Child Recruitment as a Response to Armed Group Desertions

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Abstract

The recruitment of children by armed groups has become a normalized practice in civil conflicts globally. The motivations leading children to join armed groups, and encouraging these groups to recruit children are intricate and multifaceted. This investigation focuses on one of these factors, exploring the possible effect that a high incidence of desertions may have on armed groups' child recruitment practices. Through the use of an OLS regression, negative binomial regression, fixed effects model, and negative binomial panel data model, child recruitment by armed groups in Colombia is examined. Colombia is a representative case of child recruitment, and there is a formidable supply of data on all aspects of its civil conflict provided by government agencies. Overall, the results of the investigation show that the incidence of desertion is associated with an increase in the levels of child recruitment by armed groups. Even when controlling for the incidence of poverty, the proliferation of weapons, and the presence of children, the incidence of desertion is positively associated with the number of child recruitments. These results therefore call for government institutions to improve measures for the protection of children in territories where they may be the most vulnerable to abduction and persuasion, along with DDR programs.

Key words: *child recruitment, armed groups, conflict dynamics, desertion, Colombia*

Introduction

The recruitment of children by armed groups has become a normalized practice in civil conflicts globally. According to UNICEF (2022), the records of verified child recruitment surpassed 93,000 cases between 2005 and 2020. This figure does not account for cases that have not been verified, meaning that the numbers are likely to be much higher. Under these circumstances, children are forced to work as foot soldiers, cooks, spies and even sexual slaves (United Nations, n.d.). At the same time, they experience appalling levels of violence that negatively impact their livelihoods, with permanent consequences such as physical disabilities, psychological trauma or social marginalization.

Child recruitment is a highly complex phenomenon, consisting of a variety of determining factors, consequences and dynamics. The motivations that lead children to join armed groups, and encourage these groups to recruit children are intricate and multifaceted. This investigation will narrow down on one of these factors, exploring the possible effect that a high incidence of desertions may have on armed groups' child recruitment practices. Children may present an attractive solution to armed groups' troop shortages, as they are easier to recruit and manipulate (Østby et al., 2022, p. 15). It is therefore necessary to examine the dynamics between the incidence of desertions and armed groups' child recruitment practices, to determine whether a significant relationship exists between these phenomena.

To investigate this relationship, cases of child recruitment by armed groups in Colombia will be examined through the use of an OLS regression, negative binomial regression, fixed effects model, and negative binomial panel data model. Colombia is a representative case of child recruitment, and there is a formidable supply of data on all aspects of its civil conflict. An original dataset was constructed using data provided by agencies of the Colombian government, including cases of child recruitment and desertions from the years 2010 to 2021. This allows for the influence that desertion might have on child recruitment to be weighed against other possible factors mentioned by the literature. This investigation therefore significantly contributes to the existing literature on desertion and child recruitment in Colombia, by employing sophisticated quantitative modeling to empirically test the hypothesis of a positive relationship. Overall, the results of the investigation show that high levels of desertion are associated with an increase in the levels of child recruitment by armed groups.

Literature review

There has been substantial research conducted on the conditions that lead to child recruitment. While several studies focus on the structural and systemic factors that favor the use of children in war, others focus on the individual push and pull factors that lead the children themselves to take up arms (Haer, 2019, p. 75). The availability of children to be recruited voluntarily is fostered by their need to escape situations of poverty and threats to their survival. They also seek lucrative sources of income and a renewed sense of control over their lives (Downing et al., 2022, p. 5). Another portion of the scholarship covers the factors that lead armed groups to employ children in their operations. These include the adaptability and malleability that make children more effective fighters, the cost-effectiveness of maintaining their livelihoods, and the ideological victory that incorporating children into their cause might present (Østby et al., 2022, p. 15). These factors increase the demand for children as effective recruits for armed groups.

Systemic factors

One strand of scholarship focuses specifically on how systemic and contextual factors create the conditions that favor the practice of child recruitment by armed groups. Here, the economic, social and political structures constraining and enabling children and the recruiting groups are the subject of study (Haer, 2019, p. 75).

Dudenhoefer (2016, p. 48) explains how the widespread proliferation of small arms globally enables the practice of child recruitment. The technological improvements of weaponry in the

20th century, and in particular the advent of AK-47s, have enabled children to operate them more effectively. These weapons are easy to carry and fire with precision, allowing children to become effective combatants on par with adults. Thus, armed groups can now substitute their adult fighters with children without risking their fighting effectiveness.

Singer (2010, p. 96) further argues that children in underdeveloped, conflict-ravaged and rural communities are at greater risk of being abducted by armed groups. Correspondingly, many of these children choose to join armed groups voluntarily as an escape to their marginalized socio-economic positions and in search of a more stable lifestyle (Singer, 2010, p. 99). At the same time, new types of conflict where the parties are profit-seeking enable unconstrained criminal groups to use children with no moral consequences (Singer, 2010, p. 104).

Honwana (2006, p. 46) argues that the crisis of postcolonialism has allowed for the economic restructuring of underdeveloped states, which in turn has led to a rupture of the social fabric by widening inequalities and increasing insecurity in these communities. Subsequently, the traditional structures, social norms and value systems that supported households and groups in nurturing and protecting children have weakened (Honwana, 2006, p. 46). "This trend has resulted in the commodification of children and a revaluation that has induced an increase in child labor, including child soldiering" (Honwana, 2006, p. 46).

Supply factors

To account for the agency of children and recruiters, and for variations in child recruitment across armed groups, several scholars have turned to the study of elements that shape individual behavior (Haer, 2019, p. 76). Kohrt et al. (2016, p. 215) claim that children who feel that their ability to pursue personal goals is constrained by their society are more likely to join armed groups. Taking up arms presents an opportunity for children who find themselves in stressful situations where they might feel powerless. It creates an incentive to attain a renewed sense of status and individual will, which may not be accessible to them through nonviolent means.

Brett (2003) examines the family's role in leading children to fight. Specifically, the author claims that several youngsters seek to escape domestic situations of abuse and exploitation by joining an armed group that welcomes them as one of their own (Brett, 2003, p. 862). It may also be the case that family works as a pull factor, wherein children are compelled to join an armed group to reinforce their family status or because the family itself is involved in the fight.

Demand factors

Conversely, a section of the scholarship highlights how specific demand factors compel the armed groups themselves to adopt the practice of child recruitment. Beber and Blattman (2013, p. 74) ask why child recruitment is still a common practice in some armed groups, even though children are assumed to be less capable than adults in warfare and potentially bring several disadvantages to the group. The authors argue that "children are attractive recruits if and only if they are easier to intimidate, indoctrinate, and misinform than adults" (Beber & Blattman, 2013, p. 65). Thus, children present the opportunity to contribute to the fight at a lower cost, and their ease of retention neutralizes their lack of combat skills.

Achvarina and Reich (2010, p. 57) outline the relationship between the congregation of children in large, unprotected places, such as refugee camps, and a higher incidence of child recruitment by armed groups in the area. The sheer number of children who find themselves in a vulnerable position, often as orphans, in refugee/Internally Displaced People (IDP) camps makes them a lucrative resource for insurgents to come in and abduct or manipulate them into taking up arms. In the absence of appropriate deterrents, armed groups may take this opportunity to recruit new members into their ranks.

A gap in the literature

One factor that has been scarcely mentioned in the scholarship on child recruitment is the incidence of desertions from armed groups as an incentive to adopt this practice. Haer (2019, p. 77) points to specific authors who have examined how armed groups recruit children for the mere purpose of filling up their ranks. Meanwhile, Nussio and Ugarriza (2021) claim that "preliminary analysis suggests that desertion is associated with the forced recruitment of minors" (p. 202). However, this line of research has not been explored extensively.

In line with the existing literature, the relative ease and low cost of child recruitment, particularly in various marginalized and conflict-driven communities, may incentivize armed groups to employ children in their ranks. In the face of a high incidence of desertion and subsequently weakened military performance, recruiting children may present a time- and resource-efficient solution. This relationship will therefore be investigated in depth to answer the question: *Does the incidence of desertions from armed groups affect their levels of child recruitment?*

Theoretical framework

Conceptualization

In investigating the factors leading to desertion from armed groups, Nussio and Ugarriza (2021) define 'desertion' in simple terms as "the unauthorized exit from an armed organization" (p. 167). This conceptualization is helpful because it accounts for a comprehensive range of reasons and actions through which fighters leave their armed group. However, it is important to refine it by limiting cases of desertion to those members who leave by their own choice and without the intention to return. This definition distinguishes desertion from unauthorized absence or absence without leave.

It is also crucial to define the armed groups that deserters are escaping from. The Colombian agency that deals with demobilized fighters who deserted their post in illegal armed groups defines these organizations as "guerrilla or self-defense groups, or a significant and integral part of them such as blocks, fronts or other modalities of those same organizations that, under the direction of a responsible command, exercise control over a part of the territory that allows it to carry out sustained and concerted military operations" (Agencia para la Reincorporación y la Normalización, 2023, para. 16). This definition will be employed for this investigation.

The 2007 Paris Principles present the most comprehensive definition for children associated with armed forces or armed groups. Here, UNICEF (2007) defines them as "any person below 18 years of age who is or who has been recruited or used by an armed force or armed group in any capacity, including but not limited to children, boys, and girls used as fighters, cooks, porters, messengers, spies, or for sexual purposes. It does not only refer to a child who is taking or has taken a direct part in hostilities" (p. 7). It is important to note that while civil war scholars tend to focus on the factors that push individuals to join armed groups voluntarily, this approach does not recognize the incidence of forced recruitments (Beber & Blattman, 2013, p. 70). It also does not account for the factors that lead armed groups to implement child recruitment as a practice. Thus, the focus here will be on the armed group's decision to recruit child soldiers through any means, including persuasion and abduction.

Theories

Although no comprehensive theory has linked the influence of desertion to child recruitment by armed groups, several studies may help in the formulation of a hypothesis. Twum-Danso (2003, p. 29) argues that a shortage of manpower is a primary reason for using children in conflicts. According to the author, long-running conflicts, poverty, and disease tend to diminish the supply of fighters. This phenomenon is complemented by the evidence that child recruitment is rare in the early stages of conflicts but increases as the conflict progresses (Twum-Danso, 2003, p. 29). Thus, there could be a relationship between the decreased supply of fighters as a conflict prolongs and the observed increase in

child recruitment.

Andvig and Gates (2010, p. 77) analyze the influence of situations of excess demand. These are situations in which violent organizations attempt to recruit more fighters than they are able to. This creates an excess demand for child recruits, dictated by factors such as "the accessibility of recruits, including the proportion of usable children versus adults in the area; the ease of capturing a child compared to an adult; and the existence of exceptionally good fishing grounds, such as refugee camps or secondary schools" (Andvig & Gates, 2010, p. 90). Armed organizations have also been observed to recruit high numbers of children in the face of nearing defeat. Such was the case of the German SS Youth Division in the final days of the Second World War (Andvig & Gates, 2010, p. 90). In these cases, children pose a cost-effective solution to emergency situations of troop shortages, increasing the likelihood that they will be recruited.

Similarly, Faulkner and Doctor (2021, p. 11) investigate the recruitment practices of armed groups' splinter factions and find that they are more likely to recruit children. Given that splinter factions emerge amidst ongoing conflicts, the pressure they experience to scramble for resources and swiftly gather recruits increases. Children become an attractive solution when splinter factions lack the time and resources to conduct extensive screenings of new recruits (Faulkner & Doctor, 2021, p. 11). In this sense, the competitive and high-pressure environment in which splinter factions arise leads to an increased demand for fast recruitment, leading them to employ child recruitment.

Hypothesis

Having surveyed the existing literature and theory on child recruitment, a relationship between the high demand for recruits in armed groups and the implementation of child recruitment as a practice may be assumed. Increased desertions from such organizations present a situation that may create excess demand for recruits. Thus, the hypothesis for this investigation is that *as the incidence of desertion from armed groups increases, their levels of child recruitment increase.*

Research design

Case selection

To investigate the possible effect of the incidence of desertion on child recruitment, the case of Colombia will be examined. Colombia is a republic comprising 32 departments, which are the country's subdivisions and are granted a certain degree of autonomy. The civil war in Colombia has seen 60 years of fighting and has evolved into a protracted conflict involving the government, left-wing guerrillas, far-right paramilitary groups and drug cartels (Justice for Colombia, 2018). The most prominent armed groups in the conflict have been the Revolutionary Armed Forces of Colombia (FARC), officially demobilized in 2017; the National Liberation Army (ELN); and the United Self-Defense Forces of Colombia (AUC), demobilized in 2006 (Justice for Colombia, 2018).

The practice of child recruitment by armed groups in Colombia has been identified as an ongoing trend since the 1980s (Downing et al., 2022, p. 6). The erosion of the social fabric in Colombia throughout the conflict has ruptured the moral and ideological pillars of the insurgent's initial struggle. Today, the Colombian conflict has seen the intrusion of criminal activities such as drug trafficking and kidnapping, as well as the implementation of child recruitment by armed groups. This practice takes place through coercion as well as voluntary participation from children. Downing et al. (2022, p. 7) explain how "structural factors such as poverty, individual factors including interrupted schooling and domestic violence, and incentives such as money, adventure, weapons, and status" lead children to take up arms in search of an escape from their personal circumstances in Colombia. Overall, at least 17,866 children were recruited and utilized by Colombian armed groups up until 2020 since the start of the conflict (Centro Nacional de Memoria Histórica, 2021).

Another prominent aspect of the conflict in Colombia has been the phenomenon of the *desmovilizados*. Colombia has established a wide

range of processes through which fighters in the conflict are able to individually stop their military activity and be reintegrated into society with the help of government agencies such as the *Agencia para la Reincorporación y la Normalización*. Supported by promotional campaigns and strong government institutions that grant accessible channels for fighters to renounce war, Colombia saw a total of 63,000 demobilized fighters since the beginning of the conflict and up to 2016 (El Tiempo, 2016). As opposed to collective demobilization such as in the 2016 Peace Accords, these fighters individually chose to desert from their armed group and submit themselves to reintegration and judicial procedures.

Due to the all-encompassing impact of the armed conflict in Colombia on its history and society, several initiatives for collecting information and delivering truth accessible to all have been established. The country's institutions for data collection, processing, and reporting are highly developed, recounting the history of the conflict and all its aspects. Thus, the Colombian conflict presents an excellent case to study the incidence of desertions from armed groups and their practice of child recruitment, as both these phenomena have been present throughout its history and have been rigorously documented by the country's institutions.

Conducting a national case study in the context of Colombia allows for a narrower scope, and delving deeper into the specific national context of the country. This information may then add to further comparative analyses at the regional or global level, identifying commonalities or differences across different contexts. The robust and context-specific empirical evidence gathered from this investigation may therefore contribute to the existing literature on child recruitment, ultimately benefiting global efforts to address this phenomenon.

Data collection and operationalization

Centro Nacional de Memoria Histórica (2023) is a government agency in Colombia that deals with preserving the collective memory of the internal armed conflict. Within this organization, the Observatory for Memory and Conflict collects and manages data on various modes of violence conducted by actors in the war, including massacres, kidnappings and recruitment of children, from 1958 to 2022. The dataset utilized for this investigation lists individual cases of child recruitment within this time frame, including information such as the department where the event took place, the responsible armed group and the recruitment date. The observations amount to a total of 16,850 cases, which abide by the definition of child recruitment previously discussed. These include cases of child recruitment committed by a wide range of armed groups in the country, including armed dissidents from the defunct FARC guerrilla. For the purpose of this investigation, the individual cases of child recruitment will be aggregated so that each observation in the dataset accounts for the number of recruitments per department per month. In this way, the levels of child recruitment by armed groups in Colombia will be measured as the dependent variable.

The Colombian Ministry of Defense, in collaboration with the Agency for Reincorporation and Normalization, keeps track of the demobilization of deserters from illegal armed groups (Ministerio de Defensa Nacional, 2023). During this process, data is collected about the group the fighter deserted from, the date of the desertion and the department where the fighter deserted. The dataset provided lists individual cases of desertion, amounting to 9,629 cases between 2010 and 2021. Here, the individual cases of demobilization will also be aggregated in the same manner as with the child recruitment cases. Thus, the incidence of desertions from armed groups in Colombia will be measured by the number of cases per department per month, as the independent variable. This will allow for the number of cases of child recruitment to be compared to the number of desertions for each department in specific months to empirically test the hypothesis of a positive relationship between the two variables. Therefore, the unit of analysis is department by month.

In line with the existing literature, several control variables will be included to account for the variation of child recruitments that is not explained by the incidence of desertion and to

avoid bias in the statistical results. These are the levels of poverty in each department, the proliferation of light weapons and the presence of children per department. It must be noted that the data utilized for the control variables is not available for each specific month. Instead, the yearly value for each variable will be utilized as the value for each individual month. In this way, the monthly variation in the main variables of interest is maintained, while accounting for a rough estimate of the control variables.

Poverty has been shown to be a major structural factor leading to more child recruitment (Singer, 2010, p. 96). DANE (2021), the Colombian National Administrative Department of Statistics, provides data on the monetary poverty levels per department, from 2010 to 2021. These will be measured as the percentage of people experiencing monetary poverty in each department, and will be labeled as *Poverty*.

Another control variable measures the proliferation of light weapons, which aids in the effectiveness of children as combatants in civil conflicts (Dudenhoefer, 2016, p. 48). *Datos Abiertos Colombia* (2023), the government's open data website, provides a dataset that lists the cases of crimes registered by the National Attorney General. Here, the cases of fabrication, trafficking and carrying of weapons will be aggregated per department to control for variation in the proliferation of weapons. This variable will be labeled as *Weapons*.

Lastly, to account for variation in the presence of children per department, the number of births in each department will be included as a control variable. However, it is noted that newborn children do not tend to be recruited by armed groups. According to Singer (2016), the average age of child soldiers is just over 12. Thus, this control variable will be lagged to account for the number of births 12 years prior to each observation as a representation of the presence of children available to be recruited. For this variable, data provided by DANE (2023) will be utilized. The variable will be labeled as *Births*.

It is important to note that the measurement of these variables is subject to specific limitations which must be considered. The variable for desertions used data from Colombia's Ministry of Defense (2023) program to reintegrate demobilized fighters. Only the cases of desertion in which the fighter chose to demobilize through legal means and the reintegration program were accounted for. It is also noted that only the cases of desertions from Colombia's two largest guerrillas, FARC and ELN, were included in the data gathered. Thus, the analysis did not consider desertions from the myriad of other small armed organizations in the country.

A similar limitation holds for the dependent variables, as only the cases of child recruitment registered by the Centro de Memoria Histórica (2023) were accounted for. Because the Colombian conflict mostly takes place in the rural and isolated areas of the country, where government reach is limited, there may be a large number of child recruitments taking place that were never registered. Thus, the variation in the dependent variable must be considered with caution.

Both FARC and ELN were not in control of all departments at all times. For example, post-2002 FARC began to weaken in its membership size and military capacity, including the size of territorial holds (Al Jazeera, 2012, para. 21). The presence of an armed group in each department therefore stands as a relevant confounder between the dependent and independent variables. It was however not possible to identify available data on the presence of armed groups per department for the years surveyed in this investigation. There is therefore a serious limitation in the data, as the presence of armed groups in each department has not been accounted for.

The control variables are also limited by the data collection process implemented to measure them. While the *Weapons* control variable only measures the cases of weapons crime caught and registered, the *Births* control variable estimates the number of births yearly. Additionally, the *Weapons* control variable aimed to account for the proliferation of light weapons, which greatly aids in the effective participation of children in combat. In reality, it measured the number of crimes related to the fabrication, carrying and trafficking of all weapons and their components (Datos Abiertos Colombia, 2023). Lastly, there may have also been specific issues with the nature of the data and the assumptions desired

for the models employed, such as independence of observations or linearity for the fixed effects model.

However, the variables of interest, models, and data employed are the best estimations available to study the conflict phenomena in Colombia. It is important to note that this investigation seeks to establish an overarching picture of the general relationship between desertion and child recruitment, which may be explored in depth in future projects. Thus, the research presented is valuable in establishing an initial estimation of this relationship and shed light on its possible policy implications.

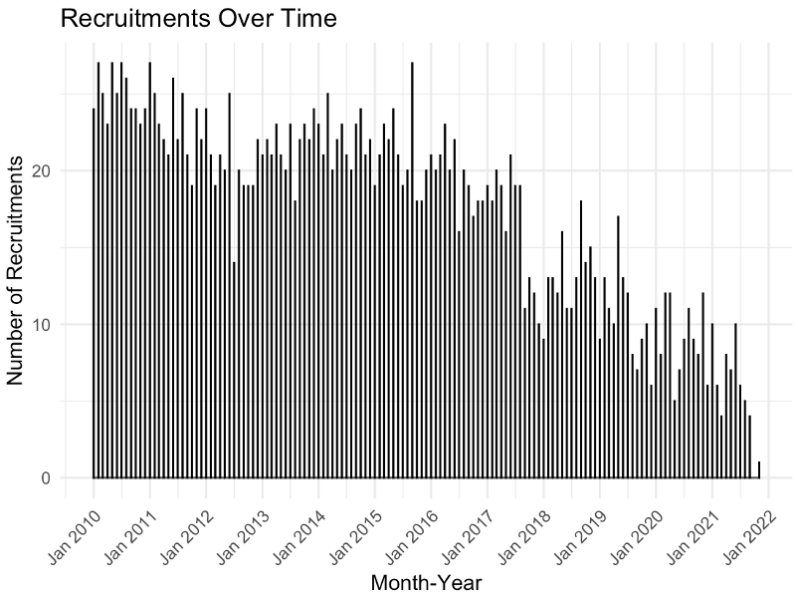
Methods of data analysis

To test the effect of the incidence of desertions from armed groups in Colombia on their levels of child recruitment, a statistical analysis will be conducted on the data previously described using the statistical program R.

Using R, a dataset was constructed covering the number of desertions and the number of child recruitments per department in each specific month.[8] Because the number of cases was aggregated, there were observations for which either no recruitment or desertion was observed in a department-month. A value of 0 was thus assigned to these observations, in order to account for the lack of cases. Per the statistics, the dataset contains a total of 2482 observations, from January 2010 to November 2021. There is great variation in the number of cases per department, with the highest amounts concentrated in densely populated and economically active areas such as Bogotá D.C. and Antioquia, and areas with high presence of armed groups such as Cauca and Nariño (Pardo Quintero, 2019, para. 2). This could be due to the Colombian government's increased ability to access information about events taking place in cities, which must be considered as a potential sampling bias. A prominent decrease in the number of monthly observations may be observed after 2016. This may be explained by the peace accord signed between FARC and the Colombian government, which effectively disbanded the guerrilla group.

The histogram in Figure 1 displays the distribution of child recruitments over time. As expected, a prominent decrease in the number of child recruitments may be observed post-2016, likely due to the signing of the peace accords and the subsequent changing political environment within FARC.

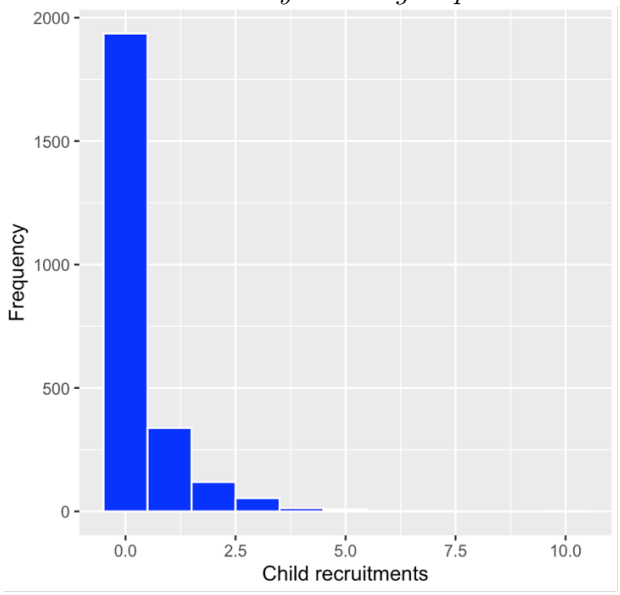
Figure 1.
Child recruitments over time



[8]See Appendix 1 for the descriptive statistics of this dataset.

The dependent variable shows a disproportionate number of observations with 0 child recruitments per department-month. More specifically, 1946 observations showed 0 child recruitments, and only 87 observations showed more than two recruitments in a department-month. Thus, this variable provides count data with a low mean. Figure 2 shows a histogram of the number of child recruitments per department-month, displaying how the data resembles a negative binomial distribution, with a right-skewed tail following the lump of the data. Additionally, the dependent variable's variance-to-mean ratio (VMR) was calculated, yielding a value of 2.01, as well as the dispersion index (DI), yielding a value of 1.01. Both these values indicate that there is overdispersion in the dependent variable. It was therefore deemed appropriate to employ a negative binomial regression to investigate the effect of desertions on child recruitment, as it includes a dispersion parameter. This regression allows for the modeling of count variables with over-dispersed outcomes. Furthermore, robust standard errors will be employed to account for any potential issues of heteroscedasticity.

Figure 2.
Child recruitments by armed groups in Colombia



Subsequently, the aforementioned control variables were included in the dataset.[9]

Not all departments were surveyed in all months by the data collection agencies corresponding to this control variable. Therefore, there were several observations which had no data available, and were therefore removed. This led the sample size in this dataset to decrease to 1891 observations. The control variable, *Weapons*, has values ranging from 66 crimes related to weapons per department-month, to 876 crimes per department-month, with a mean of 208 crimes. Aggregating the number of weapons crimes per department reveals that Antioquia, a department known for its infamous crime scene, has disproportionately more weapons crimes than other departments, with 9222 total cases from 2010 to 2021.

The *Poverty* control variable has a minimum of 13% of households experiencing monetary poverty in a department-year and a maximum of 74%, with a mean of 44%. This data shows the high levels of inequality among Colombia's departments. Chocó shows the highest incidence of poverty, with an average of 67% of households experiencing monetary poverty in any particular year. Meanwhile, Bogotá D.C. holds an average of 26% of households experiencing monetary poverty per month.

The lagged number of births per department-month also shows great variation, ranging from 3166 births to 139,276 births per department month. Certain rural and mountainous areas of Colombia are extremely sparsely populated, compared to the densely populated cities, accounting for this variation. These descriptive statistics show the vast variation in the levels of poverty across departments, the proliferation of weapons and the supply of children. Thus, they reinforce the need to control for these variables. Subsequently, the two models presented so far will be compared to determine whether the control variables improve the quality of estimations.

Lastly, the cases of desertion and child recruitment from armed groups were aggregated by armed group, per department and month. The theoretical framework previously outlined describes the effect of desertions, specifically on the armed groups themselves and their subsequent choice to recruit children as a response to this phenomenon. Thus, it is crucial to an-

[9]Descriptive statistics for this dataset may be surveyed in Appendix 2.

alyze the data from the perspective of armed groups specifically, seeing as the effect we are testing does not occur at the level of departments. The resulting dataset contains 2979 observations across two armed groups, ELN and FARC, all 32 departments, and all months from 2010 to 2020.

To analyze this data, a fixed-effects model will be employed to test the effect of desertion on child recruitment. The dataset is constructed as panel data, with observations containing aggregated cases for each variable of interest by armed group, department and month. Thus, variables that have fixed effects on the dependent variable across armed groups, departments, or over time might be omitted (SebastianWaiEcon, 2020). These will be accounted for, along with idiosyncratic errors, by including a within estimator in the fixed-effects model. This fixed effects model will be applied to linear and negative binomial regression.

To this end, the armed group, department and month of the observations were included in the within estimator. Child recruitment practices may vary between armed groups, depending on unobserved factors such as the group's organizational structure, ideological goals and the leadership style of their command. The incidence of such a practice may also depend on unobserved effects pertaining to the department from where children are recruited, as different departments may have varying cultural attitudes towards violence, diverse presence from armed groups and changing rural landscapes, which leave children more vulnerable to recruitment. Lastly, the incidence of child recruitment may vary across time periods, as a changing political climate, major shock events such as the COVID-19 pandemic, or developments in the civil conflict itself such as the 2016 Peace Agreement may have unobserved effects.

The conduct of a wide variety of statistical tests on the variables of interest allows for the robustness of the results to be tested from different theoretical perspectives. Each statistical test represents a different approach to analyze the data, each with their own value and shortcomings, as explained above. By subjecting the data to this variety of tests, the conclusions drawn from the statistical analysis are made more robust and the results more reliable, helping to craft an overall picture of the relationship between armed group desertions and their child recruitment practices.

Analysis

Desertion vs child recruitment

Table 1.
Negative binomial regression with Child Recruitment as the dependent variable

	Model 1
(Intercept)	-1.757***
	(0.067)
Desertions	0.142***
	(0.009)
AIC	3597.1
N	2482

Note: Negative binomial regression coefficients with standard errors in parentheses.
***p < 0.001, **p < 0.01, *p < 0.05

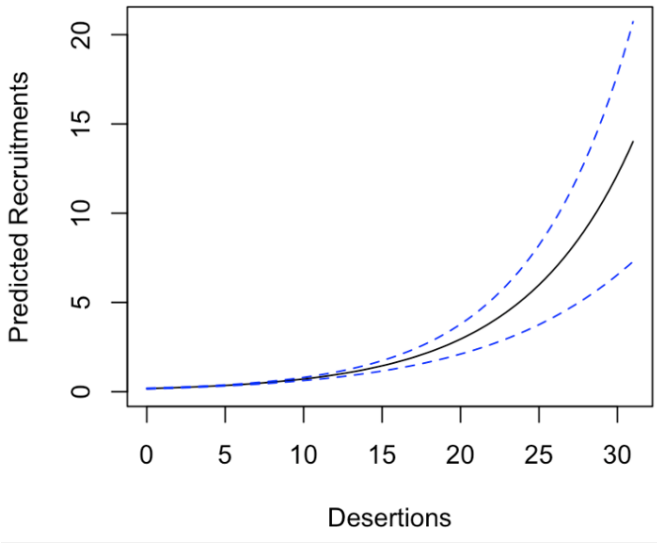
The main elements to observe from Table 1 are the direction and statistical significance of the estimated coefficient for *Desertions*. There is a positive association between the number of desertions from armed groups and the number of child recruitments that occur in the departments of Colombia each month. The estimated coefficient is 0.142, meaning that for each unit increase in the number of desertions, the expected log count in the number of child recruitments increases by this amount. Exponentiating 0.142 yields a value of $exp(0.142)=1.152$, meaning that for each unit increase in the number of desertions, the number of child recruitments is expected to increase by 15.2%. This coefficient is statistically significant ($p < 0.001$). This means that if there was no relationship between the variables of interest, such an estimated coefficient as was yielded by Model 1 would be unlikely to be observed by chance alone. More specifically, such a value is expected to be ob-

served by chance in only 0.1% of cases if there was no relationship between the variables. Thus, Model 1 indicates evidence of a positive relationship between desertion and child recruitment.

A list of one hundred predicted values for the number of child recruitments was generated for a sequence of values of desertions. Confidence intervals were also generated for these predicted values at the 95% level. These were used to plot the predicted relationship between child recruitment and desertion, which may be surveyed below.

As expected, the predicted number of child recruitment increases exponentially as the number of desertions increases. This reflects the effect that the estimated *Desertions* coefficient produced in the negative binomial regression, where each unit increase in the number of desertions is associated with a 15.2% increase in the number of child recruitments.

Figure 3.
Predicted child recruitments vs desertions



Note: Confidence intervals generated at the 95% level

As expected, the predicted number of child recruitment increases exponentially as the number of desertions increases. This reflects the effect that the estimated *Desertions* coefficient produced in the negative binomial regression, where each unit increase in the number of desertions is associated with a 15.2% increase in the number of child recruitments.

Control variables

While the first model employed is useful for grasping the effect of desertions on child recruitment, it is necessary to then model this relationship while controlling for other factors that may have an influence on the dependent variable. In this way, the effect of the independent variable is isolated to avoid bias and increase precision in the results.

Table 2.
Regression Results with Child Recruitments as the dependent variable

	Model 2
(Intercept)	-3.934***
	(2.894e-01)
Desertions	0.1665***
	(1.021e-02)
Poverty	0.0355***
	(4.819e-03)
Weapons	0.0029***
	(4.720e-04)
Births	-1.347e-05***
	(3.540e-06)
AIC	2650.1
N	1891

Note: Negative binomial regression coefficients with standard errors in parentheses.
***p < 0.001, **p < 0.01, *p < 0.05

Model 2 produced the estimated coefficients when controlling for the incidence of poverty, the proliferation of weapons and the lagged number of births. The Akaike Information Criterion (AIC) value is a measure of how well the models fit the data, while considering their complexity. A lower AIC value indicates a better fit of the data. The AIC indeed decreases from Model 1 (3597.1) to Model 2 (2650.1) and thus, it appears that adding the control variables improved the relative quality of the statistical model.

In Model 2, the coefficient for the *Desertions* variable is $exp0.612{=}1.181$. This means that a

one unit increase in the number of desertions per department-month is associated with an increase of 18.1% in the number of child recruitments. This estimated coefficient is statistically significant ($p<0.001$). A positive association between the variables of interest persists, and the effect size increased for each additional desertion. This increase must be considered with caution, as it may have been induced by the omission of observations which had no available values for the independent variable.

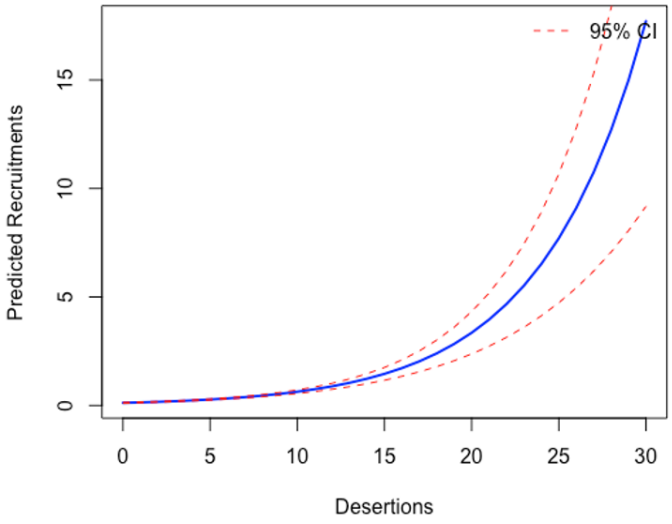
Regarding the control variables, the incidence of poverty appears to be positively associated with the number of child recruitments per department-year, as expected from the literature. A one unit increase in the percentage of people experiencing monetary poverty is associated with an increase of 3.6% ($exp(0.0355) =1.036$) in the number of child recruitments. This result is statistically significant ($p < 0.001$).

The proliferation of weapons is also positively associated with the number of child recruitments. The estimated coefficient for the *Weapons* variable is $exp(0.0029) = 1.003$. This effect is smaller in comparison to other variables: a one unit increase in the number of crimes committed relating to fabrication, trafficking and carrying of weapons is associated with a 0.03% increase in the number of child recruitments. This is likely due to the fact that the *Weapons* variable measures the number of individual cases of weapons crimes. Summary statistics show the values for this variable ranging from 66 to 876 cases per month in a single department, meaning that a one unit increase is not expected to induce a large change in the dependent variable. In other words, the existence of one more weapon available for use is not expected to influence the ability of armed groups to recruit more children. Rather, it is expected that this effect will occur most prominently with the aggregate and structural consequences of a large proliferation of weapons. Nevertheless, there is indication of a positive effect of the proliferation of weapons on the number of child recruitments, as expected from the literature, and this result showed to be statistically significant ($p < 0.001$).

Lastly, the lagged number of births showed a small negative association with the number of child recruitments, as opposed to the expectations from the literature. For every one unit increase in the lagged number of births, it is expected that the number of child recruitments will decrease by a factor of $exp(-1.347\times10\text{-}5) = 0.999$. This estimated coefficient is statistically significant ($p < 0.001$). Even though the effect of an increase of one birth on the dependent variable is small, a large increase in the lagged number of births may be associated with a significant decrease in the number of child recruitments. Further research may explore the factors leading to these unexpected results.

As with Model 1, a graph of the predicted values for child recruitments against values of desertions was constructed to visualize the relationship between these two variables better while controlling for the incidence of poverty, the proliferation of weapons, and the presence of children.

Figure 4.
Predicted child recruitments vs desertions based on Model 2



Note: Confidence intervals generated at the 95% level. Graph constructed based on Model 2.

The graph shows the positive and exponential relationship between the number of desertions from armed groups in Colombia per department-year and the number of child recruitments. Overall, this graph is useful to visualize the relationship between the variables of interest more generally, as the actual observations of child recruitments did not surpass 10

cases per department-month.

Fixed effects model

Although the aforementioned results indicate a positive effect of the incidence of desertions from armed groups in Colombia on their levels of child recruitment, it is necessary to apply the fixed effects model to the variables aggregated by armed groups per department per month. This will help examine the relationship between the variables of interest from the armed groups' perspective, and possible unobserved fixed effects from the nesting of the data may be accounted for.

Table 3.
Fixed effects model with child recruitment as the dependent variable

	Model 3
Desertions	0.011***
	(0.002)
F	4.68***
R^2	0.048
Adj. R^2	0.038
N	2979

Note: Fixed effects model coefficient with standard errors in parentheses.
***p < 0.001, **p < 0.01, *p < 0.05

As shown in Table 3, even when aggregating the cases of desertion and child recruitment by armed group per department-month, and controlling for fixed effects, there is evidence of a positive association between the variables of interest. According to Model 3, for every unit increase in the number of desertions from armed groups, we expect a 0.011 increase in child recruitments. This effect indicates that for every ten desertions an armed group experiences, they are expected to recruit approximately one extra child. This result is statistically significant ($p < 0.001$).

The F-statistic tests whether the estimated model coefficient is significantly different from zero. This estimated coefficient is statistically significant ($p < 0.001$), disclosing that the model is a good fit for the data. However, the adjusted R^2 produces a value of merely 0.038, which states that the independent variable explains 3.8% of the variation in the dependent variable. Although the incidence of desertions may not explain a large portion of the variation in the number of child recruitments, this model still indicates a positive association between them in the broader sense, which is useful to draw conclusions for the hypothesis being tested.

Another model was applied to survey the possible effect of the armed group on the dependent variable, with the armed group variable included as a factor in the model equation, and not in the within estimator.

Table 4.
Fixed effects model with child recruitment as the dependent variable and an armed group factor

	Model 4
Desertions	0.010***
	(0.002)
FARC	0.030***
	(0.012)
F	19.709***
R^2	0.013
Adj. R^2	0.002
N	2979

Note: Fixed effects model coefficient with standard errors in parentheses.
***p < 0.001, **p < 0.01, *p < 0.05

According to Model 4, FARC is more likely than ELN to employ child recruitment as a practice. More specifically, the estimated coefficient suggests that, on average, FARC tended to recruit 0.030 more children than ELN per department month. This variation may be explained by the difference in the relative size of the armed groups, which may contribute to their territorial coverage and ability to recruit more children. At its peak, FARC ranks reached 20,700

fighters (NoticiasRCN, 2014). Meanwhile, ELN capped their maximum number of fighters at 5,000 (Velásquez Loaiza, 2022). Further research may explore the specific characteristics that lead some armed groups to recruit more children than others.

The last model employed was a negative binomial panel data model. This model accounts for the possible fixed effects of the armed group, department, and month of the observations through a panel data model while also considering the over-dispersed count data in the dependent variable.

Table 5.
Negative binomial panel data model with child recruitment as the dependent variable

	Model 5
(Intercept)	-2.109***
	(0.241)
Desertions	0.092***
	(0.014)
AIC	1364.8
N	2979

Note: Negative binomial panel data model coefficients with standard errors in parentheses.
***p < 0.001, **p < 0.01, *p < 0.05

The results produced by Model 5 still indicate a positive association between the number of desertions from armed groups in Colombia and the number of children they recruit. According to the estimated coefficient, a one unit increase in the number of desertions per armed group-department-month is associated with an increase of $exp0.092 - 1 \times 100\% = 9.6\%$ in the number of children recruited. The effect of desertions on child recruitment thus appears to be smaller than in Model 1 and Model 2, when considering the possible fixed effects of the armed group, department and time period of each observation. This estimated coefficient is statistically significant ($p < 0.001$).

Discussion

Overall, the results of the statistical analysis indicate that there is a positive association between the variables of interest. This relationship was tested through various statistical models and methods, including a negative binomial regression, fixed effects model, negative binomial panel data model, and through the inclusion of control variables. All statistical models yielded positive estimated coefficients for the *Desertions* variable, which were statistically significant. The control variables improved the quality of the statistical model, while considering the possible fixed effects at the armed group, department and month of the observations solidified the robustness of the results.

The results of this analysis thus support the hypothesis established from the existing literature on child recruitment. It was discussed in the theoretical framework that existing scholarship points to certain characteristics of desertions in civil conflicts that enable and promote the practice of child recruitment by armed groups. According to the sources reviewed, prolonged conflicts where the supply of fighters diminishes due to disease, poverty, and death create excess demand for recruits. Where children are vulnerable to recruitment through abduction or persuasion, armed organizations may find the need to employ these tactics, especially when operating in competitive and high-pressure environments. These theoretical expectations are met by the evidence presented in the statistical analysis. Even when controlling for the incidence of poverty, the proliferation of weapons, and the supply of children, the incidence of desertion was still positively associated with the number of child recruitments. Most of the control variables also exhibited the expected results, with children in socio-economic marginalized situations being more vulnerable to recruitment, and the proliferation of weapons making them more attractive to armed groups as effective combatants. Thus, it is concluded that as the incidence of desertions from armed groups increases, their levels of child recruitment increase.

These results stand as an important contribution to the study of child recruitment and

conflict more generally. Conducting a national case study in the context of Colombia allowed for a narrow research scope, and to delve deeper into the specific national context of the country. This information may add to further comparative analyses at the regional or global level, identifying commonalities or differences across different contexts. The robust and context-specific empirical evidence gathered from this investigation may therefore contribute to the existing literature on child recruitment, ultimately benefiting global efforts to address this phenomenon. The conduct of a wide variety of statistical tests on the variables of interest allowed for the robustness of the results to be tested from different theoretical perspectives. Each statistical test represents a different approach to analyze the data, each with their own value and shortcomings, as previously explained. By subjecting the data to this variety of tests, the conclusions drawn from the statistical analysis are made more robust and the results more reliable, helping to craft an overall picture of the relationship between armed group desertions and their child recruitment practices.

There were however several limitations in the data employed that must be considered when drawing conclusions. Most prominently, the presence of armed groups in specific departments acted as a relevant confounder which was not accounted for in the statistical models, due to the unavailability of the data. The conflict in Colombia mostly takes place in the rural and isolated areas of the country, where government reach is limited. The operationalisation of the variables therefore generally estimated their trends according to the methods of data collection employed by different agencies. They did not however, capture an entirely accurate picture of reality, as several cases of child recruitment or desertions for example may have gone undetected. The results of this investigation would therefore be best considered together with additional and complementary research projects, which together may present a more complete and robust representation of the effect which armed group desertions may have on their child recruitment practices.

Nevertheless, the variables of interest, models, and data employed are the best estimations available to study the conflict phenomena in Colombia. It is important to note that this investigation sought to establish an overarching picture of the general relationship between desertion and child recruitment, which may be explored in depth in future projects. Thus, the research presented is valuable in establishing an initial estimation of this relationship and shedding light on its possible policy implications.

These results have crucial implications for the practice and study of civil conflicts. A large incidence of desertions from armed groups may traditionally be considered a sign of victory by the governments combating them. Policies and programs pertaining to the Disarmament, Demobilization and Reintegration (DDR) of fighters are part of the most commonly applied framework by national and international organizations for the consolidation of peace (Howe et al., 2010, p. 3). Colombia itself has invested a large amount of resources into its programs for *desmovilizados*; including the establishment of institutions dedicated to the reintegration of fighters into society, promotional campaigns, and programs for humanitarian and legal assistance to deserters from armed groups in the country (Herrera & González, 2013, p. 275).

The results of this investigation call for a revision of the unintended consequences of such policies promoting desertions from armed groups. Impairing the military operations of armed groups and placing them in situations of high pressure might lead them to employ the recruitment of children as a last-resort strategy for survival. It is then necessary for government institutions to implement measures for the protection of children in territories where they may be the most vulnerable to abduction and persuasion, along with DDR programs.

Conclusion

This research project began with a review of several structural, supply and demand factors which lead armed groups to recruit children into their ranks. It was identified that due to the excess demand for recruits which increased desertions create, there may be a possible influence on

armed groups' child recruitment practices. This hypothesis was explored in the context of the Colombian conflict, using data provided by government agencies from the years 2010 to 2021. A statistical analysis revealed that there is indeed evidence of a possible association between the variables of interest. As the incidence of desertions from armed groups increases, their levels of child recruitment increase. These results stand as an important contribution to the study of child recruitment and conflict more generally, as they establish an overarching picture of the general relationship between desertion and child recruitment, which may be explored in depth in future projects.

Further research may complement the results produced by this investigation by conducting a qualitative analysis of the specific mechanisms through which the incidence of desertion may affect child recruitment practices. In this way, methods of investigation such as interviews may be employed to support the statistical results and get further insight into the individual decision-making process of armed group leaders and recruiters.

It is also worth noting that even though the incidence of poverty, the proliferation of weapons and the presence of children were controlled for in Model 2, the existing literature provides a myriad of other factors that could affect the levels of child recruitment by armed groups. These include family push factors, such as domestic violence, and structural factors, such as the proliferation of small arms, as discussed in the literature review. It is, therefore, necessary to conduct a more comprehensive investigation, which controls for a more extensive range of possible predictors and yields more precise results on the specific relationship between desertions and child recruitment.

More focus may also be placed on the specific characteristics of armed groups, which may lead them to recruit children or not. This investigation focused only on FARC and ELN, limiting the variation in the characteristics of armed groups, which may affect their child recruitment practices. By including a wide array of armed groups in a future project and analyzing the variation in their leader's personality, ideology, size and hierarchy, further insight may be gained into the non-structural factors that lead them to recruit children.

Lastly, further investigation may be required on the control variables employed. In particular, the lagged number of births per department-year unexpectedly negatively affected the number of child recruitment. It is possible that in environments where children are recruited for combat, there is less incentive for families to conceive to avoid bringing newborns into a life of violence and despair. Thus, this avenue of investigation should be examined further.

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Appendix 1

Dataset summary statistics

Departamento	month_year	Recruitments	Desertions	phat
Length:2482	Min. :2010-01-01	Min. : 0.0000	Min. : 0.00	Min. : 0.1726
Class :character	1st Qu.:2012-02-08	1st Qu.: 0.0000	1st Qu.: 1.00	1st Qu.: 0.1990
Mode :character	Median :2014-08-01	Median : 0.0000	Median : 2.00	Median : 0.2293
	Mean :2014-10-19	Mean : 0.3566	Mean : 3.88	Mean : 0.3851
	3rd Qu.:2017-02-01	3rd Qu.: 0.0000	3rd Qu.: 5.00	3rd Qu.: 0.3508
	Max. :2021-11-01	Max. :10.0000	Max. :31.00	Max. :14.0111

Frequency of observations per department

AMAZONAS	ANTIOQUIA	ARAUCA	ATLÁNTICO	BOGOTÁ D.C.	BOLÍVAR
6	139	114	22	119	106
BOYACÁ	CALDAS	CAQUETÁ	CASANARE	CAUCA	CESAR
52	26	94	72	116	94
CHOCÓ	CÓRDOBA	CUNDINAMARCA	GUAINÍA	GUAVIARE	HUILA
137	45	82	30	91	95
LA GUAJIRA	MAGDALENA	META	NARIÑO	NORTE DE SANTANDER	PUTUMAYO
59	29	101	110	122	84
QUINDÍO	RISARALDA	SANTANDER	SUCRE	TOLIMA	VALLE DEL CAUCA
57	92	86	13	95	117
VAUPÉS	VICHADA				
41	36				

Frequency of observations per month

2010-01-01	2010-02-01	2010-03-01	2010-04-01	2010-05-01	2010-06-01	2010-07-01	2010-08-01	2010-09-01	2010-10-01	2010-11-01
24	27	25	23	27	25	27	26	24	24	23
2010-12-01	2011-01-01	2011-02-01	2011-03-01	2011-04-01	2011-05-01	2011-06-01	2011-07-01	2011-08-01	2011-09-01	2011-10-01
24	27	25	23	22	21	26	22	25	21	19
2011-11-01	2011-12-01	2012-01-01	2012-02-01	2012-03-01	2012-04-01	2012-05-01	2012-06-01	2012-07-01	2012-08-01	2012-09-01
24	22	24	21	19	21	20	25	14	20	19
2012-10-01	2012-11-01	2012-12-01	2013-01-01	2013-02-01	2013-03-01	2013-04-01	2013-05-01	2013-06-01	2013-07-01	2013-08-01
19	19	22	21	22	21	23	21	20	23	18
2013-09-01	2013-10-01	2013-11-01	2013-12-01	2014-01-01	2014-02-01	2014-03-01	2014-04-01	2014-05-01	2014-06-01	2014-07-01
22	23	22	24	23	21	25	20	22	23	21
2014-08-01	2014-09-01	2014-10-01	2014-11-01	2014-12-01	2015-01-01	2015-02-01	2015-03-01	2015-04-01	2015-05-01	2015-06-01
20	23	24	21	22	19	21	23	22	24	21
2015-07-01	2015-08-01	2015-09-01	2015-10-01	2015-11-01	2015-12-01	2016-01-01	2016-02-01	2016-03-01	2016-04-01	2016-05-01
19	20	27	18	18	20	21	20	21	23	20

2016-06-01	2016-07-01	2016-08-01	2016-09-01	2016-10-01	2016-11-01	2016-12-01	2017-01-01	2017-02-01	2017-03-01	2017-04-01
22	16	20	19	17	18	18	19	18	20	19
2017-05-01	2017-06-01	2017-07-01	2017-08-01	2017-09-01	2017-10-01	2017-11-01	2017-12-01	2018-01-01	2018-02-01	2018-03-01
16	21	19	19	11	13	12	10	9	13	13
2018-04-01	2018-05-01	2018-06-01	2018-07-01	2018-08-01	2018-09-01	2018-10-01	2018-11-01	2018-12-01	2019-01-01	2019-02-01
12	16	11	11	13	18	14	15	13	9	13
2019-03-01	2019-04-01	2019-05-01	2019-06-01	2019-07-01	2019-08-01	2019-09-01	2019-10-01	2019-11-01	2019-12-01	2020-01-01
11	10	17	13	12	8	7	9	10	6	11
2020-02-01	2020-03-01	2020-04-01	2020-05-01	2020-06-01	2020-07-01	2020-08-01	2020-09-01	2020-10-01	2020-11-01	2020-12-01
8	12	12	5	7	9	11	9	8	12	6
2021-01-01	2021-02-01	2021-03-01	2021-04-01	2021-05-01	2021-06-01	2021-07-01	2021-08-01	2021-09-01	2021-11-01	
10	6	4	8	7	10	6	5	4	1	

Frequencies per number of child recruitments

0	1	2	3	4	5	6	7	10
1946	332	117	56	16	10	1	3	1

Appendix 2

Dataset summary statistics

Departamento	month_year	Recruitments	Desertions	Year	Births
Length:1891	Min. :2010-01-01	Min. : 0.0000	Min. : 0.000	Min. :2010	Min. : 3166
Class :character	1st Qu.:2012-03-01	1st Qu.: 0.0000	1st Qu.: 1.000	1st Qu.:2012	1st Qu.: 14736
Mode :character	Median :2014-09-01	Median : 0.0000	Median : 3.000	Median :2014	Median : 21710
	Mean :2014-11-16	Mean : 0.3733	Mean : 4.245	Mean :2014	Mean : 31526
	3rd Qu.:2017-03-01	3rd Qu.: 0.0000	3rd Qu.: 6.000	3rd Qu.:2017	3rd Qu.: 28898
	Max. :2021-11-01	Max. :10.0000	Max. :31.000	Max. :2021	Max. :139276

Cases	Pobreza
Min. : 66.0	Min. :13.09
1st Qu.:130.0	1st Qu.:31.70
Median :189.0	Median :44.60
Mean :235.3	Mean :44.01
3rd Qu.:285.0	3rd Qu.:53.60
Max. :876.0	Max. :73.90

Frequency of observations per department

ANTIOQUIA	ATLÁNTICO	BOGOTÁ D.C.	BOLÍVAR	BOYACÁ
139	22	119	106	52
CALDAS	CAQUETÁ	CAUCA	CESAR	CHOCÓ
26	94	116	94	137
CÓRDOBA	CUNDINAMARCA	HUILA	LA GUAJIRA	MAGDALENA
45	82	95	59	29
META	NARIÑO	NORTE DE SANTANDER	QUINDÍO	RISARALDA
101	110	122	57	92
SANTANDER	SUCRE	TOLIMA		
86	13	95		

Frequencies per number of child recruitments

0	1	2	3	4	5	6	7	10
1483	240	95	43	15	10	1	3	1