

## Forced displacement and Multidimensional Poverty in Antioquia, Colombia: an assessment by means of a Seemingly Unrelated Regression

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**ABSTRACT:** This paper analyzes the incidence of forced displacement on multidimensional poverty at the municipal level in Antioquia, Colombia. To measure poverty we compute the Multidimensional Poverty Index (MPI). The forced displacement data is used as a measure of armed conflict intensity. Then, through a Seemingly Unrelated Regression (SUR) model, it is found that in rural Antioquia the living standards and education dimensions account for a big share of multidimensional poverty, whereas in urban Antioquia are the employment and income dimensions. Moreover, it was found that the municipal level of poverty were highly sensitive to the rate of reception of forced displacement people.

**JEL Classification:** D74; I32; O1; C5.

**Keywords:** armed conflict; forced displacement; Antioquia; Colombia, multidimensional poverty index; poverty breakdown; econometric modeling.

### Desplazamiento forzado y pobreza multidimensional en Antioquia, Colombia: un análisis a través de la Regresión Aparentemente No Relacionada

**RESUMEN:** El artículo analiza la incidencia del desplazamiento forzado sobre la pobreza multidimensional en los municipios del departamento de Antioquia, Colombia. La pobreza se calcula con un índice de pobreza multidimensional (IPM). Los datos de desplazamiento forzado se usan como medida de la intensidad del

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conflicto armado. A través de un modelo de Regresión Aparentemente no Relacionado (SUR), se encuentra que las dimensiones de educación y estándar de vida en las áreas rurales de Antioquia tienen gran contribución a la pobreza; mientras, en las zonas urbanas, la dimensión que tiene la mayor contribución al IPM es el empleo y el ingreso. Además, se encontró que los niveles de pobreza de los municipios, son altamente sensibles a la tasa de recepción de desplazados forzados.

**Clasificación JEL:** D74; I32; O1; C5.

**Palabras claves:** conflicto armado; desplazamiento forzado; Antioquia; Colombia; índice de pobreza multidimensional.

## 1. Introduction

Violence is a phenomenon that highly restricts the ability of societies to overcome the deprivations that affect their members. Indeed, some voices have emerged that talk about a «violence trap», instead of a «poverty trap», as an obstacle that hampers the improvement of living conditions (The Economist, 2011). Usually it was said that individuals lacked the material basis to carry on a dignifying life and that States lacked the resources to provide the services and investments required in a context conducive to economic development. Nevertheless, there is clear cut evidence that portrays violence as a key obstacle, since countries free of armed conflicts are gradually finding a route out of poverty (World Bank, 2011), whereas poverty is concentrating in countries with civil conflicts, ethnic confrontations or organized crime (The Economist, 2011). In that vein, this paper tries to study the incidence of armed conflict —as measured through internal forced displacement— on poverty. The case of Antioquia, in Colombia, will provide the setting to study this relationship. Antioquia showcases areas of widespread poverty and also has a history of armed conflict that has put indelible marks on almost its entire population. Hence, to be more specific, this paper will study the incidence of internal forced displacement on multidimensional poverty at the municipal level in Antioquia (please refer to Graph A2 in the appendix to see this department's location).

Following the capability approach developed by Sen (1985, 1996, and 2000) poverty is interpreted as a multidimensional issue in which income is just an element among many others that help reach a decent life. As Sen (1985, 1996, and 2000) suggests, life quality can be seen through an approach in which it is judged through the capabilities a person has to achieve alternative functionings. From this lens, poverty is seen as a problem of capability-deprivation.

Alkire and Foster (2011) have indicated that measuring poverty may entail certain limitations when using traditional methods such as poverty lines. In fact, these authors' approach to measuring poverty, the Multidimensional Poverty Index (MPI), may overcome these limitations, which have been implemented occasionally in Colombia, and is consistent with Sen's capability approach. Moreover, armed conflict's impact on Antioquia's municipalities will be proxied through data about conflict gen-

erated internal forced displacement. We use forced displacement data as a measure of conflict because: 1) data about armed attacks may understate the impact of the actions of some illegal groups, as in those areas in which there is unquestionable territorial dominance by one group, bellicose activities give way to other more subtle forms to assert dominance; 2) internal forced displacement closely reflects the intensity of armed conflict, as those fleeing from their home territories do so because of security concerns, as an imminent threat to life.

In this paper Antioquia's MPI is composed of four dimensions: health, education, employment and standard of living. Then, the estimated MPI, which will be measured at the municipal level, will be related to internal forced displacement data and a set of control variables in a linear regression framework. The control variables comprise economic and institutional information about Antioquia's municipalities. However, instead of relating the MPI to forced displacement through a single equation regression framework, we will take advantage of the dimensional breakdown of the MPI. Hence, in this paper the incidence of forced displacement on poverty will be assessed through a multiple equations model, which will be estimated using the SUR (*Seemingly Unrelated Regression*) estimator. The reason for this methodological approach is that each dimension's contribution to municipal poverty could have a different sensitivity to forced displacement, or respond to a different set of control variables. Consequently, the SUR model can provide a more detailed picture of the incidence of forced displacement on overall municipal poverty, as it also offers the possibility of identifying the dimensions more affected by armed conflict, and thus contributing the most to overall poverty.

In the current context of peace negotiations between Colombia's government and the heads of the FARC guerrilla and because social reconciliation is based on the recognition of the armed conflict's implications on human development, it is important to bear in mind the social costs of a continued armed conflict when compared to a pacific solution to hostilities. This paper contributes indirectly to the assessment of some of this social cost, because the SUR model estimated here will give us a clue about the incidence of conflict generated forced displacement on multidimensional poverty.

## **2. Literature Review: The relationship between armed conflict and poverty**

### **2.1. International overview**

The study of the relationship between armed conflict and poverty has gained increased attention in recent years as evidenced by the expanding literature (Goodhand, 2001, 2003; Luckham *et al.*, 2001; Fearon and Laitin, 2003; Collier and Hoefler, 2004; Miguel *et al.*, 2004; Orero *et al.*, 2007; Engel and Ibañez, 2007; Brück and Schindler, 2008; Restrepo *et al.*, 2006; Justino, 2009; Djankov and Reynal-Querol, 2010; Addison *et al.*, 2010; World Bank, 2011; Rodríguez and Sánchez,

2012; Kugler *et al.*, 2013; Justino *et al.*, 2013; Lemus, 2014; Buhaug *et al.*, 2014; Fiala, 2015). Within this wide body of literature, there is a big strand which portrays physical and human capital destruction (namely, loss of assets and human lives) as direct causes of poverty. Armed conflict entails forced displacement, threats to population's physical and mental health, restricted job and education opportunities, and hampers the presence of State's institutions. Moreover, armed conflict breaks local social networks, degrades social cohesion, and creates uncertainty around property rights. All these are direct or indirect effects of armed conflict that manifest themselves through individual's capability deprivations, and hence through multidimensional poverty.

For Justino (2009) civil wars, as one of the clearest manifestations of armed conflict, are more likely to occur in poor areas. In this vein, novel work by Fearon and Laitin (2003) and Collier and Hoeffler (2004) have approached this issue by analyzing whether there is a causal relationship linking income to violence. Specifically, they have tried to determine whether a low per capita income makes it more likely for civil wars to occur. On the one hand, Fearon and Laitin (2003) suggest that the prevalence of weak governance structures (financially and politically) favors the emergence of civil wars. But at the same time, they claim that a weak governance is partially explained by a low per capita income. So they appear to suggest that a low income level is an indirect cause of violence. On the other hand, Collier and Hoeffler (2004) appear to show that the distribution and growth of income are closely and directly related to a higher risk of rebellion.

But according to Miguel *et al.* (2004), from a methodological point of view, there are issues of endogeneity and omitted variables bias that make it difficult to assess such a causality link between economic conditions and armed conflict. Miguel *et al.* (2004) have tried to tackle this issue in an econometric setting by using the instrumental variables estimator. By doing so, they found that negative shocks on economic growth have a tendency to increase the probability for a civil war to occur. Opposing this view, Djankov and Reynal-Querol (2010) found that the relationship between income poverty and civil wars is spurious, and is explained by historical dynamics that determine the joint evolution of income and armed conflicts.

As an alternative to this rather economicist view, the political science literature usually puts forward the existence of material incentives as key drivers of violence involvement. Hence, it is not income poverty, but inequality, greed or popular grievances that are viewed as the more plausible explanations of violence.

It should be noted that in academic literature there has been controversy about the linkages between armed conflicts and poverty. Although there is an agreement on the fact that armed conflicts have an effect on poverty, there is a shortage of studies portraying systematic views that help disentangle such effect (Goodhand, 2001). Nonetheless, there are some studies that try to overcome this shortcoming, such as Orero *et al.* (2007); Justino (2009); Addison *et al.* (2010) and World Bank (2011). This group of studies posit that physical capital (such as assets) and human capital destruction (such as human lives losses) are direct causes of poverty. Although it can-

not be forgotten that the nature and extent of those impacts are dependent upon the specific context, individual's reactions, armed groups strategies and the institutional response to war induced shocks.

Regarding the specific case of forced displacement, available literature is fairly recent. According to (Ruiz and Vargas-Silva, 2013), results on the topic provide mixed results. On the one hand, in Europe the long run effect of forced displacement after World War II has been found to be largely positive, probably because of increased labor mobility across regions and because of a shift of labor force from agriculture to other sectors. On the other hand, in the case of developing countries the short term and medium term effects of forced displacement have been found to be negative. This is attributed to the unavailability of job opportunities outside the agricultural sector, and the loss of assets, all of which leads to a decrease consumption. This is clearly exemplified by Fiala (2015) for the case of Uganda. Other examples are provided by Verwimp and Muñoz-Mora (2017) who show that in Burundi forced displacement led to food insecurity and malnourishment.

Poverty can be a transitory or a chronic status. However, according to Otero *et al.* (2007), there's a high risk that armed conflict accentuates the intergenerational transmission of chronic poverty, because it creates critical junctures that have lasting effects in the ability of individuals to have access to the market and non-market provision of goods and services. As the persistence of poverty is a longitudinal concept, this paper will be unable to assess this facet of the poverty-armed conflict relationship. However, it should be recognized that forced displacement can be closely related to chronic poverty, as forced migrants leave behind their jobs and assets in the urgency to protect their lives.

## **2.2. The Colombian case**

In Colombia, the discussion about the causes of the internal armed conflict had its international counterpart in the well-known debate between greed and grievance. However, there are other standpoints from which to study the causes of conflict. For example, Gómez (2001) argues that some contemporary studies showed that the «objective causes» hypothesis<sup>1</sup> did not explain the surge and persistence of the armed conflict in Colombia. Hence, Gómez (2001) brings forward an opposing hypothesis: it is not harsh living conditions nor social exclusion which causes violence, but it is violence the one cause of inequality. Such a view brings to the fore an issue that has been much less examined but in which there is a wider theoretical agreement, that is, the effects of armed conflict on poverty and living conditions (Valencia, 2006). Hence, change of emphasis moves the focus from the causes of conflict to the costs of conflict.

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<sup>1</sup> The so called «objective causes» hypothesis broke an old mold, by defying the view that violence had a political origin, and instead it puts forward that violence stems from harsh living conditions and social exclusion (Bonilla, 2009).

The literature examining the effects of conflict on poverty is not so wide in Colombia as the literature devoted to explain the causes of armed conflict. Valencia (2006) warns that works on the measurement of the costs of armed conflict focus primarily on analyzing correlations of homicide violence with economic growth and to compare the economic performance of countries with and without armed conflicts, thus offering inconclusive results. Although, authors like Echeverri, Salazar and Navas (2000), Gómez (2001), Sánchez *et al.* (2005), Rubio (1997), Trujillo and Badel (1997), Londoño (1998) and Arias *et al.* (2014) have studied the costs of conflict in Colombia within the realm of economics, Valencia (2006) states that there is a shortage of studies addressing the way in which armed conflict affects poverty, investment and growth. In general, there is agreement on the fact that armed conflicts worsen poverty conditions. Indeed, Depetris-Chauvin and Santos (2017) find that municipalities receiving forced migrants face an increase in house rents, lowered food prices and a slight increase in local poverty, whereas Morales (2018) finds a negative short term effect on wages, which vanishes over time for men, but persists for unqualified women.

Within the realm of human security, Galindo, Restrepo and Sánchez (2009) point out to some other costs, like the hampering of social development, evidenced by the drop in schooling rates, the impoverishment related to the destruction of infrastructure, reduced access to health services, and higher infant mortality rates. Moreover, they state that there is consensus about the claim that conflict has bigger negative impact on populations with previously high poverty levels.

This work adheres to this strand of the literature, as it tries to examine the effect of conflict engendered migration (or forced displacement) on the poverty level of Antioquia's territories. That is, the costs of forced displacement are not assessed through economic or pecuniary measures, but through the human costs brought about by forced migration on the level of capability deprivation of resident populations.

### **3. Methodology**

#### **3.1. Data**

In order to relate internal forced displacement and poverty in Antioquia, this study uses two key sources of information: 1) a government database called SISBEN (cross-section 2013), which is used in Colombia as an instrument to target social assistance programs and 2) a public database which contains information about internal forced displacement, collected by the government and ONG's (Observatorio de DD.HH. de la Vicepresidencia de la República and Banco de Datos Noche y Niebla, CINEP). Also, Antioquia's Statistical Annals will be used as a source of complementary information to provide control variables to include in the SUR regression. All these sources provide data at the municipal (city or village) level, that in Colombia is usually the smallest geographical unit of measurement at which reliable information is available. Finally, we advise the reader to Graphs A2 in the appendix to see the location of Antioquia in relation to Latin America and Colombia, and to Graph A3 to see the list and locations of Antioquia's subregions.

### 3.2. The multidimensional poverty index

In a sense, the MPI is not a novelty: the direct method to poverty measurement, which «shows whether people satisfy a set of specified basic needs, rights, or—in line with Sen’s capability approach—functionings» (Alkire and Foster, 2011: 5), has been widely implemented in Latin America, through government backed measurements of Unsatisfied Basic Needs (or *NBI* for its acronym in Spanish). This measurement «shows whether people satisfy a set of specified basic needs, rights, or—in line with Sen’s capability approach—functionings» (Alkire and Foster, 2011: 5). In terms of the MPI index each functioning is called *dimension*. Direct methods to poverty measurement rely on a *dual cut off method* to identify the poor. First, direct methods determine the deprivations of the population, namely, the basic needs or rights that people do not satisfy. Second, among the individuals with any deprivation, the poor are identified. The traditional direct poverty measures usually rely either on the union or the intersection identification methods. The union approach regards as poor the individuals with at least one deprivation or unsatisfied need. The intersection approach regards as poor the individuals with deprivations across all dimensions. Thus, a key contribution of the MPI of Alkire and Foster (2011) resides in the development of a new identification procedure, «that identifies the poor by counting the dimensions in which a person is deprived» (Alkire and Foster, 2009: 1).

Let  $d$  be the number of dimensions selected to compute a direct poverty measure, and let  $k$  be the poverty cut off. In the union approach  $k = 1$ ; in the intersection approach  $k = d$ . However, the MPI allows  $k$  to be such that  $1 \leq k \leq d$ . Thus the identification method of Alkire and Foster (2011) lays half-way between the two aforementioned identification methods.

The MPI also satisfies the property of dimensional monotonicity, «which says that if a poor person becomes newly deprived in an additional dimension, then overall poverty should increase» (Alkire and Foster, 2009: 12). That is the case with the MPI, but not with poverty measures based on a straightforward headcount ratio, as the Unsatisfied Basic Needs Index. Moreover, the MPI can be decomposed by population groups and by dimensions. In the first case, it allows to see which population groups are hard hit by poverty. In the second case, it allows to determine the contribution of each dimension to poverty. This second property is of utter usefulness from a policymaking perspective, as it makes possible to determine the dimensions which contribute the most to overall poverty, providing valuable information for policy prioritization. The multiple equations regression fitted in this paper will exploit the additional information provided by the dimensional breakdown.

### 3.3. Dimensions and deprivation thresholds

In this paper the Antioquia’s MPI is composed of four dimensions: health, education, employment and standard of living. These dimensions, which represent functionings socially accepted as valuable, are proxied through eleven indicators. These

indicators do not necessarily reflect specific functionings, but at the very least they do reflect circumstances conducive to the realization of a given functioning. Moreover, data limitations are largely responsible for the fact that only four dimensions can be considered and proxied by a handful of indicators. The deprivation cut off's are established following the ones used by UNPD (2014) or those used by DANE in the computation of the Basic Unmet Needs indicator. Moreover, all dimensions are given equal importance, namely, each dimension is assigned a weight of one fourth (1/4).

The indicators and cut offs used to classify a household as deprived are as follows:

— Living Standards:

- Electricity: the household has no access to electricity.
- Water conduit: the household has no access to fresh water through a water conduit.
- Sanitation: the household does not have access to a non-shared sanitation facility connected to a sewage system or a cesspit.
- Assets: the household does not own at least two of the following assets: refrigerator, tv, radio, computer, scooter.
- Housing: Households residing in dwellings built with inadequate materials, *i. e.* with floor or wall materials like dirt, sand, ill wood, dung, fabric.

— Health:

- Health insurance: A household is deprived if any of its members has no health insurance.
- Permanent disability: A household is regarded as deprived if any of its members has some permanent disability according to the Sisben database.

— Employment and income:

- Employment: A household is regarded as deprived if any of its working age members is unemployed.
- A household is regarded as deprived if it earns an average monthly income level below 300.000 COP (namely, approximately less than 115 USD).

— Education:

- School attainment: no adult (> 18 years old) household member has completed at primary education cycle.
- School attendance: a school age child is not attending to school. The school age goes from 6 to 12 years old.

After identifying the deprived households within each indicator, the deprivation share or deprivation score for each household is computed. Then, to identify the multidimensionally poor a multidimensional cut-off is chosen, which is used to filter households according to their deprivation score. Any household with a deprivation score (or share) above the one given by the multidimensional cut-off is regarded as poor. Finally, the MPI for Antioquia's municipalities is computed. The Multidimensional Poverty Index (MPI) or M0 (as it is referred to in Alkire and Foster, 2011) is the product of the average deprivation share and the head count ratio. The headcount ratio is the share of



households regarded as multidimensionally poor within each municipality. The average deprivation share is the deprivation score of the typical household.

### **3.4. The multidimensional or poverty cut off**

«The poverty cut off is the proportion of weighted deprivations a person needs to experience in order to be considered multidimensionally poor» (Alkire and Santos, 2015: 8). As the MPI is computed here using eleven indicators, we have eleven possible cut offs from which to choose to identify the multidimensionally poor. Thus, in order to test the robustness of the MPI to the multidimensional cut off, we compute the MPI eleven times, using each time a different cut off. Then, we compare the resulting MPI's by means of three different correlation measures: the Pearson, Kendall, and Spearman correlation indices. If the correlations are high, then this is a sign that the rankings of poverty resulting by using different multidimensional cut offs are fairly similar. Hence, in this case we could say that the MPI is robust to the cut off. Conversely, if we get low correlations, it means that the MPI is sensitive to the multidimensional cut off, a fact that should be a source of concern, as the resulting rankings of poverty would be unstable.

### **3.5. The multiple equations framework or SUR model**

The MPI can be broken down into dimensions, thus allowing to determine the contribution of each dimension to overall poverty. This paper will take advantage of the additional information provided by the multidimensional breakdown of poverty, by relating each dimension's contribution to poverty with a set of explanatory variables, and with forced displacement data. Hence, we will be able to analyze the incidence of armed conflict generated forced displacement on the level of poverty. But, most importantly, we will be able to assess the incidence of forced displacement on Antioquia's poverty profile, namely, we will be able to assess which dimensions of poverty are the most affected by forced displacement.

In order to accomplish this task, we will fit a multiple equations model. As the MPI we have computed encompasses four dimensions, then the model will comprise four equations. Given the likely specificity of each dimension's determinants, each equation may include a different set of explanatory variables. Moreover, given the likely correlation among dimensions, as they all reflect different aspects of the same problem —poverty—, to treat each estimating equation as isolated from each other will be misleading. This implies that standard single equation estimation methods will provide unreliable estimates of the relationships. Hence, we will use a well established multiple equations model, called the Seemingly Unrelated Regression Estimator —or SUR—, to estimate the system of four equations defined by each dimension. The SUR model provides a consistent estimator of a multiple equations model as it takes into account the cross-equation correlations, which in this case are generated by the correlations among poverty dimensions.

Thus, the SUR estimator will provide us with reliable estimates of the four equations or relationships, and with valuable information about the incidence of forced displacement on each dimension's contribution to poverty. Indirectly, it will also provide us with information about the incidence of forced displacement on overall poverty, as it will be possible to establish the dimensions receiving the greater impact from the armed conflict.

## 4. Results

### 4.1. Robustness of the MPI

We will start by analyzing the robustness of the poverty rankings resulting from the MPI calculated using different multidimensional cut off's. As it was pointed out in the methodology there are eleven different cut off values we may use. Hence, we computed the MPI for each possible cut off value and then compared the resulting distributions via three different correlation coefficients. The results of this analysis are shown in Table 1, and Tables A1 and A2 in the appendix.

For example, Table 1 shows that the Pearson correlation between M0\_3 and M0\_4 is very high and close to one (0.9856). M0\_3 refers to the MPI obtained after applying a multidimensional cut off of (3/11) or 27%, that identifies as poor any household with three or more deprivations or, equivalently, with a deprivation share (or score) above 27%. Similarly, M0\_4 refers to the MPI obtained after applying a multidimensional cut off of 36% (4/11), that identifies as poor any household with a deprivation share above 36%, namely, deprived in at least four dimensions. Tables A1 and A2 can be interpreted in a similar fashion.

In general, the Pearson correlations are high for all the MPI's computed after applying intermediate multidimensional thresholds. However, the correlations for the MPI's with cut off's under 8 with those with higher cut off values are slightly lower. What is more, when comparing the correlations of all the MPI's with those obtained after using a multidimensional cut off above 10, the correlations we get are very small or slightly negative. Nonetheless, these facts should not be a source of concern, because high values of the multidimensional cut off put the MPI in a field closer to the traditional intersection identification approach. Indeed, when the multidimensional cut off equals eleven (11/11) or —equivalently— 100%, the intersection identification method is obtained. However, as already mentioned, a key feature of the Alkire and Foster (2011) methodology underpinning the MPI is that the identification procedure lays half-way between the traditional union and intersection approaches. Moreover, it is worth noting that when we look at the MPI with a cut off of 91% or (10/11), we only identify 22 municipalities —out of 125— as poor, a figure which shrinks even further when the cut off is set to 100%. This illustrates that the closer a cut off brings the identification procedure to the interception approach, the more it fails to identify the multidimensionally poor.

**Table 1.** Pearson correlations

PEARSON	MO_1	MO_2	MO_3	MO_4	MO_5	MO_6	MO_7	MO_8	MO_9	MO_10	MO_11	N. Obs
MO_1	1.000											125
MO_2	0.999	1.000										125
MO_3	0.997	0.998	1.000									125
MO_4	0.962	0.964	0.963	1.000								125
MO_5	0.933	0.933	0.932	0.982	1.000							125
MO_6	0.894	0.890	0.890	0.959	0.978	1.000						125
MO_7	0.865	0.861	0.861	0.922	0.954	0.953	1.000					125
MO_8	0.653	0.649	0.644	0.701	0.751	0.762	0.812	1.000				115
MO_9	0.689	0.681	0.679	0.712	0.748	0.772	0.851	0.844	1.000			93
MO_10	-0.101	-0.095	-0.086	-0.120	-0.158	-0.141	-0.112	0.075	0.032	1.000		22
MO_11	0.048	0.048	0.059	-0.055	-0.034	-0.098	-0.221	-0.260	-0.254	0.966	1.000	5

Source: own elaboration.

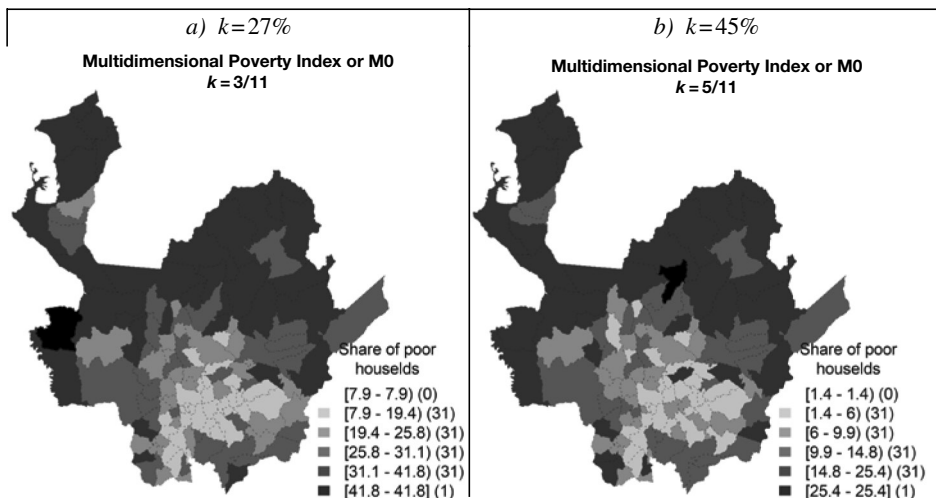
Finally, Tables A1 and A2 show Spearman and Kendall rank correlations, respectively, among different MPI's. These correlation coefficients also showcase a high correlation among the MPI's obtained after applying a multidimensional cut off under nine (9/11) or 82%, but similarly these have a slightly lower correlation with those MPI's computed with a multidimensional cut off above 91% (or 10 dimensions). Thus, the results suggest that, after excluding identification procedures close to the intersection approach, the MPI orderings are fairly robust.

#### 4.2. Spatial distribution of the MPI

Graph 1 shows the spatial distribution of the MPI in Antioquia for two intermediate multidimensional cut off values. Because of the robustness of the MPI, it is no surprise that the two maps showcase a very similar spatial distribution. Indeed, comparing the spatial distributions of the MPI for different cut off values provides another way to check the robustness of the measure.

In both maps it can be seen that multidimensional poverty is more acute in northern municipalities, whereas the lowest levels of poverty are found in the central area of the department, which happens to host Antioquia's only metropolitan area (Valle de Aburrá) and its capital city (Medellín). Also, this pocket of low poverty extends from Medellín's metro area to neighbouring municipalities on the east. Overall, it's possible to discern some sort of core-periphery structure from the spatial distribution of multidimensional poverty, as those areas with a high MPI are comparatively far from Medellín's metro area-Antioquia's central region and economic core.

**Graph 1.** Spatial distribution of the MPI



Source: cartographic elaboration with the support of R software.

### 4.3. Dimensional contributions to the MPI

The MPI is a composite index that involves a set of sub-indicators, *i. e.*, poverty dimensions. It is possible to disentangle the MPI in order to know which dimensions contribute the most to overall poverty. Table 2 shows the average and median relative contribution of each dimension to the MPI in Antioquia. In all cases it can be seen that the mean is close to the median, which suggests that the distributions of the dimensions' contributions are fairly symmetric; this amounts to say that in this case the mean is a reliable estimate of central tendency. On average, the greatest contributor to overall poverty is the «Employment and Income» dimension, followed by the «Education» dimension. These two dimensions alone account for close to 56% of the MPI.

**Table 2.** Mean and Median relative contributions to the MPI

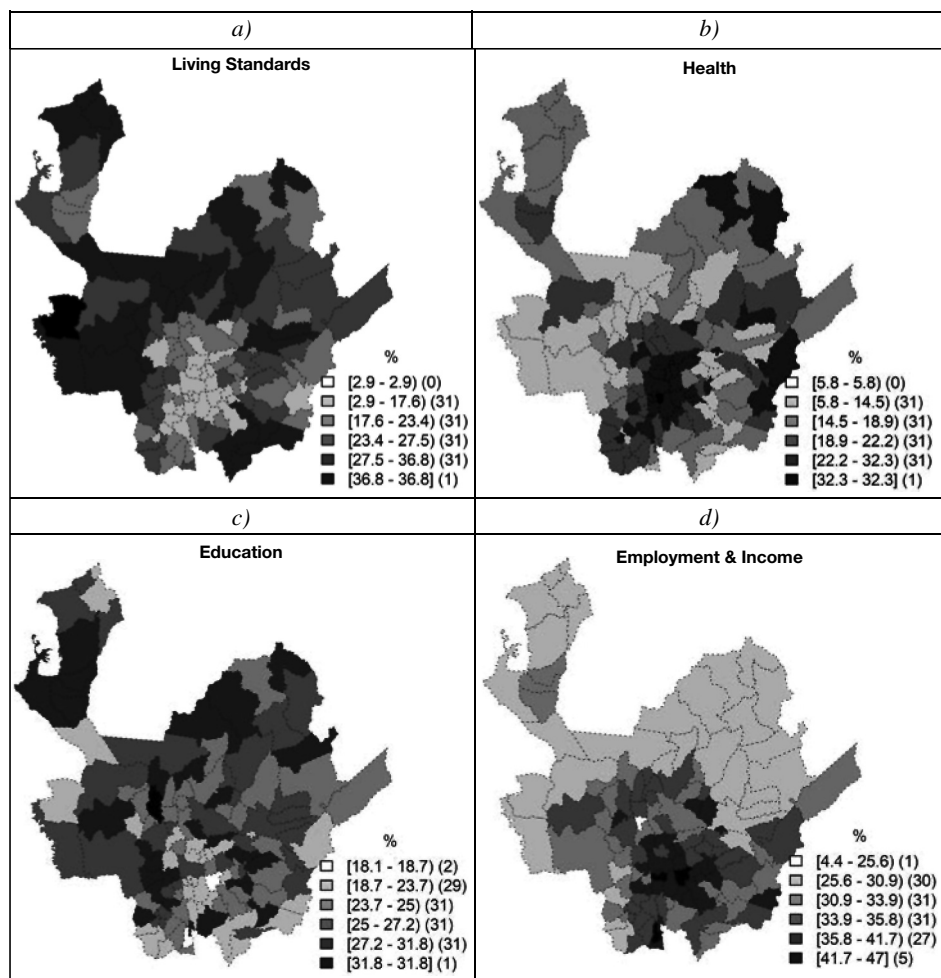
	<i>Living Standards</i>	<i>Health</i>	<i>Education</i>	<i>Employment and Income</i>
<b>Mean</b>	22.35	18.66	25.10	33.62
<b>Median</b>	23.38	18.84	24.99	33.88

Source: own elaboration.

Graph 2 shows the spatial distributions of the relative contribution of each dimension to the municipal MPI, and conveys a complementary and somewhat different picture to that in Table 2. It can be seen that in Antioquia's periphery, mainly in the

north and the west, the «Living Standards» dimension has its greatest slice of overall municipal poverty, whereas in the central «core» region the «Living Standards» contribution is much lower (Graph 2a). However, the «Health» dimension makes its greatest contribution to poverty precisely in the municipalities located in the central «core» region (Graph 2b). The distribution of the contribution of the «Education» dimension shows a less clear spatial pattern: as expected, the «Education» dimension takes its biggest slice in overall poverty in the northern municipalities, whereas in the central region its share is smaller. Nevertheless, Antioquia’s capital, Medellín, escapes from this pattern, as a surprisingly high share of overall poverty is accounted for by the «Education» dimension —over 25%— (Graph 2c).

**Graph 2.** Spatial distribution of the relative dimensional contributions to the MPI



Source: cartographic elaboration with the support of R software.

Finally, the «Employment and Income» dimension shows the sharpest spatial pattern, but in a somewhat unexpected direction (Graph 2d). Almost in every municipality of Antioquia this dimension accounts for about a quarter or more of multidimensional poverty. However, the «Employment and Income» dimension makes its biggest strike on poverty not in Antioquia's periphery, but in its core region. This fact could be explained because in non-central Antioquia agriculture is yet an important activity, in which informal arrangements and disguised unemployment takes a big share of the population out of open unemployment. Moreover, Antioquia's core region is a big receptor of migrants from the rest of Antioquia and from Colombia, being many of these migrants propelled to cities by Colombia's armed conflict. Therefore, Antioquia's core region has an ever increasing population and labor force, that its labor market is barely able to employ.

#### 4.4. The SUR model

As stated in the methodology, the SUR model offers a way to exploit the information provided by the multidimensional breakdown of the MPI. The model to be estimated includes an equation for each dimension, thus forming a system of four equations in which armed conflict generated internal forced displacement is an explanatory variable. More precisely, the dependent variable in each equation is the *absolute* contribution to the MPI by each dimension, in log scale. Moreover, armed conflict generated forced displacement is measured through the median expulsion and reception of forced migrants. Also, a set of explanatory control variables will be included, reflecting socio-economic conditions and infrastructure. It should be noted that all the variables included in the model are described in Table A3 in the appendix. Finally, the overall or total effect of forced displacement on poverty is calculated as the sum of the percentage change times the percentage contribution of each dimension to the MPI.

Table 3 reports the estimation results for the SUR model. Graph A1 in the appendix reports some graphs that help confirm the adequacy of the model. Results suggest that armed conflict increases poverty on those municipalities receiving forced migrants (*rec*), while those municipalities expelling forced migrants (*exp*) could see a slight reduction in poverty. At least in the education dimension, the SUR model suggests that those municipalities expelling forced migrants show a small although significant negative effect on education deprivation; namely, the contribution of education to poverty diminishes. This result could stem from the fact that a diminishing population puts less strain on public education supply.

It is worth noting that the expulsion of forced migrants was found to be significant only for the education dimension, whereas the reception of forced migrants was found to be significant and positive in all equations. Hence, it seems that armed conflict has a greater impact on the poverty level of those municipalities receiving the expelled population. This fact could stem from a twofold explanation: firstly, it could be the case that the bulk of the population expelled by illegal armed groups is already vulnerable and poor; secondly, forced migrants, which are mainly from a rural back-

ground, are forced to leave behind their assets (land) and jobs (mainly in agriculture). Hence, when they arrive to a new place to avoid the security threats posed by illegal armed groups, forced migrants have no option but to start a new life from scratch and in a very disadvantageous setting, as they are deprived of any wealth, thus having a limited capability to satisfy their needs through the market mechanisms.

**Table 3.** SUR model estimates

		<i>Living Standards</i>	<i>Health</i>	<i>Education</i>	<i>Employment and Income</i>
<b>intercept</b>	<i>est</i>	6.55993	5.51249	6.695554	6.64734
	<i>sd</i>	0.72552	0.4263	0.323508	0.46207
	<i>t-val</i>	9.042	12.931	20.697	14.386
<b>exp</b>	<i>est</i>			-0.02637	
	<i>sd</i>			0.008789	
	<i>t-val</i>			-3.001	
<b>rec</b>	<i>est</i>	0.09223	0.06744	0.052656	0.05553
	<i>sd</i>	0.02967	0.02052	0.01352	0.01881
	<i>t-val</i>	3.109	3.287	3.895	2.953
<b>dens</b>	<i>est</i>	-0.10387		-0.06563	-0.07347
	<i>sd</i>	0.05744		0.025068	0.03685
	<i>t-val</i>	-1.808		-2.618	-1.994
<b>ec</b>	<i>est</i>	-0.39755	0.07485	-0.15096	-0.18783
	<i>sd</i>	0.07555	0.05022	0.035841	0.05087
	<i>t-val</i>	-5.262	1.491	-4.212	-3.692
<b>lx100</b>	<i>est</i>			-0.08938	0.1654
	<i>sd</i>			0.022016	0.03813
	<i>t-val</i>			-4.06	4.338
<b>numcam</b>	<i>est</i>		-0.04903		
	<i>sd</i>		0.04128		
	<i>t-val</i>		-1.188		
<b>depend</b>	<i>est</i>	2.97855		1.272976	0.98126
	<i>sd</i>	0.60673		0.274461	0.40497
	<i>t-val</i>	4.909		4.638	2.423

Source: own elaboration with the support of R software.

Apparently, the reception of forced migrants has its biggest effect on the Living Standards dimension (0.092). This is probably the effect of wiped out assets or dis-possession, as the living standards dimension comprises things like access to housing and public utility services, but such access is hindered by armed conflict. Next, the reception of forced migrants has its second biggest effect on the Health dimension (0.067), probably as a result of the direct effects of the armed conflict on health, or because of obstacles to health services access faced by forced migrants.

These results suggest that a 1% (one percent) increase in the median reception of forced migrants is related to a 0.092% increase in municipal poverty as measured exclusively through Living Standards. Also, a 1% increase in the median reception of forced migrants is related to a 0.067% increase in municipal poverty as measured exclusively through the Health dimension.

Finally, overall, a 1% percent increase in the reception of forced migrants can lead to 0.066 % increase in overall poverty, being the biggest contributor to this increase the living standards dimension, followed by the «employment and income» dimension (Table 4). Notwithstanding its relatively low elasticity, the employment and income dimension makes a big contribution to the MPI (see Table 2). This makes its contribution to the increase in overall poverty bigger than the Health dimension, which turns out to be the smallest contributor to the percentage increase in the MPI, in spite of having the second highest elasticity of dimensional poverty to forced displacement.

**Table 4.** Overall effect on multidimensional poverty of a 1% increase in the reception of forced migrants

	<i>Partial increase in poverty</i>	<i>Share of the overall increase accounted for by the dimension</i>
<b>Living Standards</b>	0.0216	0.3254
<b>Health</b>	0.0127	0.1918
<b>Education</b>	0.0132	0.1987
<b>Labor</b>	0.0188	0.2840
<b>Total</b>	<b>0.0662</b>	<b>1</b>

*Source:* own elaboration.

## 5. Concluding Remarks

This paper has tried to give a sense of some of the social costs of armed conflict in Antioquia, Colombia, by assessing the influence of forced displacement on multidimensional poverty. We found that the multidimensional poverty index here computed for Antioquia is fairly robust to the multidimensional cut off, as the correlations among the resulting rankings are pretty high according the Kendall and Spearman correlation coefficients.



Although the spatial distribution of the MPI suggests a core-periphery pattern, with the lowest levels of poverty around its capital city, it turns out that each dimension's contribution to the MPI has contrasting patterns across space. For instance, in urban Antioquia the *Employment and Income* dimension makes a big contribution to the MPI, while in rural Antioquia we have the opposite situation. This fact could be explained because in non-central Antioquia agriculture is yet an important activity, in which informal arrangements and disguised unemployment takes a big share of the population out of open unemployment. Nonetheless, other dimensions, like the *Living Standards* and the *Education* dimensions, show the expected spatial patterns, with the higher levels of deprivation in Antioquia's north.

According to the SUR model we estimated, it was found that the municipal level of poverty as measured through the living standards and health dimensions were highly sensitive to the rate of reception of internal forced migrants (Table 3). However, given that the employment and income dimension explains on average a big share of multidimensional poverty (Table 2) it turns out that a simulated 1% increase in the log of the median rate of reception of forced migrants causes a 0.0662% increase in overall poverty, that is attributed mainly to the *Living Standards* and *Employment and Income* dimensions (Table 4). Hence, the results manifest that internal forced displacement hits mainly the material well being of the population. However, as forced migrants usually move from the rural areas to populated areas or to urban centers, where the presence of public institution is not as weak as in rural areas, it appears to be the case that the dimensions related to services usually provided by the State are less affected by forced displacement, as the simulated 1% increase in the rate of reception of forced migrants has a lower impact on the Health and Education dimensions. But at the same time it could be interpreted that the diminished material well being caused by forced displacement is associated with the difficulties faced by forced migrants to find jobs or well paid positions in the reception territories, which translate themselves in the difficulties to provide for decent living conditions.

Therefore, as the results derived from the SUR model suggest that the *Health* and *Education* dimensions appear not to be so hard hit by forced displacement, it could be hypothesized that this finding stems from the fact that the public provision of Education and Health services help reduce the negative impact that the population would suffer otherwise reflect. Hence, it can also be hypothesized that the bigger impact of the simulated increase in forced displacement on the *Employment and Income* dimension could be related to the weakened social networks of forced migrants, which makes it more difficult for them to find a job in a new place, and to the high levels of informality that characterize labor markets in developing markets, which makes it hard to find stable or well paid jobs in the overcrowded urban centers. The job market situation of the forced migrants, combined with the loss of their assets due to the conflict, both act to produce a high level of material deprivations which are reflected in the high increase of the Living Standards dimension in the face of the simulated 1% increase in the rate of reception of forced migrants.

## References

- Addison, T., Bach, K., Shepherd, A., and Wadugodapitiya, D. (2010): «Fragile states, conflict, and chronic poverty», *Chronic Poverty Research Centre Policy Brief*, 24, 1-8.
- Alkire, S., and Foster, J. (2011): «Counting and Multidimensional Poverty Measurement Counting and Multidimensional Poverty Measurement», *Journal of Public Economics*, 95, 7-8, 476-487.
- Alkire, S., Foster, J., Seth, S., Santos, M., Roche, J., and Ballon, P. (2015): «Multidimensional Poverty Measurement and Analysis: Chapter 5-The Alkire-Foster Counting Methodology», *OPHI Working Paper*, 86, 1-51.
- Arias, M., Camacho, A., Ibáñez, A., Mejía, D., and Rodríguez, C. (2014): *Costos económicos y sociales del conflicto en Colombia: ¿Cómo construir un posconflicto sostenible?*, Bogotá, Ediciones Uniandes.
- Bonilla Mejía, L. (2009): «Revisión de la literatura económica reciente sobre las causas de la violencia homicida en Colombia», *Serie Documentos de Trabajo sobre Economía Regional*, 114, 1-30.
- Bottia, M. (2003): «La presencia y expansión municipal de las FARC: es avaricia y contagio, más que ausencia estatal», *Documento CEDE*, 03, 1-56.
- Brück, T., and Schindler, K. (2008): «The impact of conflict and fragility on households: A conceptual framework with reference to widows», *UNU Wider Research Paper*, 2008/83, 1-18.
- Buhaug, H., Cederman, L., and Gleditsch, K. (2014): «Square pegs in round holes: Inequalities, grievances, and civil war», *International Studies Quarterly*, 58, 2, 418-431.
- Collier, P., and Hoeffler, A. (2004): «Greed and grievance in civil war», *Oxford Economic Papers*, 56, 4, 563-595.
- Cramer, C. (2009): «Violent conflict and the very poorest», *Chronic Poverty Research Centre Working Paper*, 129, 1-25.
- Depetris-Chauvin, E., and Santos, R. J. (2017): «The Impacts of Internal Displacement Inflows on Host Communities in Colombia», *Knomad Working Paper*, 27, 1-50.
- Djankov, S., and Reynal-Querol, M. (2010): «Poverty and civil war: Revisiting the evidence», *The Review of Economics and Statistics*, 92, 4, 1035-1041.
- Echeverry, J., Salazar, C., and Navas, V. (2000): «La violencia en el municipio colombiano: un análisis de la distribución regional de los hechos de violencia», *Seminario de Economía de la Cátedra Colombia*, Bogotá.
- Engel, S., and Ibáñez, A. (2007): «Displacement due to violence in Colombia: A household-level analysis», *Economic Development and Cultural Change*, 55, 2, 335-365.
- Fearon, J., and Laitin, D. (2003): «Ethnicity, insurgency, and civil war», *American Political Science Review*, 97, 01, 75-90.
- Fiala, N. (2015): «Economic consequences of forced displacement», *The Journal of Development Studies*, 51(10), 1275-1293.
- Fransen, S., Ruiz, I., and Vargas-Silva, C. (2017): «Return migration and economic outcomes in the conflict context», *World Development*, 95, 196-210.
- Galindo, H., Restrepo, J., and Sánchez, F. (2009): «Conflicto y pobreza en Colombia: un enfoque institucionalista», in J. Restrepo and D. Aponte (eds.), *Guerra y violencias en Colombia: herramientas e interpretaciones*, Bogotá, Editorial Pontificia Universidad Javeriana, 315-351.
- Gallego, L. (2003): «Los efectos intrafamiliares del bienestar: aplicación de un modelo de estructura de covarianza al caso de Antioquia», *Lecturas de Economía*, 72, 77-102.
- Goodhand, J. (2001): «Violent conflict, poverty and chronic poverty», *Chronic Poverty Research Centre Working Paper*, 6, 1-49.
- (2003): «Enduring Disorder and Persistent Poverty: A Review of the Linkages between War and Chronic Poverty», *World Development*, 31, 3, 629-646.

- Gómez, C. (2001): «Economía y Violencia en Colombia», in A. Martínez Ortiz (ed.), *Economía, Crimen y Conflicto*, Bogotá, Universidad Nacional de Colombia, 41-58.
- Justino, P. (2009): «Poverty and violent conflict: A micro-level perspective on the causes and duration of warfare», *Journal of Peace Research*, 46, 3, 315-333.
- Justino, P., Brück, T., and Verwimp, P. (2013): «Micro-Level Dynamics of Conflict, Violence, and Development: A New Analytical Framework», *Households in Conflict Network Working Paper*, 138, 1-45.
- Kakwani, N., and Silber, J. (2008): *Quantitative approaches to multidimensional poverty measurement*, Houndmills, Palgrave Macmillan.
- Kugler, T., Kook Kang, K., Kugler, J., Arbetman-Rabinowitz, M., and Thomas, J. (2013): «Demographic and Economic Consequences of Conflict», *International Studies Quarterly*, 57, 1, 1-12.
- Lemus, N. (2014): «Conflict-Induced Poverty: Evidence from Colombia», *Peace Economics, Peace Science and Public Policy*, 20, 1, 113-142.
- Londoño, J. (1998): *Epidemiología económica de la violencia*, Ponencia ante la Asamblea del BID, Cartagena.
- Luckham, R., Ahmed, I., Muggah, R., and White, S. (2001): «Conflict and poverty in sub-Saharan Africa: an assessment of the issues and evidence», *IDS Working Paper*, 128, 1-63.
- Miguel, E., Satyanath, S., and Sergenti, E. (2004): «Economic shocks and civil conflict: An instrumental variables approach», *Journal of Political Economy*, 112, 4, 725-753.
- Morales, J. (2018): «The impact of internal displacement on destination communities: Evidence from the colombian conflict», *Journal of Development Economics*, 131, 132-150.
- Orero, M., Heime, C., Cutler, S., and Mohaupt, S. (2007): «The impact of conflict on the intergenerational transmission of chronic poverty: An overview and annotated bibliography», *Chronic Poverty Research Centre Working Paper*, 71, 1-58.
- Restrepo, J., Spagat, M., and Vargas, J. (2006): «The Severity of the Colombian Conflict: Cross-Country Datasets Versus New Micro-Data», *Journal of Peace Research*, 43, 1, 99-115.
- Rodríguez, C., and Sánchez, F. (2012): «Armed Conflict Exposure, Human Capital Investments and Child Labor: Evidence from Colombia», *Defense and Peace Economics*, 23, 2, 161-184.
- Rubio, M. (1997): «Los costos de la violencia en Colombia», *Documentos CEDE*, 11, 1-23.
- Ruiz, I., and Vargas-Silva, C. (2013): «The economics of forced migration», *The Journal of Development Studies*, 49(6), 772-784.
- Sánchez, F., and Díaz, A. (2005): «Los efectos del conflicto armado en el desarrollo social colombiano, 1990-2002», *Documentos CEDE*, 58, 1-76.
- Sánchez, F., Solimano, A., and Formisano, M. (2005): «Conflict, Violence and Crime in Colombia», in P. Collier and N. Sambanis (eds.), *Understanding Civil War: Evidence and Analysis*, vol. 2: Europe, Central Asia, and Other Regions, Washington D. C., The World Bank, 119-159.
- Sen, A. (1985): *Commodities and capabilities*, New Delhi, Oxford University Press.
- (1996): «Capacidad y bienestar», in M. Nussbaum and A. Sen (eds.), *La calidad de vida*, México, Fondo de Cultura Económica, 54-83.
- (2000): *Desarrollo y Libertad*, Barcelona, Planeta.
- The Economist (2011): *The economics of violence: Are countries poor because they are violent or violent because they are poor?*, The Economist, Conflict and Poverty, April 14th [online] [www.economist.com/node/18558041](http://www.economist.com/node/18558041).
- Trujillo, E., and Badel, M. (1997): «Los costos económicos de la criminalidad y la violencia en Colombia 1991-1996», *Archivos de Macroeconomía*, 76, 1-44.
- Valencia, G. (2006). «La economía frente al conflicto armado interno colombiano, 1990-2006», *Perfil de Coyuntura Económica*, 8, 141-174.
- Verwimp, P., and Muñoz-Mora, J. (2017): «Returning Home after Civil War: Food Security and Nutrition among Burundian Households», *The Journal of Development Studies*, 1-22.
- World Bank (2011): *World Development Report: conflict, security, and development*, Washington, World Bank.

## Appendix

**Table A1.** Spearman correlations

<i>SPEARMAN</i>	<i>M0_1</i>	<i>M0_2</i>	<i>M0_3</i>	<i>M0_4</i>	<i>M0_5</i>	<i>M0_6</i>	<i>M0_7</i>	<i>M0_8</i>	<i>M0_9</i>	<i>M0_10</i>	<i>M0_11</i>	<i>N.Obs</i>
<i>M0_1</i>	1.000	0.999	0.997	0.969	0.946	0.925	0.912	0.817	0.807	-0.189	-0.200	125
<i>M0_2</i>	0.999	1.000	0.998	0.971	0.948	0.923	0.910	0.812	0.800	-0.172	-0.200	125
<i>M0_3</i>	0.997	0.998	1.000	0.969	0.945	0.920	0.908	0.809	0.801	-0.189	-0.200	125
<i>M0_4</i>	0.969	0.971	0.969	1.000	0.982	0.969	0.947	0.848	0.815	-0.176	-0.200	125
<i>M0_5</i>	0.946	0.948	0.945	0.982	1.000	0.985	0.973	0.879	0.835	-0.231	-0.200	125
<i>M0_6</i>	0.925	0.923	0.920	0.969	0.985	1.000	0.976	0.888	0.863	-0.249	0.100	125
<i>M0_7</i>	0.912	0.910	0.908	0.947	0.973	0.976	1.000	0.921	0.901	-0.181	0.100	125
<i>M0_8</i>	0.817	0.812	0.809	0.848	0.879	0.888	0.921	1.000	0.894	0.074	0.200	115
<i>M0_9</i>	0.807	0.800	0.801	0.815	0.835	0.863	0.901	0.894	1.000	-0.084	0.200	93
<i>M0_10</i>	-0.189	-0.172	-0.189	-0.176	-0.231	-0.249	-0.181	0.074	-0.084	1.000	0.900	22
<i>M0_11</i>	-0.200	-0.200	-0.200	-0.200	-0.200	0.100	0.100	0.200	0.200	0.900	1.000	5

*Source:* own elaboration with the support of *R* software.

**Table A2.** Kendall correlations

<i>KENDALL</i>	<i>M0_1</i>	<i>M0_2</i>	<i>M0_3</i>	<i>M0_4</i>	<i>M0_5</i>	<i>M0_6</i>	<i>M0_7</i>	<i>M0_8</i>	<i>M0_9</i>	<i>M0_10</i>	<i>M0_11</i>	<i>N.Obs</i>
<i>M0_1</i>	1.000	0.979	0.963	0.858	0.807	0.767	0.746	0.620	0.605	-0.117	-0.200	125
<i>M0_2</i>	0.979	1.000	0.965	0.862	0.810	0.766	0.745	0.615	0.599	-0.108	-0.200	125
<i>M0_3</i>	0.963	0.965	1.000	0.854	0.804	0.761	0.742	0.616	0.603	-0.117	-0.200	125
<i>M0_4</i>	0.858	0.862	0.854	1.000	0.894	0.854	0.804	0.661	0.616	-0.117	-0.200	125
<i>M0_5</i>	0.807	0.810	0.804	0.894	1.000	0.899	0.862	0.702	0.640	-0.169	-0.200	125
<i>M0_6</i>	0.767	0.766	0.761	0.854	0.899	1.000	0.867	0.714	0.671	-0.177	0.000	125
<i>M0_7</i>	0.746	0.745	0.742	0.804	0.862	0.867	1.000	0.760	0.730	-0.108	0.000	125
<i>M0_8</i>	0.620	0.615	0.616	0.661	0.702	0.714	0.760	1.000	0.714	0.056	0.200	115
<i>M0_9</i>	0.605	0.599	0.603	0.616	0.640	0.671	0.730	0.714	1.000	-0.065	0.200	93
<i>M0_10</i>	-0.117	-0.108	-0.117	-0.117	-0.169	-0.177	-0.108	0.056	-0.065	1.000	0.800	22
<i>M0_11</i>	-0.200	-0.200	-0.200	-0.200	-0.200	0.000	0.000	0.200	0.200	0.800	1.000	5

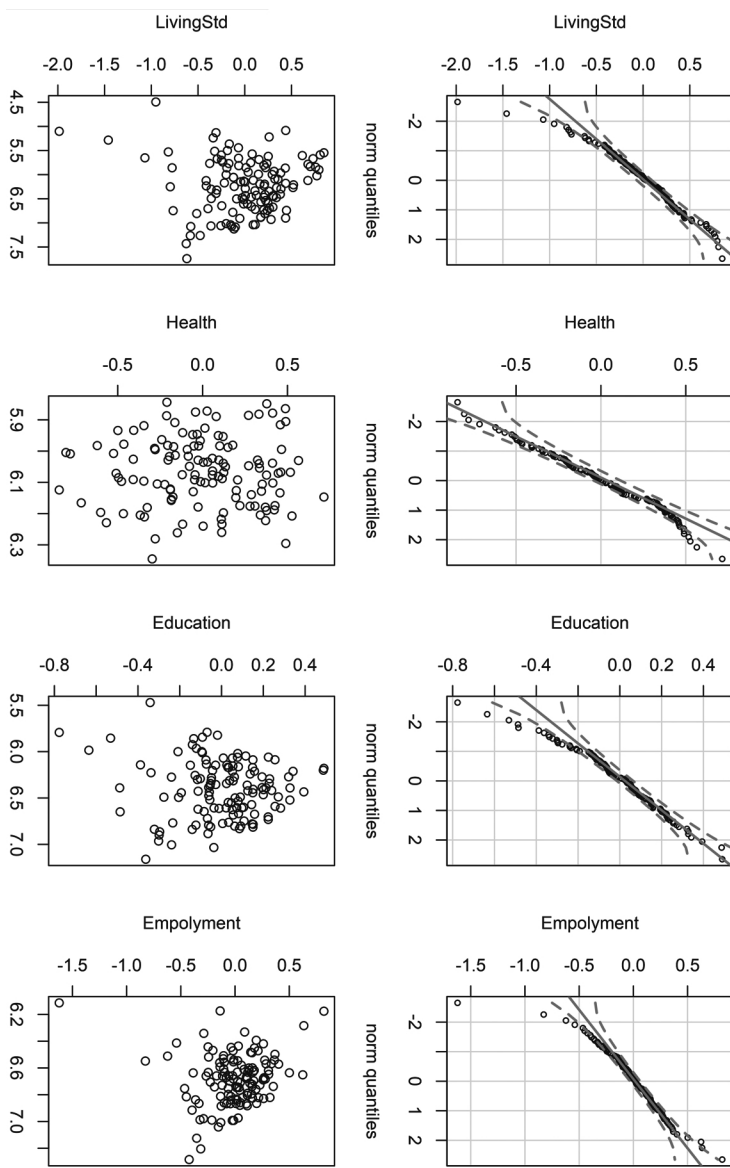
*Source:* own elaboration with the support of *R* software.

**Table A3.** List of Variables

<i>Abbreviation</i>	<i>Variable</i>	<i>Data Source</i>	<i>Links to sources</i>
<i>rec</i>	log of the median of total reception of forced migrants	Observatorio de Derechos Humanos de la Presidencia for forced displacement data between 1985 and 2010. Dane (Colombia's Statistical Office) for population data.	<a href="https://www.nocheyniebla.org/?page_id=566">https://www.nocheyniebla.org/?page_id=566</a> <a href="http://historico.derechos-humanos.gov.co/Observatorio/Paginas/EstadisticasDepartamento.aspx">http://historico.derechos-humanos.gov.co/Observatorio/Paginas/EstadisticasDepartamento.aspx</a> <a href="https://www.dane.gov.co/index.php/estadisticas-por-tema/demografia-y-poblacion/proyecciones-de-poblacion">https://www.dane.gov.co/index.php/estadisticas-por-tema/demografia-y-poblacion/proyecciones-de-poblacion</a>
<i>exp</i>	log of the median of total expulsion of forced migrants		
<i>dens</i>	log of road density	Antioquia's Statistical Annals.	<a href="http://www.antioquiadatos.gov.co/index.php/2-uncategorised/1-anuario-estadistico">http://www.antioquiadatos.gov.co/index.php/2-uncategorised/1-anuario-estadistico</a>
<i>ec</i>	log of per capita electricity consumption (as proxy of economic activity)		
<i>lx100</i>	phone lines per 100 inhabitants		
<i>numcam</i>	hospital beds per 100.000 inhabitants		
<i>depend</i>	dependency ratio	Dane (Colombia's Statistical Office) population figures.	<a href="https://www.dane.gov.co/index.php/estadisticas-por-tema/demografia-y-poblacion/proyecciones-de-poblacion">https://www.dane.gov.co/index.php/estadisticas-por-tema/demografia-y-poblacion/proyecciones-de-poblacion</a>
<i>MPI</i>	Multidimensional Poverty Index	Own calculations based on microdata from Sisbén (Government's system to identify social program's beneficiary's).	Sisbén microdata is not publicly available. It must be requested to Departamento Administrativo de planeación.
<i>Health</i>	Health Dimension contribution to the MPI		
<i>Education</i>	Education Dimension contribution to the MPI		
<i>Living</i>	Living Standards Dimension contribution to the MPI		
<i>Job</i>	Employment and Income Dimension contribution to the MPI		

Source: own elaboration.

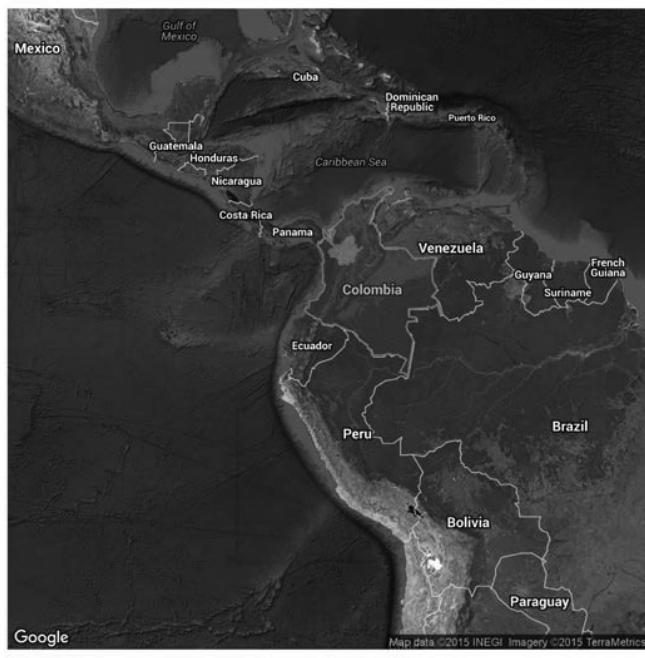
**Graph A1.** Residuals of the equations in the SUR model



Source: own elaboration with the support of R software.

**Graph A2.** Antioquia's Province Location

*a) In relation to Central and South America*



*b) In Colombia*



Source: cartographic elaboration with the support of Google Maps and R software.

**Graph A3.** Antioquia's Sub-regions



Source: own elaboration with the support of R software.