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The Relationship Between Economic Structure and Political Violence in Latin America (1990–2019)

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Abstract: This paper provides evidence about the relationship between economic structure and political violence in Latin American countries in the period 1990–2019. The empirical analysis suggests that manufacturing activities are negatively associated with the number of terroristic attacks. On the contrary it exists a positive relationship between mining activities and political violence. A further analysis suggests that the relative size of manufacturing with respect to mining sector is negatively associated to terroristic attacks occurrence. Such relationship becomes stronger when it is associated to high levels of trade openness.

Keywords: political violence, economic structure, resource curse, manufacturing sector

JEL Classification: D74, O13, O14, H56

1 Introduction

This paper is intended to verify the relationship of economic structure on occurrence of political violence in Latin America for the period 1990–2019. This work takes as point of departure the approach developed by Hirshleifer (1988) and further enriched by other scholars. In particular, this paper considers the Hirshleifer-like model developed by Caruso (2010) which shows that in a dual-sector economy, the incentive for conflict is related to the presence of secure property rights over output. In other words, if there are two sectors, the contested one – in which there are no secure property rights over output that in turn can be coercively appropriate by means of violence – and the uncontested sector, in which property rights over output are secure, the incentive for conflict is positively related to the size of the contested output. As long as it increases, there is a strong incentive in embezzling it. In fact, this work is an empirical analysis of the impact

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of contested and uncontested activities on the occurrence of political violence, where the main difference between the two activities is the existence of secure property rights which can reduce the incentive for conflict (Caruso 2012). Usually, political violence is measured by the existence of conflict in accepted definition, such as provided by the Correlates of War project.¹ In this work, because of peculiarity of Latin American region I use the number of terroristic attacks as a proxy of political violence. Results suggest that the manufacturing sector – identified as the uncontested activity – is negatively associated with the number of terroristic attacks occurring in the region. On the other hand, mining activities – detected as contested activities – show a positive relation with the occurrence of political violence. In addition, it has been used also an alternative approach to test theoretical predictions. In detail it has been used the ratio between uncontested and contested activities. Empirical results show that as long as that ratio increases, the expected number of terroristic attacks decrease. The latter result is augmented when a high manufacturing–mining ratio is associated to high levels of trade openness. The paper is designed as follow: in Section 2 a review of literature on the state of art on causes of conflict is presented. Section 3 starts with a brief description of theoretical framework used for the following empirical analysis that is declined in two different approaches. This section also contains robustness check. Eventually, in Section 4 results are summarized.

2 Literature Review

Political violence has its roots in political, social, and economic factors. There is a vast literature – both theoretical and empirical – on economic causes of political violence which laid on concepts of poverty and resource curse (Collier and Hoeffler 1998, 2004; Fearon and Laitin 2003; et al.).

Hereafter, the point of departure is the theoretical model provided by Hirshleifer (1988) – and further developed by other scholars (Eggert, Itaya, and Mino 2011; Grossman and Kim 1995; Maxwell and Reuveny, 2005; Skaperdas 1992, 1996). In particular, Caruso (2010) proposed a new conflict model based on the distinction between contested and non-contested activities which differ from each other by the existence of secure property rights: more specifically the model predicts that the larger the uncontested sector is, the smaller will be the probability of conflict. The model has been empirically tested in Sub-Saharan African countries in the period 1995–2006 (Caruso 2010, 2011). The results confirmed the theoretical

¹ Sarkees, Meredith Reid. 1982. The COW Typology of War: Defining and Categorizing Wars (Version 4 of the Data).

prediction: a larger manufacturing sector – identified as the uncontested sector – is associated with a lower probability of conflict, while, on the contrary, the mining and agricultural sectors are associated with the prevalence of conflict. The manufacturing sector can be considered as a sector not directly affected by the existence of a bloody conflict. In fact, the evidence shows that bloody competitions are in place for the exploitation of natural and agricultural resources (Dube, García-Ponce, and Kevin 2016; McGuirk and Burke 2020). At the same time there is no evidence of bloody competition in manufacturing sector: in other words, countries whose economy relies on manufacturing activities do not exhibit high level of conflict. Secondly, as Rodrik points out (2011), the manufacturing sector is a “special” sector as it exhibits unconditional convergence in path growth: in detail, manufacturing activities are the engine of growth as they allow to absorb a large mass of unskilled workers and to increase labour productivity. This idea is in line with the study of Collier and Hoeffler (1998, 2004) on civil conflicts: by observing civil conflicts in the period 1960–1992 they demonstrate that economic factors play a crucial role in the insurgence of violence. In fact, in general if the GDP rises, the opportunity cost to participate in conflict decreases. This means that the increase of manufacturing would lead to an increase in GDP which in turn could be expected to reduce the probability of conflict. However, as stated by Dal Bò and Dal Bò (2011) not all positive economic shocks reduce the incentive for conflict. For instance a growing GDP is often associated to a growing military spending, which in turn could increase the probability of conflict. Moreover, GDP is a macroeconomic indicator that is not able to distinguish among different economic structures: recently, Vestby, Buhaug, and von Uexkull (2021), starting from the Lewis dual-sector model, prove that poor countries that show higher levels of relative labour productivity in the modern sector with respect to traditional sector, are less likely to engage in bloody conflict.

Economic growth induced by agricultural and mining activities is less stable: as Ross (2019) emphasizes, oil-producer countries have a low rate of exports diversification which in turn make them more vulnerable to price shocks. In this respect, several studies point out the link between commodity price shocks and intensity of conflict (Ubilava, Atalay, and Hastings 2021). For instance, Dube and Vargas (2013) investigate the relationship between the escalation of civil conflict in Colombia and the evolution of oil and coffee prices – the main resources produced by Colombia – in the 90’s. The authors found that an oil or coffee price shock increase the intensity of conflict in Colombia, even if the mechanism is quite different according to the resource considered. In detail, as the coffee production is labour-intensive, a drop of coffee price increases conflict manifestation, while, as the oil production is not labour-intensive a rise in the oil price boosts the intensity of conflict. Dube, García-Ponce, and Kevin (2016) shows that exists a clear

relationship between maize price and narcotraffic in Mexico in the period 1990–2010. Their findings highlight that a drop in maize price leads farmers to substitute maize crops with marijuana and opium as the latter are more profitable. Moreover, the drop in maize price causes a contraction of wages: people prefer to participate to a more lucrative activities as drug production, feeding, in this way, the power of narcotraffic.

The predominance of agricultural and mining activities is also related to conflict duration, as they constitute a primary source of funding for rebel groups. Conrad et al. (2019) examine how the financing strategy chosen by the rebel group can impact the duration of a conflict. Results show that the former has no significant effect on conflict duration because an effective extortion strategy implies a deep linkage between the rebel group and the place where resources are extracted or produced. On the contrary, a smuggling strategy does not require a control over resource production because it is focused on the transport. It follows that rebel groups that finance themselves through smuggling operation can easily diversify the kind of smuggled goods and consequently have great opportunities to cope with state repression. The authors distinguished between the two strategies with respect to natural resources. However, one could add that manufacturing activities are more subject to extortion compared to agricultural and mining activities.

The relationship between economic structure and political violence becomes clearer if we take into account the institutional environment. Humphrey (2005) suggests that the more a country's economy is commodity-based, the weaker the political institutions will be: on one hand, if politicians do not need to tax citizens the latter have weak or no power over politics; on the other hand, if the government does not rely on taxation, it would have weak incentives to set up strong institutions. Another mechanism through which commodity dependency could strengthen autocracies calls into question the resource value: when commodity prices rise, the value of remaining in power rises too. Autocrats are so more prone to allocate larger amounts of resources in activities that help them to remain in power – as prosecution or by influencing political elections – which in turn fuel the overall resources misallocation (Mauro 1995; Mo 2001). Moreover, as Ross (2015) stated, the oil-dependency enhances authoritarianism: in particular, several studies demonstrate that commodity-dependency lengthens the viability of authoritarian leaders. For instance, Cuaresma, Harald, and Raschky (2010) studied 106 dictatorships and found that the larger the oil endowment is, the longer dictators stay in power; moreover, Andersen and Aslaksen (2013) added that the same relationship is in force if a country has a large endowment of non-lootable diamonds. The evidence shows that political violence is more frequent in autocracies or weak democracies. However, as many scholars have proven, the relationship between democracy and conflict is not linear; there is instead an inverted U-shape

relationship (Hegre 2014; Hegre et al. 2001): it means that there must be a minimum level of freedom allowing people to organise themselves in order to start a conflict.

Further, the resources misallocation could strengthen conflicts if they are not equally distributed among groups (Cramer 2003): both ethnic fractionalisation and polarization could enhance the probability of violence occurrence. There is no consensus in existing literature on the impact of ethnic diversity on conflict. Collier and Hoeffler (2004) found that ethnic fractionalised societies have a lower probability to engage in civil conflict. They stated that, if dominance is avoided, a social fractionalised society is safer than homogenous one because rebel cohesion is more costly. Collier, Hoeffler, and Söderbom (2004) show that ethnic fractionalisation has a great impact on the duration of civil conflict. In detail they show that the relationship between ethnic fractionalisation and the duration of conflict is non-monotonic: the expected duration reaches its maximum when the society is partly fragmented. Elbadawi and Sambanis (2002) find the same relationship: when social fractionalisation tends to polarization – in other words, when each group account for 40–60% of population – the risk of civil conflict is higher.

3 Theoretical Approach

The theoretical framework is the “butter, guns and ice-cream” model developed by Caruso (2010). Consider a dual economy with a contested and uncontested sector and two agents. The contested sector is characterized by the absence of secure property rights. Resources invested in the contested sector can be used to produce two goods: (1) butter, which is a consumer good, and (2) guns. Then, one may choose to produce butter or to invest in the production of guns that, in turn, are used to appropriate butter produced by others. In other words, each group must choose how many resources to allocate in production and the amount of resources to allocate in conflict. The uncontested sector, on the contrary, is characterized by secure property rights. Resources invested in the uncontested sector are used to produce ice-cream. The ice-cream production cannot be forcibly appropriate by others. The main difference between consumer goods concerns the way in which they are produced. The aggregate contested activity production function is a linear additive function characterized by constant return to scale and constant elasticity of substitution. On the other hand, the ice cream production functions are standard intensive production functions characterized by decreasing returns to scale that differ between agents. So, in terms of production technology, butter production is cheaper than ice-cream production. At the same time butter can be embezzled by others. The competition over butter depends on the resources invested in guns by each agent. The probability of each agent to win the competitions depends on the

resources he has invested in guns compared to total guns. It is noteworthy that no agent chooses a level of guns equal to zero. If so, its probability to win the conflict shrinks to 0 and therefore the investment in butter production would be in vain. Moreover, during the conflict resources can be destroyed. It follows that investment choices are affected by a perceived destructiveness parameter. This parameter measures the perceived destructiveness of conflict, or, in other words, how much butter will be destroyed during the conflict. It ranges from 0 (the maximum level of perceived destructiveness) to 1 (no destructiveness perceived). In this context, each agent maximizes his welfare function under the resource endowment constraint. In sum, the model shows that in equilibrium:

1. The amount of resources invested in ice-cream depends positively on the degree of return to scale and negatively on the perceived destructiveness parameter. As long as the degree of return to scale increases, each group will prefer to invest resources in the secure activity. On the other hand, if the conflict is perceived as not damaging, each group will prefer to allocate resources in the butter production as it has constant returns to scale, while the secure activity has decreasing returns to scale.
2. The amount of resources invested in guns depends positively on the resource endowment and negatively on the perceived destructiveness parameter. A higher amount of resources corresponds to a higher investment in guns as each group is able to bear a higher level of risk. On the other hand, if the perceived destructiveness parameter decreases the level of guns in equilibrium increases. If the level of perceived destructiveness decreases the amount of butter is higher: it follows that each group prefer to invest in gun in order to appropriate a large fraction of butter production.
3. The amount of resources invested in butter depends positively on the resource endowment of the group and negatively on the resource endowment of the rival group. The idea is that the larger its own resource endowment is, the greater will be the ability to protect the production of butter through guns. It follows that the larger will be the investment in butter production. On the other hand, if the resource endowment of the rival group increases, the investment in guns of the rival group will be higher. It follows that, *ceteris paribus*, the lower will be the probability to win the conflict and therefore the investment in butter production will reduce.

4 The Empirical Evidence

Hereafter, I empirically test the hypothesis that a negative relationship exists between the level of conflict and the ice-cream production, and, at the same time, a

positive relationship exists between the level of conflict and the production of butter. I use the manufacturing share of GDP as a proxy of ice-cream production and the agricultural and mining share of GDP as a proxy of butter production. The theoretical model stated that the occurrence of conflict is related to the existence of contested sector, as guns are used to coercively appropriate the butter production. So, relying on Caruso (2010) and empirical evidence, the contested sector is approximated by the agricultural and mining share of GDP and the uncontested sector is approximated by the manufacturing share of GDP.

In order to test such hypothesis, I set up a panel database for the period 1990–2019.² The econometric model used is:

$$\begin{aligned} Pol. Violence_{i,t} = & \beta_i + \beta_1 Agriculture_{i,t-1} + \beta_2 Mining_{i,t-1} + \beta_3 Manufacturing_{i,t-1} \\ & + \beta_k X + u_{i,t} \end{aligned}$$

where $i = \{1, \dots, 20\}$ and $t = \{1990, \dots, 2019\}$,

$Pol.Violence_{i,t}$ is the level of conflict of each country in a specific year; $Agriculture_{i,t-1}$ is the GDP share of agriculture of each country lagged behind one year; $Mining_{i,t-1}$ is the GDP share of mining of each country lagged behind one year; $Manufacturing_{i,t-1}$ is the GDP share of manufacturing of each country lagged behind one year; X denotes a vector of control variables which includes one-year lagged GDP, population, trade openness, type of regime, ethnic polarization and ethnic fractionalisation.

Political violence is proxied by means of the number of terroristic attacks that occurred in a calendar year. The choice of using terroristic attacks relies on the evidence that in Latin America there are few civil conflicts according to the standard definitions³ despite the region is one of the most violent in the world. Figures are provided by the Global Terrorism Database (GTD).⁴ Events included in the database meet at least two of the following criteria: (a) the attack must have a political, religious, or social goal, (b) perpetrators intend to coerce, intimidate, or convey a message to a large audience, (c) the act is outside the context of legitimate warfare activities.⁵ Since the early nineties of the last century the number of terroristic attacks has declined steadily, as shown in Figure 1. Moreover, terroristic

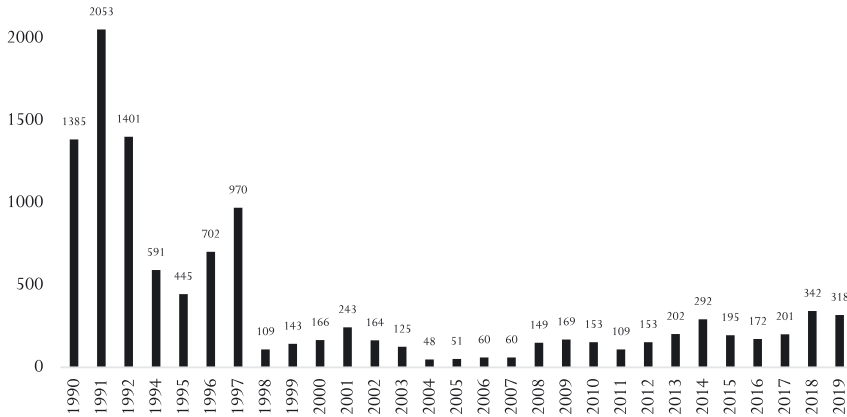
² Countries included in the panel are in Appendix.

³ The UCDP/PRIO Armed Conflict Dataset defines civil conflict as “a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths in one calendar year.” Petterson, T. 2020. *UCDP/PRIO Armed Conflict Dataset Codebook v 20.1*.

⁴ Data for 1993 are from Appendix II of GTD Codebook available at <https://www.start.umd.edu/gtd/>.

⁵ Start, GTD Codebook. Retrieved in August 2021.

Terroristic attacks in Latin America: 1990 - 2019

**Figure 1:** Source: GTD.

attacks are not equally distributed across the region. Colombia, the most violent country, recorded 5372 events in the considered period, followed by Peru (1867), El Salvador (752) and Chile (628). Less violent countries recorded a number of events smaller than 20: Costa Rica (11), Uruguay (25) and Cuba (30). It follows that the variable is over-dispersed. In general, we observe an overall mean of 20 events for each year and an overall variance of 4637. It follows that the variable is over-dispersed. Furthermore, standard deviation within country (54) is higher than standard deviation between countries (42).

Predictor variables are agricultural, mining⁶ and manufacturing shares of GDP. Predictors are one-year lagged. Data are from UNCTAD. The classification is based on ISIC Rev.3. In detail: agriculture corresponds to ISIC A-B activities, mining is referred to ISIC C-E and ISIC F activities and manufacturing corresponds to ISIC D activities. The agricultural share of GDP has decreased overtime: it passed from 13.7% in 1989 to 7.9% in 2018 on average. The country where the magnitude of reduction was greatest is Panama, where the agricultural share of GDP has experienced an overall 75% reduction, passing from 9.17% in 1990 to 2.33% 2019, followed by Cuba with an overall reduction of 63.9% in the considered period, Costa Rica (−62.3%) and Dominican Republic (−62%). In Venezuela and Peru, the overall decrease was lower, respectively −13.12% and −12% in the period 1990–2019. It is noteworthy that no country increases its GDP share of agriculture during the considered period. Also GDP share of manufacturing shrank from 20.7 to 14% on average during the same period. Brazil and Panama are the country in

⁶ Mining is computed by subtracting manufacturing from “mining, manufacturing and utilities”.

which the overall contraction of manufacturing activities was higher: in detail, in Brazil, the GDP share of manufacturing passed from 25.6% in 1990 to 11.43% in 2019; in Panama it passed from 12.7% in 1990 to 6.1% in 2019. Only three countries recorded an overall increase of GDP share of manufacturing: El Salvador (6.1%), Honduras (6.4%) and Cuba (20.4%). The mining share started to increase in the mid-nineties (5.9% in 1989) until the first half of the 2000s (9.5% in 2007) during the commodity boom. If we take into account the period 1995–2008 the greatest increases in mining share were recorded in Paraguay (%), Ecuador (368%), El Salvador (128%) and Chile (124%). Afterwards, because of the Great Recession and the end of the commodities' cycle, it started to decrease, but its level is still higher than in 1989 (6.7% in 2018). In almost all countries the mining share in 2019 was higher than it was in 1990. The countries which experienced the highest increases in the period 1990–2019 are Paraguay (474%) where the mining share passed from 1.68% in 1990 to 9.7% in 2019; Nicaragua (306%) where the mining share passed from 1.73% in 1990 to 7% in 2019 and El Salvador (117%) where the mining share passed from 2% in 1990 to 4.5% in 2019.

The empirical model includes some controls drawn by the existing literature: the level of GDP of the previous year, population, trade openness, the type of regime, and indexes of ethnic fragmentation and polarization (Cleary 2000; Hoeffler 2011; Reynal-Querol 2002). Trade openness is measured by *Trade Globalization Index de facto* developed by KOF: it ranges from 0 (low) to 100 (high). The idea, as suggested by liberal theory, is that trade openness is negatively related to conflict. For the type of regime, it has been used the *Electoral Democracy Index* (EDI) developed by the V-Dem Institute: the index takes into account all the features of polyarchies as defined by Dahl (2008). It ranges from 0 (low) to 1 (high). The ethnic composition is measured by indexes of ethnic polarization and ethnic fragmentation developed by Montalvo and Reynal-Querol (2005).⁷ The former measures to what degree the groups distribution differs from a bimodal distribution. The index ranges from 0 (polarization absent) to 1 (strong polarization). The fragmentation index measures the probability that if we randomly take two individuals from the same country, they will belong to different ethnolinguistic groups. It ranges from 0 to 1.⁸ Figures 2 and 3 show that Latin-American countries are quite highly polarized and partly fragmented. In Table 1 summary statistics are presented.

A random effect negative binomial regression model is applied since political violence is a count variable (Cameron and Trivedi 1999, 2015). A negative binomial

7 The dataset is available at http://www.econ.upf.edu/~reynal/data_web.htm (accessed on July 2021).

8 Ethnic polarization and ethnic fractionalisation data do not vary over time.

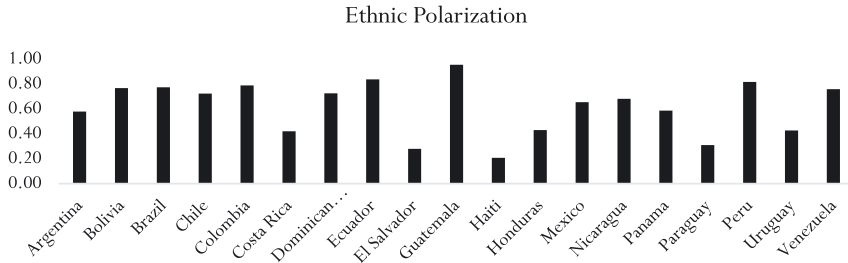


Figure 2: Source: Reynal-Querol.

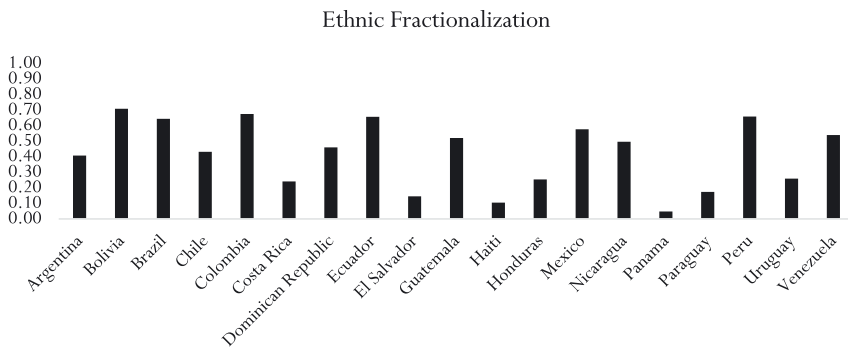


Figure 3: Source: Reynal-Querol.

Table 1: Descriptive statistics.

Variable	Source	Obs.	Mean	St.dev.	Min	Max
Political violence	GTD	600	20.38	68.10	0	658
Agriculture _{t-1} (%GDP)	UNCTAD	600	10.16	5.64	2.33	34.81
Mining _{t-1} (%GDP)	UNCTAD	600	6.88	5.80	0.75	33.83
Manufacturing _{t-1} (%GDP)	UNCTAD	600	17.01	4.34	6.08	32.47
Political violence _{t-1}	GTD	600	22.94	75.90	0	658
GDP _{t-1} (logged)	UNCTAD	600	11.03	1.48	8.56	14.44
Population (logged)	UNCTAD	600	9.49	1.07	7.81	12.26
Trade openness (logged)	KOF	580	3.59	0.45	1.42	4.45
EDI	V-Dem	600	0.62	0.20	0.07	0.91
Ethnic polarization	Reynal-Querol	570	0.62	0.21	0.21	0.95
Ethnic fractionalization	Reynal-Querol	570	0.42	0.21	0.05	0.71

regression is preferred to a Poisson regression because the dependent variable is over-dispersed. In fact, the mean of Political Violence is 20.38 and its variance is 4637.82. Since the variance of Political Violence is more than two hundred times greater than its mean, the negative binomial regression is preferred to Poisson regression. Random effects are the best viable option as suggested by Hausman test. Nevertheless, for the sake of robustness and clarity I also use a fixed effect negative binomial regression model. All the following specifications are controlled for time fixed effects, in other words they are controlled for factors changing each year that are common to all countries for a given year.

Results are presented in Table 2. As expected, the economic structure plays a crucial role in explaining political violence. In detail, the mining sector is positively associated with the occurrence of political violence whereas manufacturing sector is significantly negative associated with the occurrence of terrorist attacks. In particular, the latter result is confirmed in all the specification adopted in column (1)–(5). In detail, in column (1) are reported coefficients of baseline model. It emerges that an increase of one unit in manufacturing percentage of GDP leads to a decline in terrorist attacks of 5.8% (it stems from the following calculation: $e^{-0.06} = 0.942$). On the contrary, an increase of 1 unit in mining GDP share results in a rise in terrorist attacks occurrence of 5.4%. Column (2) includes the number of events occurred in the previous year as a predictor. Its coefficient can be interpreted as a growth rate (Caruso and Schneider 2013). Political violence $_{t-1}$ is positive and statistically significant: an increase of 1 unit in the number of events occurred in $t - 1$ results in an increase of 0.2% of current number of episodes. Mining and manufacturing shares of GDP are still statistically significant. In column (3) it has been added economic and social indicators: one-year lagged GDP, population, and trade openness. Among them only the population appears to be statistically significant. Lack of significance of GDP is noteworthy. The empirical evidence suggests that the GDP has not a crowding out effect with respect to its shares. One may conclude that the GDP breakdown outweighs the level of GDP as explanatory variable of political violence. Mining and manufacturing are still statistically significant. Moreover, in this specification, also agriculture show a positive significant coefficient: an increase of one unit in the percentage of agriculture results in a 5.3% increase in the number of events. In column (4) it has been added to baseline model demographic and political indicators, in detail the type of regime (EDI) and indexes of ethnic polarization and ethnic fractionalization. Among base predictors, only manufacturing is significant. The Electoral Democracy Index show a positive and significant coefficient. This result can be interpreted in the light of the level of democratization of Latin American countries. In fact, Latin American countries are not consolidated democracies: weaken regimes are not able to properly safeguard people instances, and they are not able to provide basic public goods. On

the other hand, they provide to people the minimum level of freedom needed in order to ensure the emergence of rebel groups. Among ethnic indexes only fractionalization index is highly significant. The medium value of the index in the region is 0.42. As literature have shown, the maximum incidence of conflict is reached when ethnic fractionalization reaches the value of 0.5. Because of this, an increase in the index will lead to increase the number of terroristic attacks occurring. In column (5) are reported only significant covariates of previous specifications. The GDP breakdown is still highly significant, as well as other covariates except for fractionalization index. In columns (6)–(10) are reported the same specifications with fixed effect: the negative association between the manufacturing share of GDP and the occurrence of terrorist attacks is confirmed.

4.1 The Relative Size of Sectors

An alternative way to test the theory is to use the ratio between manufacturing and mining activities instead of their GDP shares. The idea is that the ratio between uncontested and contested activities means more than their absolute value. In other words, what matters is the relative size of manufacturing sector. As long as the relative size of uncontested activity increases, the incentive to conflict is expected to fall. If most of the resources are used to ice-cream production, there is a weak incentive in investing in guns for grabbing butter.

As above, I set up a panel database for the period 1990–2019. The econometric model used is the following:

$$Pol. Violence_{i,t} = \beta_0 + \beta_1 \left(\frac{Manufacturing}{Mining} \right)_{i,t-1} + \beta_k X + u_{i,t}$$

where $i = \{1, \dots, 20\}$ and $t = \{1990, \dots, 2019\}$.

As in the previous analysis, political violence is captured by means of the number of terroristic attacks occurred in a calendar year. The main predictor is the ratio between the share of GDP of manufacturing sector and the share of GDP of mining sector at time $t - 1$. The choice of lagging predictor of one year is grounded on the evidence that a certain amount of time must elapse before political violence emerges. Covariates include the one-year lagged GDP and the trade openness index.

In Table 3 are reported estimated coefficients of such approach. In column (1) I use only the ratio between manufacturing and mining as explanatory variable: as expected an increase of that ratio leads to a 7.4% reduction of terroristic attack

Table 2: The impact of GDP breakdown on political violence in Latin America (1990–2019).

	FE									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable: Political Violence										
Negative Binomial Regression										
Agriculture _{t-1}	0.011 (0.433)	0.010 (0.479)	0.052^a (0.008)	0.008 (0.552)	0.047^a (0.004)	0.008 (0.579)	0.007 (0.642)	0.056^a (0.005)	0.010 (0.518)	0.046^a (0.009)
Mining _{t-1}	0.053^a (0.000)	0.056^a (0.000)	0.036^a (0.007)	0.153 (0.304)	0.028^c (0.058)	0.050^a (0.000)	0.052^a (0.000)	0.023^b (0.032)	0.120 (0.439)	0.022 (0.147)
Manufacturing _{t-1}	-0.060^a (0.000)	-0.052^a (0.001)	-0.033^b (0.049)	-0.072^a (0.000)	-0.056^c (0.001)	-0.063^a (0.000)	-0.055^a (0.001)	-0.035^b (0.044)	-0.074^a (0.000)	-0.058^a (0.001)
Terr _{t-1}	0.002^a (0.000)	0.002^a (0.000)	0.002^a (0.000)	0.001^a (0.000)	0.002^a (0.000)	0.002^a (0.000)	0.002^a (0.000)	0.002^a (0.000)	0.001^a (0.001)	0.002^a (0.000)
GDP _{t-1} (logged)			0.106 (0.502)					0.207 (0.206)		
Population (logged)			0.470^b (0.011)		0.544^a (0.000)			0.368^c (0.065)		0.520^a (0.000)
Trade openness (logged)			-0.039 (0.800)					-0.005 (0.972)		
EDI				0.859^b (0.019)	0.988^a (0.009)				1.126^a (0.003)	1.258^a (0.001)
Ethnic polarization				-0.253 (0.742)					-0.535 (0.504)	
Ethnic fractionalization				2.389^a (0.003)	0.220 (0.713)				2.654^a (0.002)	0.342 (0.606)
Const.	1.482^a (0.002)	1.186^b (0.011)	-5.328^a (0.000)	0.672 (0.234)	-4.893^a (0.000)	1.601^a (0.001)	1.337^a (0.006)	-5.518^a (0.000)	0.660 (0.250)	-4.734^a (0.002)

Table 2: (continued)

		FE												
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)			
Dependent variable: Political Violence														
Negative Binomial Regression														
Obs.		600	600	580	570	570	570	600	580	570	570	570	570	570
Groups		20	20	20	19	19	19	20	20	20	20	20	19	19
LogLikelihood		-1500.523	-1492.341	-1417.165	-1441.042	-1431.837	-1359.628	-1353.148	-1281.640	-1306.492	-1300.223	-1300.223	-1300.223	-1300.223

Time fixed effect p -value are in parenthesis. ^aSignificant at 1%; ^bsignificant at 5%; ^csignificant at 10%. For sake of readability statistically significant coefficients are in bold.

Table 3: The impact of manufacturing–mining ratio on political violence in Latin America (1990–2019).

Dependent variable: Political Violence				
Negative Binomial Regression				
	RE		FE	
	(1)	(2)	(3)	(4)
(Manufacturing/ Mining) _{<i>t</i>-1}	-0.077^a (0.000)	0.244^c (0.058)	-0.075^a (0.000)	0.262^b (0.044)
Terr _{<i>t</i>-1}		0.002^a (0.000)		0.002^a (0.000)
GDP _{<i>t</i>-1} (logged)		0.304^a (0.000)		0.325^a (0.000)
Trade openness (logged)		0.015 (0.950)		-0.072 (0.768)
Trade openness (log- ged) × (Manufacturing/ Mining) _{<i>t</i>-1}		-0.073^b (0.036)		-0.078^b (0.028)
Const.	1.105^a (0.000)	-2.940^b (0.030)	1.091^a (0.000)	-3.362^b (0.016)
Obs.	600	580	600	580
Groups	20	20	20	20
LogLikelihood	-1507.209	-1427.741	-1365.818	-1289.380

Time fixed effect applied to all models. *p*-value are in parenthesis. ^aSignificant at 1%; ^bsignificant at 5%; ^csignificant at 10%. For sake of readability statistically significant coefficients are in bold.

occurrence. In column (2) I added the number of events occurred in the previous year, the GDP in $t - 1$ and the trade openness index. As in the prior specifications, the earlier level of violence can be interpreted as a growth rate. The coefficient of terroristic attacks in $t - 1$ is positive and highly significant: this means that for a one unit increase in terroristic attacks occurred in the previous year, the expected number of terroristic attacks in t increases by 0.2%. Also, the GDP presents a positive and highly significant coefficient. This result can be explained in the light of the theory: a greater endowment of resources translates in a higher level of guns, which in turn increases conflicts. However, in this case, the manufacturing–mining ratio presents a positive coefficient. On the contrary its interaction with trade openness index is highly significant, and it is negative. These results suggest that what matters is the production for global markets.

In fact, as showed in Figure 4, as long as trade openness increases, the average marginal effect of manufacturing–mining ratio decreases. It is negative and statistically significant at 95% when the log of trade openness index is greater than or equal to 4, which corresponds to a trade openness index value of 50 in a 0–100 range. In columns (3) and (4) are reported coefficients of the same specifications with fixed effect: all the results are confirmed.

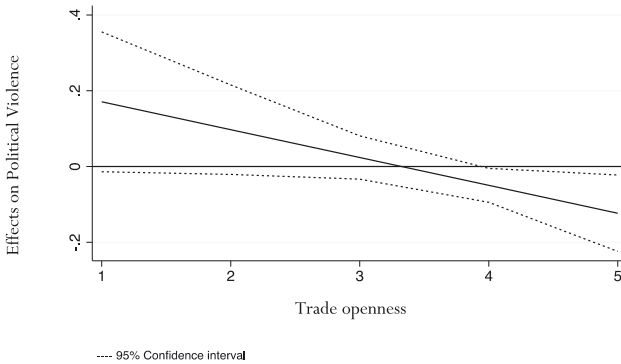


Figure 4: Average marginal effect of manufacturing/mining.

4.2 Robustness Check

Here are presented some robustness checks of the baseline model in which explanatory variables are the percentage of agriculture, mining and manufacturing sector. Results are in Table 4. In column (1) and (2) are reported estimates without the most three violent countries: Colombia (5372 events), Peru (1867) and El Salvador (752). Estimated coefficients confirm the theoretical predictions. Manufacturing sector has a significant negative impact on political violence, while mining sector increases the occurrence of political violence. In both the specifications is confirmed the theoretical prediction that violence reproduces itself. Among covariates, as in the main analysis, both population and ethnic fractionalization exhibits significant positive correlation to the number of terroristic attacks occurred.

In column (3) and (4) are reported estimates without less violent countries: Costa Rica (11 events), Uruguay (25) and Cuba (30). Estimated coefficients confirm the results. In particular, as in the previous check, manufacturing sector has significant negative impact on violence occurrence. When social and political covariates are added, the impact of agriculture and mining shares of GDP on political violence loses significance, as in the main analysis. Among covariates, ethnic fractionalization has a strong positive and significant impact on the occurrence of violence.

In columns (5) and (6) are reported estimate results excluding countries in which the share of mining is on average the highest during the considered period. Excluded countries are Venezuela (21.3%), Chile (14.4%) and Bolivia (13.8%). In column (5) are included economic and demographic covariates. Even if the manufacturing sector is no longer significant (although it maintains a negative sign), the estimation shows a positive and significant relationship between the

Table 4: Robustness checks. The impact of GDP breakdown on political violence in Latin America (1990–2019).

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: Political Violence						
Random Effect Negative Binomial Regression						
Agriculture _{<i>t</i>-1}	0.062^a (0.001)	0.015 (0.324)	0.046^b (0.025)	0.004 (0.802)	0.058^b (0.003)	0.019 (0.216)
Mining _{<i>t</i>-1}	0.035^a (0.009)	0.023 (0.129)	0.028^b (0.034)	0.013 (0.392)	0.037^c (0.094)	-0.007 (0.792)
Manufacturing _{<i>t</i>-1}	-0.031^b (0.049)	-0.052^a (0.002)	-0.049^a (0.010)	-0.074^a (0.000)	-0.025 (0.156)	-0.063^a (0.001)
Terr _{<i>t</i>-1}	0.145^a (0.000)	0.011^a (0.000)	0.002^a (0.000)	0.002^a (0.000)	0.002^a (0.000)	0.002^a (0.000)
GDP _{<i>t</i>-1} (logged)	0.157 (0.307)		0.171 (0.312)		0.019 (0.911)	
Population (logged)	0.384^b (0.031)		0.348^c (0.089)		0.606^a (0.003)	
Trade openness (logged)	0.060 (0.664)		-0.023 (0.864)		-0.079 (0.627)	
EDI		0.807 (0.122)		0.920^b (0.013)		1.091^a (0.010)
Ethnic polarization		-1.377 (0.119)		-0.538 (0.471)		-1.651^b (0.052)
Ethnic fractionalization		2.493^a (0.006)		2.473^a (0.001)		4.243^a (0.000)
Const.	-5.382^a (0.000)	0.883 (0.146)	-4.395^a (0.000)	0.885 (0.122)	-5.911^a (0.000)	0.292 (0.629)
Obs.	493	480	493	510	493	480
Groups	17	16	17	17	17	16
LogLikelihood	-1018.407	-1038.868	-1335.001	-1386.284	-1173.591	-1185.345

Time fixed effect applied to all models. *p*-value are in parenthesis. ^aSignificant at 1%; ^bsignificant at 5%; ^csignificant at 10%. For sake of readability statistically significant coefficients are in bold.

contested sector (agriculture and mining) and the occurrence of terroristic attacks. In column (6) are included social and political covariates. In this case, the relationship between contested sector and political violence loses significance, but the uncontested sector – manufacturing – is negatively significant correlated to the number of terroristic attacks. It is noteworthy that the previous level of political violence is always significant. This result confirms the thesis that violence reproduces itself. In addition, also ethnic fractionalisation index has always a positive significant impact on the occurrence of political violence.

In Table 5 are presented robustness check for the alternative approach, in which the explanatory variable is the ratio between manufacturing and mining shares of GDP. As above, in column (1) and (2) most violent countries are excluded. In column (3) and (4) less violent countries are excluded. In column (5) and (6) are excluded from the panel countries that in the considered period exhibits the average highest share of mining. In all the models where the ratio between manufacturing and mining is the only explanatory variable, it is negative and highly statistically significant. If we consider columns (2), (4) and (6), in which the abovementioned ratio is interacted with the trade openness index, we can observe that the interaction has a significant negative coefficient (except for column 2). Estimation results suggest that as long as trade openness rises, an increase in manufacturing activities with respect to mining ones contributes to reduce the occurrence on terroristic attacks. It could be concluded that the relative size of uncontested sector matters in explaining political violence, and this is more evident if activities are dedicated to export. In addition, the number of terroristic attacks occurred in the previous year has a positive impact on current level of violence in all the specifications adopted.

In sum, theoretical predictions are confirmed by robustness checks. From empirical evidence it emerges that the economic structure as a significant impact on political violence occurrence.

4.2.1 Relevant Time

As showed in Figure 1 the pattern of terroristic attacks in the region can be split in two sub-periods: the first one ranges from 1990 to 2004. In this period are concentrated most of occurred events. Moreover, we can observe a decreasing trend that reaches its minimum in 2004 (48 events). The second one ranges from 2005 to 2019. In this period the number of events is significantly lower compared to the previous one, even if we can observe a slow increase of occurred events. Because of this it has been performed an analysis on each sub-period.

In Table 6 results are presented for the period 1990–2004. In this case, theoretical predictions are confirmed: uncontested activities decrease the probability of

Table 5: Robustness checks. The impact of manufacturing–mining ratio on political violence in Latin America (1990–2019).

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: Political Violence						
Random Effect Negative Binomial Regression						
(Manufacturing/Mining) _{<i>t-1</i>}	-0.058^a (0.001)	0.127 (0.316)	-0.076^a (0.000)	0.240^c (0.062)	-0.075^a (0.000)	0.293^b (0.041)
Te _{<i>t-1</i>}		0.014^a (0.000)		0.002^a (0.000)		0.002^a (0.000)
GDP _{<i>t-1</i>} (logged)		0.245^a (0.000)		0.286^a (0.000)		0.336^a (0.000)
Trade openness (logged)		-0.041 (0.874)		-0.031 (0.898)		0.110 (0.720)
Trade openness (logged) × (Manufacturing/ Mining) _{<i>t-1</i>}		-0.039 (0.260)		-0.071^b (0.042)		-0.085^b (0.032)
Const.	0.983^a (0.000)	-1.896 (0.178)	1.151^a (0.000)	-2.615^b (0.049)	1.102^a (0.000)	-3.672^b (0.024)
Obs.	510	493	510	493	510	493
Groups	17	17	17	17	17	17
LogLikelihood	-1102.511	-1030.4953	-1421.133	-1342.380	-1254.406	-1185.767

Time fixed effect applied to all models. *p*-value are in parenthesis. ^aSignificant at 1%; ^bsignificant at 5%; ^csignificant at 10%. For sake of readability statistically significant coefficients are in bold.

Table 6: Robustness check. The impact of GDP breakdown on political violence in Latin America (1990–2004).

Dependent variable: Political Violence			
Random Effect Negative Binomial Regression			
	(1)	(2)	(3)
Agriculture _{t-1}	0.019 (0.240)	0.030 (0.223)	0.012 (0.510)
Mining _{t-1}	0.048^b (0.030)	0.028 (0.244)	-0.008 (0.790)
Manufacturing _{t-1}	-0.048^b (0.015)	-0.044^b (0.028)	-0.076^a (0.001)
Terr _{t-1}		0.002^a (0.000)	0.001^a (0.001)
GDP _{t-1} (logged)		-0.257 (0.232)	
Population (logged)		0.762^a (0.002)	
Trade openness (logged)		0.137 (0.453)	
EDI			0.965^c (0.054)
Ethnic polarization			1.373 (0.144)
Ethnic fractionalization			0.800 (0.420)
Const.	0.952 (0.103)	-4.161^b (0.015)	0.470 (0.512)
Obs.	300	300	285
Groups	20	20	19
LogLikelihood	-918.218	-902.374	-873.085

Time fixed effects applied to all models. *p*-value are in parenthesis. ^aSignificant at 1%; ^bsignificant at 5%; ^csignificant at 10%. For sake of readability statistically significant coefficients are in bold.

political violence occurrence in all the considered specifications. Interestingly, when the level of violence is higher, grievance motivation – ethnic indexes – loses significance as a determinant of conflict. Also in this case, the previous level of violence matters in explaining current violence.

Table 7 reports results for the period 2005–2019. In this period theoretical predictions are not confirmed. Only agriculture has an unexpected negative impact on violence in two of the three specifications. Among covariates, as in the main analysis the previous level of violence has a significant impact on the current level of political violence. Moreover, among economic factors, only trade openness has a huge significant negative impact on violence. In addition, contrary to the main analysis and to the previous sub-period, political and social factors have a significant impact on violence. It is noteworthy the change of sign of democracy index. In the main analysis it was positive and significant while here it is negative. The change of sign could be explained in the light of the non-monotonic relation between democracy and conflict. In fact, in the period 1990–2004 the EDI mean is slightly lower than it is in the period 2005–2019.

Also for the alternative approach I split the whole period in two sub-periods. In Table 8 are reported estimates for the period 1990–2004. As in the main analysis

Table 7: Robustness check. The impact of GDP breakdown on political violence in Latin America (2005–2019).

Dependent variable: Political Violence			
Random Effect Negative Binomial Regression			
	(1)	(2)	(3)
Agriculture _{<i>t</i>-1}	-0.159^a (0.000)	-0.030 (0.690)	-0.152^a (0.004)
Mining _{<i>t</i>-1}	-0.029 (0.178)	0.015 (0.499)	-0.023 (0.262)
Manufacturing _{<i>t</i>-1}	-0.006 (0.895)	0.043 (0.295)	0.047 (0.243)
Terr _{<i>t</i>-1}		0.005^b (0.040)	0.005^b (0.018)
GDP _{<i>t</i>-1} (logged)		-0.202 (0.610)	
Population (logged)		0.817^c (0.073)	
Trade openness (logged)		-1.225^a (0.008)	
EDI			-2.232^b (0.041)
Ethnic polarization			-3.088 (0.115)
Ethnic fractionalization			5.650^a (0.003)
Const.	1.159 (0.272)	-2.752 (0.513)	0.955 (0.570)
Obs.	300	280	285
Groups	20	20	19
LogLikelihood	-524.484	-465.230	-506.612

Time fixed effects applied to all models. *p*-value are in parenthesis. ^aSignificant at 1%; ^bsignificant at 5%; ^csignificant at 10%. For sake of readability statistically significant coefficients are in bold.

Table 8: Robustness check. The impact manufacturing–mining ratio on political violence in Latin America (1990–2004).

Dependent variable: Political Violence		
Negative Binomial Regression		
	(1)	(2)
(Manufacturing/Mining) _{<i>t</i>-1}	-0.046 ^b (0.027)	0.339 ^b (0.039)
Terr _{<i>t</i>-1}		0.002^a (0.000)
GDP _{<i>t</i>-1} (logged)		0.154^c (0.056)
Trade openness (logged)		0.423 (0.225)
Trade openness (logged) × (Manufacturing/Mining) _{<i>t</i>-1}		-0.103^b (0.023)
Const.	0.815^a (0.000)	-2.609 (0.124)
Obs.	300	300
Groups	20	20
LogLikelihood	-920.379	-908.282

Time fixed effect applied to all models. *p*-value are in parenthesis. ^aSignificant at 1%; ^bsignificant at 5%; ^csignificant at 10%. For sake of readability statistically significant coefficients are in bold.

the ratio between manufacturing and mining is negative associated to the occurrence of political violence. In particular, this association is confirmed if we take into account the interaction between the ratio and the openness index. For the period 1990–2004, as in the main analysis, the negative impact of that ratio on the number of terroristic attacks increases as long as the openness index increases too.

In Table 9 are reported estimated results of the same specifications for the period 2005–2019. In column (1) we can see that for the period 2005–2019 the main explanatory variable – the ratio between mining and manufacturing – loses its significance even if it is still negative. In column (2) interaction with trade openness index is added. Results show that the latter is negatively associated with political violence occurrence. Average marginal effect of manufacturing–mining ratio decreases as long as trade openness increases as in the previous analysis. However, it is no longer statistically significant. These results are in line with results show in Table 7 for the same period.

In sum, these empirical analyses suggest that theoretical predictions are borne out if the level of violence recorded is high.

Table 9: Robustness check. The impact manufacturing–mining ratio on political violence in Latin America (2005–2019).

Dependent Variable: Political Violence		
Negative binomial regression		
	(1)	(2)
(Manufacturing/Mining) _{t-1}	-0.025 (0.716)	0.294 (0.625)
Terr _{t-1}		0.006^b (0.013)
GDP _{t-1} (logged)		0.303^c (0.060)
Trade openness (logged)		-1.202^b (0.043)
Trade openness (logged) × (Manufacturing/Mining) _{t-1}		-0.076 (0.637)
Const.	-0.441 (0.276)	0.101 (0.975)
Obs.	300	280
Groups	20	20
LogLikelihood	-555.328	-467.013

Time fixed effect applied to all models. *p*-value are in parenthesis. ^aSignificant at 1%; ^bsignificant at 5%; ^csignificant at 10%. For sake of readability statistically significant coefficients are in bold.

5 Conclusions

Most research have focused on the role of natural resources in fostering conflict. In general, this work confirms the relationship between economic structure and political violence. In detail, in line with the stream of literature focused on the resource curse, the exploitation of natural resources is associate to a higher probability of political violence occurrence. On the other hand, the empirical evidence shows that the occurrence of violence is negatively associated with the size of manufacturing sector. This is in line with the theoretical approach and therefore manufacturing sector can be considered an uncontested activity. In addition to secure property rights, the role of manufacturing sector in reducing conflict can be explained in the light of liberal theory. Higher degree of manufacturing helps to build stronger networks of internal trade which in turn enhance social cohesion. As liberal theory suggests, deep trade relations tend to turn overtime into integration relations. This led to a decrease in the opportunity cost of conflict on one hand, and, on the other hand, it reduces grievance between groups. Further, the empirical evidence confirms theoretical predictions about the role of mining. Extractive activities can be considered as driver of political violence. This evidence appears to be even stronger if it is associated to weak political institutions.

The main issue of this empirical analysis is about the definition of political violence and the availability of data. As abovementioned, in Latin America there were few civil conflicts according to standard definitions. Because of this I use terroristic attacks in order to measure political violence. However, terroristic attacks are one of the ways in which political violence manifest itself. An interesting database on different forms of political violence is provided by ACLED but it recorded data for Latin America only for the most recent years and it is not yet useful to perform a robust analysis. Another issue that emerges is about most recent years. Further research could explore the loss of significance of the main explanatory variables in the period 2005–2019. A possible explanation for the resumption of grievance motivation might concern the distribution of resources among ethno-linguistic groups as a result of centralising power in Latin-American modern democracies. Moreover, economic activities of marginalized groups tend to focus on the informal economy: it follows that their economic activities are not captured by official statistics. At least, further research could investigate which manufacturing activities play a crucial role in reducing conflicts and the role of service sector.

Appendix

Latin American countries included in the panel

Argentina
 Bolivia
 Brasile
 Cile
 Colombia
 Costa Rica
 Cuba
 Ecuador
 El Salvador
 Guatemala
 Haiti
 Honduras
 Messico
 Nicaragua
 Panama
 Paraguay
 Perù
 Repubblica Dominicana
 Uruguay
 Venezuela

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