geographical variables such as the Log of surface area of the historical homeland of each ethnic group (*surface area*, source: Global Mapping International/Colorado Springs), a dummy variable that takes 1 for historical homelands with a major lake/river (source:

<sup>15</sup>More precisely, Wimmer, Cederman and Min (2009) define ethnic wars as follows: “we distinguish between ethnic and nonethnic conflicts using the aims of the armed organization and their recruitment and alliance structures (...) We identify as “ethnic” the aims of achieving ethnonational self-determination, a more favorable ethnic balance-of-power in government, ethnoregional autonomy, the end of ethnic and racial discrimination, language and other cultural rights, and so forth. In ethnic wars, armed organizations also recruit fighters predominantly among their leaders’ ethnic group and forge alliances on the basis of ethnic similarity”

Michapoulos and Papaioannou, 2016), a dummy variable for historical homelands of an ethnicity that are adjacent to the coast (*coastal*, source: Michapoulos and Papaioannou, 2016) and a measure of the average value of elevation in kilometers (*elevation*, source: National Oceanic and Atmospheric Administration (NOAA) and U.S. National Geophysical Data Center). The Average value of soil quality for cultivation based on two components reflecting the climatic and soil suitability for cultivation (called *mean\_suit*, source: Michalopoulos, 2012).

We also control for variables defined at the country level that vary over time,  $Z_{it}$ , such as the Log of country Gross Domestic Products (*lgdp*, source: World Bank WDI), an indicator of democracy (called *democracy*, source: PolicyIV project, variable: *Polity2*) and the Log of population in the first post-independence census (UNESCO, 1987).

### 4.3 Results about the direct effect of trade on conflicts

We successively estimate the equation of conflicts by using as an explanatory variable the international trade of ethnic groups,  $\phi^{\circ}_{rit}$ , the regional trade of countries where ethnic groups have been partitioned between nations,  $\phi^{split}_{rit}$  and the local trade of ethnic groups,  $\phi^{domestic}_{rit}$ .

#### 4.3.1 The role of international trade

We focus here on the impact of international trade,  $\phi^{\circ}_{rit}$  defined in (4.6), on civil wars. Table (4), Column 1, 2 and 3, presents the results of the estimation of Equations (4.1) and (4.2). Both the Logit and LPM models conclude that ethnic exports do not have a significant impact on the probability of war. However, as already mentioned, these estimations suffer of endogenous bias, we thus use Equations (4.4) and (4.5) to run the IV analysis of (4.2). This time, the effect of international trade is significant and negative, more foreign trade reduces the risk of escalating into war (Column 4). In Column 5 and 6, we also lead this

IV-strategy by using separately the indicator of trade based on agricultural products (defined in Equation (4.7)) and on natural mineral resources (defined in Equation (4.8)). The result is robust to this change, the international trade integration of territories defined at the ethnic level reduces the probability of wars.

Insert Table 4 here.

### 4.3.2 The role of regional trade

We now turn on the impact of the regional trade of countries where ethnic groups have been partitioned,  $\phi_{rit}^{split}$  defined in (4.9), on civil wars. Table (4.2), Column 1, 2, 3 and 4 presents the results of the estimation of Equations (4.1) and (4.2). According to these estimations, regional trade reduces the probability of conflicts. This result is in the same vein than the finding of Gleditsch (2007) who finds that the likelihood of peace is much more higher for countries which are highly trade-integrated with their neighboring countries than for countries with no trade. However Column (5), based on the IV strategy of equations (4.4), (4.5) and (4.2), raises some doubt about the significance of this result.

Insert Table 4.2 here.

### 4.3.3 The role of local trade

We now turn to the impact of internal trade  $\phi_{rit}^{domestic}$ . Table (4.3), Column 1, 2 and 3 present the results of the estimation of Equations (4.1) and (4.2). Column (4) is based on the

IV strategy of equations (4.4), (4.5) and (4.2). These results show that internal trade unambiguously promotes peace. This integration also has a stronger impact than the international trade integration (see Table, 4).

Insert Table 4.3 here.

## 4.4 Inference from export

### 4.4.1 Empirical strategy

The previous analysis aims at measuring the direct effect of trade on war focusing specifically on ethnic and local trade. But at least two caveats can be formulated. First, the measurement of ethnic trade potentially suffers of errors that may biased the analysis. Second, by merging aggregate data with micro observations by ethnic groups we make the strong assumption of independent disturbances which may be not verified for data with grouped structure (Moulton, 1990). In that case, OLS standard errors can be biased downward leading the aggregated variables to be artificially significant. Furthermore a single-stage estimation is problematic because we mislead country shocks affecting conflicts with idiosyncratic risk, e.g. a particular type of ethny has an endemic risk of conflict not totally controlled due to missing variables. We thus propose a different strategy based on a two stages estimation to capture the effect of international trade on civil wars. More precisely, the first step is an estimation of the probability of wars with controls at the national level and ethny fixed effects:

$$\Pr(war_{rit}) = \gamma_1 Y_{rit} + f_i \times F_t + F_r + F_t + \varepsilon_{rit} \quad (4.10)$$

To our knowledge, such an estimation analyzing the effect of income *at the ethnic level for all African countries* and using this specification with fixed and time-varying effects has never been done. One interest of this analysis is that we exploit the fact that there are two kind of ethnic groups, some that belong exclusively to one country and those that are shared by at least two countries. The former dimension helps to identify changes over time within countries, while the latter provides the identification that account for differences between countries over time. Ethnic groups that have not been partitioned may have followed the same social, cultural, institutional, and even economical path, while splitted groups have been influenced differently. As a consequence, ethnics groups that were split may have their contemporaneous behaviors differently influenced by changes in country they now belong to. In sum, the identification of differences between countries comes from the ethnic partition; assuming that peers across the border are interesting counterfactual.

This estimation certainly over-estimates the effect of income since we have no other variable of control that vary over time for ethnic groups. Income can also be endogenously determined by conflicts. Here we present result with a lag of one year to reduce this problem; similar results with different lag are also obtained (not reported but available on request).

In the second step, we analyze how the export of a country  $i$  at time  $t$ , denoted  $\phi_{rit}^x$ , can explain all the individual varying factors  $f_i \times F_t$  that plays on the probability of wars:

$$(f_i \times F_t) = \gamma_1 \phi_{it}^x + Z_{it} + F_t + \varepsilon_{rit}$$

The same estimation is done with domestic trade:

$$(f_i \times F_t) = \gamma_1 \phi_{it}^{domestic} + Z_{it} + F_t + \varepsilon_{rit}$$

This equation allows to capture how trade, by affecting change in the national identify  $f_i \times F_t$ , explains civil conflicts. Since this change is not related to the income change of ethnic groups, this second stage enables to assess the effect of trade on non-monetary

variables. As briefly discussed in the introduction,  $f_i \times F_t$  may be interpreted as the “national identity/culture” of a country on which globalization has various effects. On the one hand, globalization is at the source of cultural destruction which in reaction can trigger conflicts. On the other hand, the process of cultural homogenization can also help to relativize differences between ethnic groups and/or can be an opportunity to build a new culture by hybridization.<sup>16</sup> In that case, globalization by promoting a new culture has peaceful effects.<sup>17</sup> Obviously, trade can have effect on  $f_i \times F_t$  that are unrelated to culture. The resource curse is a well known example. Extraction of highly profitable resources sold on the world market can foster bad governance. In turn, institutional change with its share of injustice is a fertile ground for conflicts. Maybe less known, the relocation of polluting firms in developing countries are often the cause of a reduction/delay in the restrictiveness of environmental law at the national level (see Candau and Dienesch, 2017), and this may lead to a destruction of the local environment of some ethnic groups. Since these pollution haven are clearly motivated by international trade, the coefficient  $\gamma_1$  also capture these kinds of effect. This analysis is thus useful to assess a global impact of trade but not adequate to identity which variable is affected.

#### 4.4.2 Results

Table (4) presents the first stage of Equation (4.10). The main result of this table is that the income growth of ethnic groups reduces the risk of ethnic conflict. This result confirms at the local level what has been analyzed until now at the national one. Regarding this

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<sup>16</sup>Rauch and Trindade (2009) provide a theoretical foundation to analyze the creation of cultural goods by hybridization. They find that globalization is detrimental because the destruction of local cultures reduces the possibility of hybridization and generates a cultural blowback. On the contrary Cowen (2002) views globalization as a positive process of creative destruction. Caplan and Cowen (2004) defends that no great culture has risen in isolation. The fear that globalization builds up a culture of the least common denominator, has been modelled by Francois and van Ypersele (2002) who analyzes the pro and cons of the dumbing down argument.

<sup>17</sup>After all in Europe, the reunification of Germany has been a success in part thanks to its export performance at the world level.

result, it is noteworthy to observe the change in the R-squared from the first to the fourth column. Indeed the first column shows that there is a correlation between wars and income, but income alone is a poor predictor of wars. The introduction of individual and time effects successively improves the explained variation of civil wars. Even more interesting the introduction of ethnic group fixed effects increases the impact of income, indicating that some ethnic groups have particular characteristics which, if ignored, lead to underestimate the peaceful impact of income growth.

Insert Table 4.4 here.

Table (4) presents the second stage of our analysis. The introduction of time effects makes the impact of export on wars significant and positive (compare Column 1 and 2). However, reverse causality is likely and the instrumentation of export by the market potential totally reverse this result (see Column 3). In other words, exports reduce the probability of conflicts which confirms the result obtained in the previous section with different measure of trade integration. Similarly, we verify in this two stage estimations that the domestic trade integration favors peace (see Column 4, 5, 6).

Insert Table 4.5 here.

## 4.5 Conclusion

The beneficial impact of international trade on peace is an old idea that has been at the heart and soul of many regional trade agreements in Europe, in Latin America and in Africa. Integration in the world economy has been conceived as a way that promotes peace. Our contribution was to propose different measures and methodologies to analyze



the geographical impact of trade on conflicts. First we have presented different proxies of trade at the level of ethnic groups. This analysis leads to the conclusion that there is no negative effect of trade on conflicts. When ethnic groups are involved in international trade, the effect is positive on the the likelihood of peace but when we consider trade between countries that share the same ethnic groups the result is insignificant.

We also propose a two stages analysis in order to unbundle the income effect and the cultural effect of international trade. We find that the impact of trade on the culture of conflicts is negative. African countries that have traded more have enjoyed a reduction of conflicts. To the famous quotation of Arrow (1972) that “virtually every commercial transaction has within itself an element of trust”, we reverse the causality and guess that the performance on the world market requires and fosters mutual confidence, cooperation and good institutions inside nations that reduce the likelihood of ethnic conflicts.

## **4.6 Appendix A**

Tables (4.6) and (4.7) present the first stage regressions used in Table (4), (4.2) and (4.3).

Insert Table 4.6 and 4.7 here.

Table 4.1: International Trade effects on ethnic wars onset

	(1)	(2)	(3)	(4)	(5)	(6)
	logit-FE	LPM	LPM demean		LPM-IV	
<i>International Trade</i>	-0.136 (0.379)	0.00002 (0.0003)	0.001 (0.0008)	-0.003** (0.001)	-0.003** (0.001)	-0.002** (0.001)
<i>Income</i>	0.508 (0.467)	-0.001 (0.0006)	0.0008 (0.001)	0.006 (0.012)	0.006 (0.012)	0.006 (0.012)
<i>Polity2</i>	0.327** (0.149)	0.0002 (0.0003)	0.0003 (0.0003)	0.0006** (0.0002)	0.0006** (0.0003)	0.0003 (0.0003)
<i>GDP growth</i>	0.273*** (0.083)	0.0003 (0.0002)	0.0004* (0.0002)	0.0005** (0.0002)	(0.0005)** (0.0002)	0.0005** (0.0002)
<i>Surface area</i>		0.003*** (0.001)				
<i>River</i>		-0.005*** (0.001)				
<i>Distance from sea</i>		0.008* (0.005)				
<i>Diamond</i>		-0.004** (0.001)				
<i>Malaria Index</i>		-0.011** (0.005)				
<i>Constant</i>	2.857 (2.168)	-0.001 (0.007)	0.007 (0.004)	0.001 (0.005)	(0.001) (0.005)	0.005 (0.005)
Observations	82	6,031	6,031	6,031	5,848	1,550
Pseud/R-squared	0.345	0.032	0.015	0.012	0.012	0.015
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	Yes	No	No	No	No
Ethnic Group-Country FE	Yes	No	No	No	No	No
Within Country-Group Demean	No	No	Yes	Yes	Yes	Yes

Notes: The dependent variable is a binary variable taking 1 when an ethnic group is engaged in a new ethnic war in a given year. 'International Trade' is the sum of the relative shares of each ethnic group in the total agricultural and mining exports of the country where it is located. All specifications contain year's fixed effects. In Column 1 only Ethnic Group-Country fixed effects are introduced, in Column 2 country fixed effects and country-time varying controls are added. In Column 3, we replace the interaction of country and ethnic groups fixed effects by country fixed effects and ethnic group covariates. This set of covariates include the Log of surface area of the historical homeland of each ethnic group, river and diamond mine indicators, distance of each ethnic group homeland from sea coast and finally malaria index for ethnic homeland. Other controls described in the data section are not included in this specification because they are not significant. In the last columns (4,5,6) we use the two-stage instrumental variable method describe in Section 2.2 (see Appendix A (Table 1) for first stage results). Ethnic group-country clustered robust standard errors are reported in parenthesis. \*\*\* (\*\*) (\*) denote significance at the 1, 5 and 10 percent level respectively.

Table 4.2: Regional trade effect

	(1)	(2)	(3)	(4)
	Logit FE	LPM	LPM demean	LPM-IV
<i>Regional trade</i> ( $\phi_{rit}^{split}$ )	-1.148** (0.557)	-0.001*** (0.0005)	-0.158*** (0.056)	-0.0009 (0.003)
<i>Other countries trade</i>	-1.309 (1.348)	-0.004* (0.002)	-0.437** (0.216)	-0.003 (0.004)
<i>Income</i>	1.321** (0.591)	-0.0008 (0.0007)	0.165 (0.169)	-0.011 (0.014)
<i>Polity2</i>	0.066 (0.239)	0.0001 (.0004)	0.010 (0.040)	0.002** (0.0009)
<i>GDP growth</i>	0.096 (0.073)	0.0003 (0.0003)	0.039 (0.035)	0.0001 (0.0004)
<i>Surface area</i>		0.002*** (0.0009)		
<i>River</i>		-0.007*** (0.002)		
<i>Distance from sea</i>		0.010** (0.005)		
<i>Diamond  </i>		-0.003** (0.001)		
<i>Malaria Index</i>		-0.015** (0.006)		
<i>Constant</i>		0.031* (0.018)	0.222 (0.488)	0.036*** (0.014)
Observations	135	5,850	5,856	5,856
Pseudo/R-squared	0.3085	0.042	0.013	0.013
Year FE	Yes	Yes	yes	Yes
Country FE	No	Yes	No	No
Ethnic group-Country FE	Yes	No	No	No
Within Country-Ethnic Group Demeaning	No	No	yes	Yes

Notes: Logit and linear probability model (LPM) estimators. The dependent variable is a binary variable taking 1 when an ethnic group is engaged in a new ethnic war in a given year. 'Regional trade' represents the sum of bilateral imports of countries that share at least one ethny. All specifications contain year's fixed effects. Column 1 contains the interaction of ethnic and country fixed effects. In column 2, we replace the interaction of country and ethnic groups fixed effects by countries fixed effect and ethnic groups covariates. This set of covariates includes the Log of surface area of the historical homeland of each ethnic group, river and diamond mine indicators, distance of each ethnic group homeland from sea coast and finally malaria index for ethnic homeland. Other control variables described in the data section have been tested but are not included in this specification because they are not significant. In Column 4 we use the two-stage instrumental variable method describe in Section 2.2 (see Appendix A (Table 1) for the first stage results). Ethnic group-country clustered robust standard errors are reported in parenthesis. \*\*\* (\*\*) (\*) denote significance at the 1, 5 and 10 percent level respectively.

Table 4.3: Local Trade effects on ethnic wars onset

	(1)	(2)	(3)	(4)
	logit-FE	LPM	LPM demean	LPM-IV
<i>Local trade</i> ( $\phi_{rit}$ )	-1.614 (3.316)	-0.004* (0.002)	-0.006** (0.002)	-0.023* (0.014)
<i>Income</i>	2.236* (1.298)	-0.001* (0.0007)	0.002 (0.001)	-0.006 (0.013)
<i>Polity2</i>	0.291 (0.237)	0.0006* (0.0003)	0.0007** (0.0003)	0.0006* (0.0003)
<i>GDP growth</i>	0.275** (0.129)	0.0003 (0.0002)	0.0003* (0.0002)	0.0005* (0.0003)
<i>Surface area</i>		0.001** (0.0008)		
<i>River</i>		-0.006 (0.0019)		
<i>Distance from sea</i>		0.003 (0.005)		
<i>Diamond \</i>		-0.020*** (0.006)		
<i>Malaria Index</i>		-0.001 (0.001)		
<i>Constant</i>	47.343 (69.32)	0.118** (0.060)	0.153** (0.066)	-0.008 (0.009)
Observations	121	6,044	6,044	6,044
R-squared	0.39	0.040	0.014	0.013
Year FE	Yes	Yes	Yes	Yes
Country FE	No	Yes	No	No
Ethnic Group-Country FE	Yes	No	No	No
Within Country-Ethnic Group Demeaning	No	No	Yes	Yes

Notes: Logit and linear probability model (LPM) estimators. The dependent variable is a binary variable taking 1 when an ethnic group is engaged in a new ethnic war in a given year. Countries internal trade is used as a proxy of local trade of ethnic groups. All specifications contain year's fixed effects. Column 1 contains the interaction of ethnic and country fixed effects. In column 2, we replace the interaction of country and ethnic groups fixed effects by countries fixed effect and ethnic groups covariates. This set of covariates include the Log of surface area of the historical homeland of each ethnic group, river and diamond mine indicators, distance of each ethnic group homeland from sea coast and finally malaria index for ethnic homeland. Other control variables described in the data section are not included in this specification because they are insignificant. In the last column we use the two-stage instrumental variable method describe in Section 2.2 (see Appendix A (Table 1) for the first stage results). Ethnic group-country clustered robust standard errors are reported in parenthesis. \*\*\* (\*\*) (\*) denote significance at the 1, 5 and 10 percent level respectively.

Table 4.4: First stage regression: Ethnic war regression

Dep var : Ethnic war ( $war_{rit}$ )	(1)	(2)	(3)	(4)
$Lag(1) Income.$	-0.0018*** (0.000)	-0.0026** (0.001)	-0.0029** (0.001)	-0.0033** (0.001)
Observations	6,348	6,348	6,348	6,348
R-squared	0.01	0.13	0.14	0.36
Ethnic FE	No	Yes	Yes	Yes
Year FE	No	No	Yes	Yes
Country $\times$ Year FE ( $f_r \times F_t$ )	No	No	No	Yes

Notes: Linear probability model (LPM) estimators. The dependent variable is a binary variable taking 1 when an ethnic group is engaged in a new ethnic war in a given year. Column 1 is estimated without taking into account country characteristics, a possible temporal shock or ethnic specificity that could also explain the escalation of an ethnic group in a civil conflict. This column is our baseline. We introduce successively ethnic fixed effects (column 2), Time fixed effects (Column 3) and an interaction of country and time fixed effects (Column 4). Robust standard errors are reported in parenthesis. \*\*\* (\*\*) (\*) denote significance at the 1, 5 and 10 percent level respectively.

Table 4.5: Second stage regression: Country fixed effects regression

Dep var : $f_r \times F_t$	(1)	(2)	(3)	(4)	(5)	(6)
	International trade			Local trade		
<i>International Trade</i>	0.0001 0.001	0.008*** (0.001)	-0.202*** (0.021)			
<i>Local trade</i>				-0.004*** (0.0002)	-0.004*** (0.0003)	-.004*** (0.0003)
<i>Polity2</i>	0.009*** (0.0002)	0.010*** (0.0002)	0.096*** (0.010)	0.002*** (0.0001)	0.002*** (0.0001)	0.002*** (0.0001)
<i>GDP</i>	-0.003*** (0.0008)	-0.003*** (0.0008)	-0.002*** (0.0002)	0.008*** (0.0006)	0.008*** (0.0006)	.009*** (0.0006)
<i>GDP growth</i>	-0.002*** (0.0002)	-0.001*** (0.0002)	-0.006*** (0.001)	-0.0008*** (0.0001)	-.0007*** (0.0001)	-.0007*** (0.0001)
Estimator	OLS		OLS-IV	OLS		OLS-IV
Observations	8,406	8,406	8,406	7,423	7,423	7,423
R-squared	0.28	0.31	0.32	0.15	0.16	0.16
Year FE	No	Yes	Yes	No	Yes	Yes

Notes: This table presents the results of the second step (4.10). Estimations are done with ordinary least square estimator. All explanatory variables are lagged by one year. Predicted values of time-varying country effects are used as dependent variables and comes from Column 4 of Table (4.4). Columns 1-3 are relative to countries total exports ( $\phi_{it}^x$ ) and Columns 4-6 are about domestic trade. In Column 3 and 6, we used the two-stage instrumental variable method describe in Section 2.2 to deal with potential endogenous issue (see Appendix A (Table 2) for the first stage results). Robust standard errors are reported in parenthesis. \*\*\* (\*\*) (\*) denote significance at the 1, 5 and 10 percent level respectively.

Table 4.6: IV first stage regressions: explaining income and ethnic trade

	(ITE)	Night Light	Regional trade	Other countries trade	Internal trade
	LPM demean				
<i>Market potential</i>	3.597*** (0.461)				
<i>Remoteness</i>			0.6434*** (0.1031)	-0.3955*** (0.0360)	
<i>Precipitations</i>					0.1011** (0.0482)
<i>Temperature</i>					-2.8087*** (0.6474)
<i>Precipitations * Surface<sub>r</sub></i>		0.0546*** (0.0163)			
<i>Temperature * Surface<sub>r</sub></i>		1.1016*** (0.3449)			
<i>Polity2</i>	-0.019*** (0.007)	-0.0203*** (0.0052)	-0.1066*** (0.0121)	-0.0183*** (0.0029)	0.0047* (0.0026)
<i>GDP growth</i>	-0.006 ** (0.003)	-0.0014 (0.0027)	0.0127*** (0.0025)	0.0043*** (0.0009)	0.0015*** (0.0006)
Constant	0.062 (0.201)	-0.4738*** (0.0524)	-1.3393*** (0.0779)	-0.7393*** (0.0250)	-0.4608*** (0.0187)
Observations	7,875	6,752	7,717	8,895	7,850
R-squared	0.174	0.264	0.454	0.875	0.737
F-Test	60.63	11.21/10.20	38.98	120.58	4.41/18.82
Year FE	Yes	Yes	Yes	Yes	Yes
Country FE					
Ethnic Group FE					
Within Country-Group Demeaning	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the first stage regressions results for estimations in table (4), (4.2) and (4.3). Estimations are done with ordinary least square estimator on time demean variables. Robust standard errors are reported in parenthesis. (\*\*\*) (\*\*) (\*) denote significance at the 1, 5 and 10 percent level respectively. We present the F-tests statistics of these first stage regressions, that are always above the critical value of 10, recommended by Staiger and Stock (1997).

Table 4.7: IV first stage regressions explaining country Export and local trade in the Two-stage methodology

	Country Export	Internal trade
<i>L1.Market potential</i>	0.0193*** (0.0056)	
<i>L1.Precipitations</i>		-0.1475*** (0.0188)
<i>L1.Temperature</i>		6.7370*** (0.0551)
<i>Polity2</i>	-0.0786*** (0.0027)	-0.002097 (0.0051)
<i>L1.GDP growth</i>	-.0013 (0.0024)	-0.0302*** 0.0052
<i>L1.GDP</i>	0.4496*** (0.0104)	0.1371*** (0.0066)
Constant	0.062 (0.201)	-0.4608*** (0.0187)
Observations	8,406	7,423
R-squared	0.9701	0.9939
F-Test	11.90	61.07/14929.20
Year FE	Yes	Yes

Notes: This table presents the first stage regressions results for estimations in table (4.5). Estimations are done with ordinary least square estimator on time demean variables. Robust standard errors are reported in parenthesis. (\*\*\*) (\*\*) (\*) denote significance at the 1, 5 and 10 percent level respectively. We present the F-tests statistics of these first stage regressions, that are always above the critical value of 10, recommended by Staiger and Stock (1997).

## **Part IV**

# **General Conclusion**



The aim of this work was to use the latest developments in international trade theory to study African countries trade. The main questions of this thesis are : what are the impact of RTAs on trade and welfare? How does trade (domestic or international) impact on pacification in African countries? we use both theoretical and empirical tools to adress these questions.

Many economists believe that African RTAs failed to promote trade, arguing that they are good politics but bad economics. According to Gilles Dufrénot for example, "Africa already has a large number of regional economic communities, without any effect on trade development"<sup>18</sup>. Based on this, he summarized precisely the conventional point of view about RTAs in Africa. However, this conventional view point is based on anecdotal evidence rather than econometric investigation. Even if the gains are quite small, the results of the first part of this thesis are in contradiction with the idea of the ineffectiveness of trade agreements in Africa.

In the first chapter, using both individual-time fixed effects and bilateral fixed effects to control for multilateral resistances and deal with endogeneity, we conclude that on average African RTAs boost trade by around 95% during the 1965-2012 period. Keeping the same specification, we individually analyse different RTA and their differents enlargement. We also find that half of the agreements studied have been particularly efficient to stimulate trade. Then, we used the recents model of Costinot and Rodriguez-Clare (2012) and those of Anderson and Yotov (2016) and Anderson, Larch and Yotov (2018) to perform counterfactual analysis considering successively the removal of the COMESA, the ECOWAS and the SADC. Both models similarly conclude that all members of those RTAs benefit from a reduction in the delivered price for consumers, an increase in the factory gate price for producers and an increase in welfare (real GDP).

In chapter 2, we focused on East African Community (EAC) Agreement and in order to include tariff, we change the structure of the general equilibrium model. Hence, our counterfactual analysis demonstrates that the East African Community increased the welfare of individuals in members countries. In our counterfactual world, trade creation effect is quite important and compensates for welfare loss induced by change in terms of trade and volume of trade with the rest of the world.

Contrariwise, our results are limited to utilitarian view of welfare. We leave future research to challenge this welfare conception. Instead of studying the RTA effect only on the sum of individuals consumption or income, we could also consider it's effect on differents categories of individual or factors. In other terms, to investigate the effect of RTAs from a Rawlsian social welfare function.

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<sup>18</sup>In the conversation of 02/06/2019

We answered the second question in the next two chapters. In chapter 3, we introduced civil wars under the urban and regional theoretical framework. We extend a regional economic model in order to consider international trade and regional escalation to war. Our results suggest that spatial configuration matters in the explanation of the relationships between trade (local or international) and the probability of civil wars. When capital is evenly distributed across regions, both local and international trade promote peace. However, in an agglomerative equilibria, trade first decreases war incentive and above a certain intensity of integration, it increases civil war probability.

One of the novelties of the thesis is reported in chapter 4 where we estimate the impact of three aggregated level of trade (namely international trade of ethnies, regional trade and local trade) on ethnic war onset. We find that international trade among ethnic groups and local trade (domestic trade) reduce the probability of war escalation while trade with neighboring countries (regional trade) have not significantly promoted peace. We also proposed a two stage strategy that led us to address trade effect on ethnic war probability by the channel of cultural identity. Results gave us evidence that by alleviating cultural identity difference between ethnic groups, both international and local trade become instruments of African countries pacification.

It is noteworthy that the second part of this thesis used only economic determinants to explain the probability of ethnic wars in Africa. But since the 2000s, the world in general and Africa in particular has been experiencing a new form of civil conflict instigated by terrorist groups with religious affiliation (Boko Haram in Nigeria, Ansar Dine and MUJAO in Mali...). It will be interesting for future research to estimate how religious diversity or its conception in African countries can help to avoid this kind of civil wars.

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## Regional Trade Agreement, Conflicts and Welfare

### Abstract

This thesis aims to contribute to recent debates on the potential benefits of trade openness among African countries. This, by addressing the triptych regional trade agreements, welfare and conflict.

The African continent is currently facing two major governance challenges: regional integration and the management of armed conflicts. Indeed, the trade performance of African countries remains marginal compared to the rest of the world. This is despite the different trade policies implemented since the 1970s (import substitution policy, North-South regional agreement, etc.). Among these trade policies, African governments have decided to focus on regional agreements in order to increase trade among member countries. Have these agreements had the expected effect? To what extent?

If we refer to popular belief, the answer seems to be no. However, this answer ignores the potential political benefits of trade openness. As such, the work presented here first examines the effect of African regional agreements on trade and welfare. This is done using the latest developments in international trade theory and the best techniques for estimating gravity equations. Second, we analyze both theoretically and empirically the effect of increased trade on the probability of a civil war occurring. The results obtained allow us to conclude, on the one hand, that nearly half of the trade between members of trade agreements in Africa would not have been possible without the signing of the RTAs. On the other hand, both domestic and international trade reduces the risk of civil conflict in Africa.

**Keys Words:** Regional trade agreement, Gravity Equations, Civil wars, Trade

### Résumé

Cette thèse vise à contribuer aux récents débats sur les avantages potentiels de l'ouverture commerciale entre les pays Africains. Elle le fait en abordant la triptyque accords régionaux de commerce, bien-être et conflits. Le continent Africain fait face aujourd'hui à deux enjeux majeurs de gouvernance : l'intégration régionale et la gestion des conflits armés. En effet, les performances commerciales des pays africains restent toujours marginales comparativement au reste du monde. Et ce, malgré les différentes politiques commerciales mises en œuvre depuis les années 70 (politique d'import-substitution, accord régional nord-sud, etc...). Parmi ces politiques commerciales, les gouvernements africains ont décidé de privilégier les accords régionaux en vue d'accroître le commerce entre les pays membres. Ces accords ont-ils eu l'effet escompté ? dans quelle mesure ?

Si on se réfère au point de vue largement partagé, la réponse semble être négative. Cependant cette réponse ignore les potentiels bénéfiques politiques de l'ouverture commerciale. A ce titre, le travail présenté ici étudie l'effet des accords régionaux africains sur le commerce et le bien-être. Cela en utilisant les derniers développements de la théorie du commerce international ainsi que les meilleures techniques d'estimations des équations de gravité. Deuxièmement, Nous analysons l'effet de l'augmentation du commerce sur la probabilité de survenance d'une guerre civile à la fois de façon théorique et empirique. Les résultats obtenus, nous permettent de conclure que sans la signature des ACRs, près de la moitié des échanges entre leurs membres n'auraient pas été réalisés. D'autre part, cette thèse affirme que le commerce, à la fois domestique et international permet de diminuer le risque de conflit civil en Afrique.

**Mots clés:** Accords Régionaux de commerce, Equations de gravité, Guerres civiles, Commerce