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Buying Peace: The Mirage of Demobilizing Rebels[1]

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Abstract: In 2009, hostilities were brought to an end in Burundi when the FNL rebel group laid down weapons. In exchange for peace, ex-rebels benefited from a disarmament, demobilization and reintegration (DDR) program to finance their return to civilian life. A few years earlier, another rebel group (CNDD-FDD) had gone through the same program. In this paper, we assess the impact of this complex program from a theoretical and an empirical viewpoint. First, we develop an agricultural model in order to predict the impact of demobilization cash transfers on beneficiary and non-beneficiary households. Then, we test the theoretical model by using a household panel dataset collected in rural Burundi. We find that, in the short run, the cash payments received by ex-combatants had a positive direct impact on purchases and investments of beneficiaries, as well as an indirect positive impact on non-beneficiaries. We also find that the direct and indirect impacts on purchases vanish in the long run. These results suggest that reinsertion grants may favour the acceptation of ex-combatants in their local communities in the short run, but are most likely not sufficient for peace to hold. More generally, it emphasizes the importance of considering spillovers in the evaluation of development programs.

Key words: Civil Conflict, Burundi, Disarmament, Demobilization and Reintegration Program, Cash Transfer, Spillovers

JEL classification: D74, O12, I32, I38, N47

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1. Introduction

Burundi is recovering from a civil war that lasted more than a decade. The recent story of this densely populated, land-locked and poor country is a tragic succession of ethnic and political violence, massacres, assassinations and coups d'état. The most recent phase of the conflict ended in 2009 by the voluntary demobilization of the last Hutu rebel group, Palipehutu-FNL (Palipehutu - Forces Nationales de Libération). In 2005, another major Hutu rebel group, the CNDD-FDD, benefited from the same disarmament, demobilization and reintegration (DDR) program. Adult combatants assigned to this program have been granted two allowances of at least US$ 515, distributed over two years, the first in cash and the second in-kind[1]. This paper studies how the payments offered to ex-combatants had an impact on their households and communities.

In the literature on the causes of civil war at the micro-level, we retain two main factors advocating for the assessment of DDR programs (see Justino (2009) and Blattman and Miguel (2010) for good reviews). First, frustration and dissatisfaction among certain social or ethnic groups have been emphasised in the literature as drivers of violence and participation to civil strife. Second, the high incidence of civil conflict can mostly be attributed to economic characteristics, and in particular low average incomes. Supporting ex-combatants' social and economic reintegration is therefore central to post-conflict reconstruction, as their past in the militias makes them the most prone to re-enrollment.

The reinsertion of ex-combatants in post-conflict societies and its impact on host communities have not received much attention in the economic literature. Verwimp and Bundervoet (2009) found that Burundian households with at least one member in the rebel force increased their consumption during the period 1999-2007 more than households with none. Also in the case of Burundi, Gilligan et al. (2012) were the first to study DDR program in a quasi-experimental framework. They also found an improvement in income and livelihoods among ex-combatants. However, since they only interviewed individual ex-combatants, they do not account for spillovers on other household members and spillovers at the community or village level. This drawback may have led to an underestimation of the impact of the program (Miguel and Kremer, 2004). In a survey among ex-combatants in Sierra Leone, Humphreys and Weinstein (2007) did not find any difference in reintegration success between soldiers who benefited from the DDR program and those who did not. They suggest that spillovers from the beneficiaries to the non-beneficiaries may be an explanation for this result, but do not provide econometric analysis to substantiate this. Nor did they measure the impact of the program on households and community welfare.

Our paper advances the literature on the impact of DDR programs in three ways. First, in order to study theoretically the impact of the DDR cash transfers, we build an agricultural

[1]Each allocation was equivalent to 150% the yearly GDP per capita in 2005 as calculated in PPP, i.e. US$ 356 (World Development Indicators, 2009).

model in which money holdings are explicitly formalized. The model predicts that consumption of both beneficiaries and non-beneficiaries increase in the short run. The reasoning is that ex-combatants, when returning to their village, spend a share of their allowance on local consumption goods. As returns were often en masse, such increase in consumption stimulates local economies through an increase in prices of locally produced goods. This positive effect does not last in the long run.

Second, as in Verwimp and Bundervoet (2009) and in Gilligan et al. (2012), the empirical part of our paper aims at analyzing the direct impact of the DDR program on beneficiaries. More specifically, our analysis captures both the short- and long-run impacts by distinguishing the two phases of the DDR program, which were implemented in Burundi from 2004 for the CNDD-FDD and from 2009 for the FNL. Our analysis uses a three-round panel dataset collected in 2005, 2006 and 2010 in three provinces severely affected by the conflict. This dataset includes indicators of consumption expenditures, non-food spending and livestock units before and after the introduction of DDR program in Burundi for both civilian and ex-combatant households. In order to study the direct impact in the short run, we compare the economic indicators of ex-FNL households with that of a control group of ex-combatants that returned home but did not receive the grants. We find that growth in consumption expenditures, non-food spending and livestock ownership between 2006 and 2010 was significantly higher for ex-FNL households. This result is encouraging as it shows that the reinsertion grants reduce the vulnerability of ex-rebel households. Similarly, the direct impact of the CNDD-FDD demobilization is analyzed in order to capture the long-term impact of DDR program. The empirical analysis shows that the impact of the DDR program vanishes in the long run, suggesting that the reinsertion and reintegration successes are only temporary.

Third, our paper advances the literature by considering and measuring explicitly the externalities of the demobilization program on non-beneficiaries. In line with this, the specification of our econometric model captures both the direct impact of DDR program on the ex-combatant households, as well as the indirect externalities at the village level.

Recently, several empirical studies in development economics have pointed out the large and positive treatment externalities affecting the untreated, and hence conclude that the impact of interventions may be substantially underestimated if such spillover effects are not considered. The untreated may be affected by the treatment through three main channels. First, when the treatment aims to control a contagious epidemic, the untreated will also be positively affected if the propagation of the disease is lowered by the treatment (Miguel and Kremer, 2004). Second, information and prevention campaigns were shown to have an impact on the untreated when the desired behavior is spread into the untreated population through imitation and/or communication with treated peers (Kim et al., 1999; Handa et al., 2000; Comola, 2008; Macours and Vakis, 2009; Bobonis and Finan, 2009; Avitabile, 2011). Third, cash transfer programs may have an impact on the untreated through local economy effects. As in Keynesian models, cash transfers increase the local demand by increasing the amount of money held by the treated, which in turn may stimulate the whole local economy.

For example, using the data from PROGRESA in Mexico, Angelucci and De Giorgi (2009) and Barrientos and Sabatés-Wheeler (2010) find that non-eligible households in treatment areas show significantly higher levels of food consumption and asset holdings following the introduction of the conditional cash transfer program, compared to non-eligible households in control areas. This effect is roughly 50% of the average increase in food consumption for eligible adults (Angelucci and De Giorgi, 2009).

In order to study the importance of externalities in the context of the DDR program in Burundi, we estimate how economic indicators of civilian households were affected by the proportion of demobilized ex-combatants living in their village. We find that the number of ex-FNLs per inhabitant has a positive and significant impact on consumption expenditures, non-food spending and livestock units. These positive spillovers suggest that non-beneficiaries benefited indirectly from the DDR program in the short run. However, as for the direct impact of the DDR program, we find that the spillovers vanish in the long run. The empirical analysis ends by discussing possible channels through which the DDR program may have generated externalities affecting non-beneficiaries.

We emphasize the complexity of the demobilization and reintegration program. It involved different rebel groups at different moments in time and it took place in a very volatile and dangerous political context. Surprise rebel attacks on the capital as well as armed violence throughout the country occurred on a daily basis till 2010. The program involved several phases of arms collection, training, in kind services as well as cash payments, making a randomized controlled trial (RCT) virtually impossible. Excluding groups (even temporarily) from certain benefits allocated to others would increase violence on the spot, exactly because the exclusion of the benefits of state power and inequality in access to resources in general lay at the basis of Burundi's civil war. Hence, as researchers we were not in a position to organize an RCT let alone that the government would have accepted this. We thus make the most of the fact that (i) the demobilization program took place in between two waves of a household panel survey and (ii) that some communities in the panel did not have ex-combatants among its population whereas other communities did.

The conclusions of our empirical analysis should be considered by policy makers while implementing DDR processes in other regions. In the short run, the positive direct effect of the DDR program may discourage ex-rebels to re-engage in conflict and the positive spillovers may favor sustainable peace by lowering the general dissatisfaction and increasing the degree of acceptance of ex-combatants in their host communities. However, as this positive effect seems to vanish in the long run, the return to a precarious situation may encourage ex-rebels to take up arms again and re-engage in battle. An assessment of the DDR reintegration phase is needed to evaluate to which extent the frustration of ex-rebels may threaten peace.

The paper is organized as follows. Section 2 provides details on how the demobilization and reintegration program was set up in 2004 for CNDD-FDD rebels and in 2009 for FNL ex-combatants. In the third section, we develop a theoretical model assessing how cash

transfers received by the ex-combatants may have impacted their own economic situation, as well as the economic situation of non-beneficiaries through spillovers. The fourth section is devoted to the empirical analysis, in which we discuss our empirical results in view of our theoretical framework. The fifth section analyzes through which channels non-beneficiary households are affected by the demobilization program. The last section concludes.

2. Background of the DDR program in Burundi

The 1993-2009 conflict in Burundi has been exacerbated by years of ethnic discriminations, whose origins date back to the German and Belgian colonization (Vandeginste, 2009). After independence in July 1962, the Tutsi elite established a military dictatorship. Tensions between the Hutu majority and the Tutsi authoritarian government regularly triggered violent conflicts and massacres. In 1988, the Tutsi President Buyoya launched a process of political liberalization by establishing a government of national unity and by organizing elections in 1993. In October 1993, four months after his election, the newly-elected Hutu President Ndadaye was assassinated. A few months later, his successor, Lucien Ntaryamira, was also assassinated in an airplane crash, together with the Rwandan president Juvenal Habyarimana. This was the start of both the Rwandan genocide, and a 6-year ethnic conflict between Hutu rebel groups and the Burundian army led by Tutsis.

In 2000, the Arusha Peace agreement laid down the foundations for a peace process and a new constitution based on power-sharing and a short transition towards de-ethnicized political competition. Despite this promising peace treaty, two Hutus rebel groups, the CNDD-FDD (Conseil National pour la Défense de la Démocratie - Forces de Défense de la Démocratie) and the Palipehutu-FNL, refused to sign this agreement. The ethnic conflict turned into a civil war opposing the Burundian government and the two Hutus rebel groups. In 2003, a first rebel group, the CNDD-FDD accepted to lay down weapons. As part of the peace agreement, the CNDD-FDD leaders were given positions in the government, in the national assembly and in the administration[2]. Combatants from the national army (FAB) and from the CNDD-FDD were selected to join the national police and the new national army (The Forces de Défense de la Nation - FDN). From those who were not selected, about 23,000 combatants from both sides were assigned to the disarmament, demobilization and reinsertion (DDR) program. In 2009, the Palipehutu-FNL rebels in turn gave up their arms and the FNL became a political party, with 33 minor posts attributed to the FNL leadership. Of the 20,000 FNL members, 3,500 were reintegrated in the Burundian army, and 6,500 benefited from the DDR program.

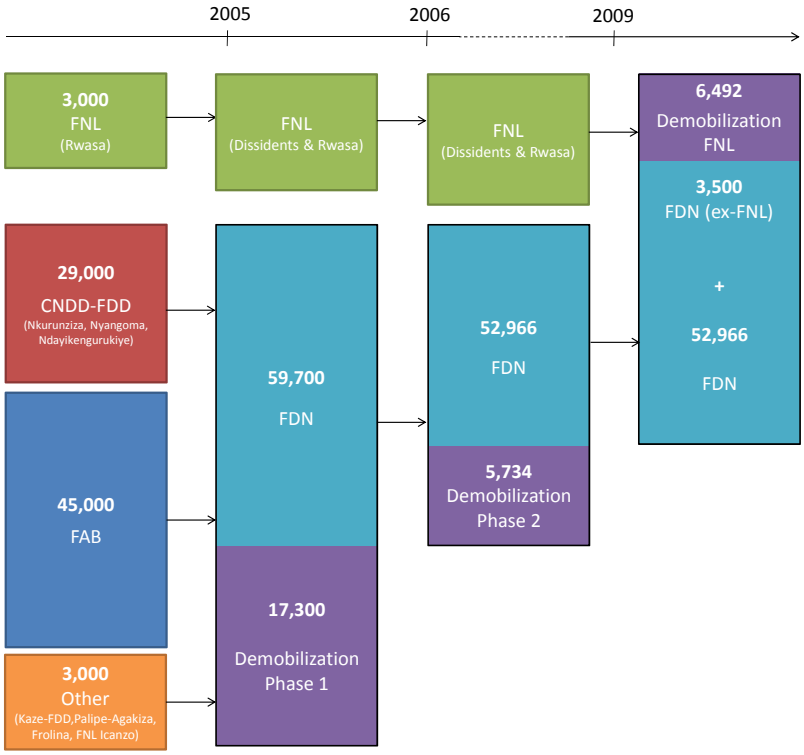
The DDR program was officially launched in December 2004, following the cease-fire signed between the government, the CNDD-FDD and other rebel groups. At this time, the FNL was still rejecting the agreement. The DDR program was coordinated by a local

[2]In 2005, two years after becoming a political party, the CNDD party of Pierre Nkurunziza won the national elections outright.

agency[3], under the supervision of the World Bank. Three types of demobilization program were implemented. The main one targeted adult ex-combatants. A second program was devoted to child soldiers, and coordinated by UNICEF. The third one aimed at dismantling the militias who were supporting the factions.

First, the demobilization of adults proceeded in two phases. In a first stage, around 60,000 selected combatants mainly from the national army ("Forces Armées Burundaises" (FAB)) and the CNDD-FDD were reintegrated into the newly created "Forces de la Défense Nationale" (FDN) or into the "National Police" (PN). The others 17,000, who did not fulfill selection criteria based on wishes, age, health status and experience, were allocated to the DDR program. In a second stage, about 6,000 FDN soldiers were in turn demobilized. During those phases, the political obedience was not a criterion for being selected to the DDR program. When the peace agreement finally included the FNL in April 2009, the FNL ex-combatants were also allocated between the FDN and the DDR program. The estimated numbers of FNL and CNDD-FDD ex-combatants assigned to the FDN and the DDR program are presented in figure 2.

Figure 1: Timeline: armed movement and demobilization



[3]The "Commission Nationale de Démobilisation, de Réinsertion et de Réintégration" (CNDRR)

The program targeting ex-combatants was organized around three packages: the demobilization, the reinsertion and the reintegration. The demobilization phase started with disarmament, followed by the transfer of the ex-combatant to a demobilization center. The ex-combatant, if admitted[4], spent 8 days in the center. During that week, he attended training on economic strategies and opportunities, HIV/AIDS, civil responsibility, as well as peace and reconciliation. A medical examination was conducted on each soldier, and they could choose to be tested for HIV. They were informed on the opportunities offered by the reinsertion and reintegration program. On the last day, they were reimbursed transportation costs (FBU 20,000, or US$ 18[5]) and they received their first reinsertion payment equivalent to 9-month salary. Three months later, they received the first of three other payments of 3-month salary each, paid every three months. The total amount of this 18-month salary allowance was differentiated by rank, with a minimum of FBU 566,000 (US$ 515). Called the Transitional Subsistence Allowance (TSA) by the World Bank, this compensation was dedicated to *"enable the ex-combatants to return to their community and to sustain themselves and their families for a limited period following demobilization"* (The World Bank Group, 2004). Simple back-of-the-envelope calculations allow us to translate these amounts in terms of purchases per adult equivalent for a civilian household. In 2010, such household consumed on average about FBU 190,000 per adult equivalent per year, which is equivalent to one third of the minimum cash allocation allowed to FNL rebels.

The next phase, aimed at reintegration, is constituted by a unique in-kind payment of FBU 600,000 (US$ 545). The ex-combatants could choose between a range of options including education, support for agro-pastoral activity, start-up material for a small business, or for a construction project. This phase was launched in September 2005 for the first rebel group, but some contracts did not start before March 2008 in the center provinces (Gilligan et al., 2012). This delay has been a source of conflict between the ex-combatants and the DDR administration, as it could have compromised the success of ex-combatants economic reintegration. From the 23,000 beneficiaries of the 2004 wave of the reinsertion program, 85% had received the reintegration support in December 2008. This phase was just starting for the FNL ex-combatants at the time of our 2010 survey.

The child soldiers, numbered 3,600, benefited from specific reinsertion and reintegration allocations. They received only in-kind payments, after being demobilized and sent back to their families. First, they were given an equivalent of FBU 22,500 (US$ 20) per month for 18 months - for which they could choose some goods in discussion with their parents. Second, they benefited from a reintegration allocation of FBU 170,000 (US$ 155), aimed at education, professional training, or investments in a small business.

Finally, the DDR program also included the disarmament and the dismantling of militias. These were formed by people helping the factions, notably in terms of logistic, but who were

[4]In order to identify opportunists who never were a combatant, a list of criteria was established in order to assess the military aptitudes of the candidate, defining whether he was accepted or not to the DDR program.

[5]All US$ equivalents are expressed in 2010 US$. US$ 1 was worth 1,100 Burundese francs in 2010.

not enrolled nor paid by rebel groups. These people were called "Gardiens de la Paix" (GdP) if they belonged to the FAB, "Militants Combatants" (MC) if they were part of the CNDD-FDD and "Adultes Associés" (AA) if they supported the FNL. 20,000 GdP, 10,000 MC and 11,000 AA benefited from the program. They received FBU 100,000 as compensation, which is roughly equivalent to US$ 91.

3. A theoretical model of cash transfer

In this section, we construct an agricultural household model[6] to predict the impact of the DDR program in Burundi, that is, the impact of few villagers benefiting from an exogenous increase in their money holdings. The specificity of the model is to look at the impact of a cash transfer program on both beneficiaries and non-beneficiaries by formalizing explicitly money exchanges and price effects.

The expected impact of the demobilization program depends on how ex-combatants used their allowances. Figure 2 shows how ex-combatants from our sample reported to have spent their grant[7]. More than 50% of ex-combatants reported to have invested part of the reinsertion allowances in a plot of land. A large proportion of ex-combatants used a share of the money to buy consumption goods: 48% reported to have purchased food and drinks and 26% reported to have bought clothes. Ex-combatants also invested part of their allowances in productive assets: 23% of them invested in a small shop, 19% in working equipment, and one ex-combatant reported to have bought a cow. In sum, figure 2 shows that the allowances were spent by ex-combatants in three main ways: for purchasing a land plot, for consumption and for investing in productive assets. For these three categories of expenses, we will analyze theoretically how the DDR allowances are expected to affect the economy in terms of consumption, production and prices.

3.1. Set-up

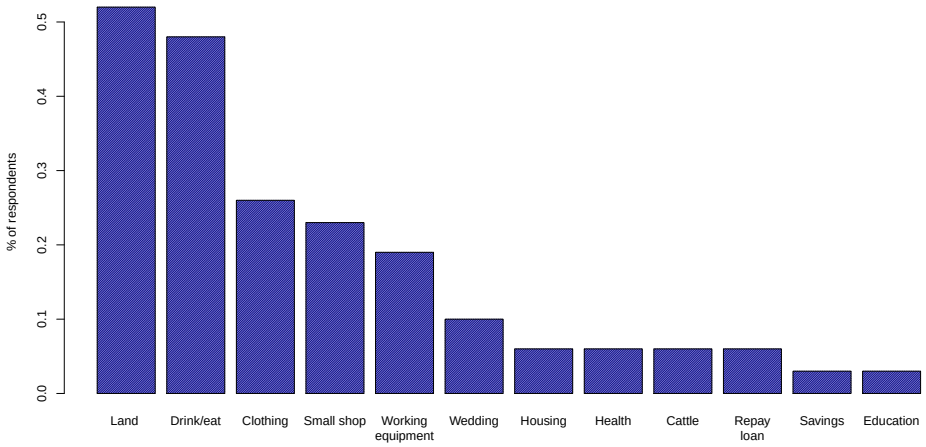
The village: The village we consider is composed by 2N infinite-living households (think about a hill in Burundi). Time is continuous. Two perishable crops are produced in the village: the good α and the good β. N households, called households a and denoted with the superscript $ak, k \in 1...N$, produce the good α. The remaining N households, called b and denoted with the superscript $bk, k \in 1...N$, produce the good β.

On top of the two local crops, we assume the existence of a third desirable good which is not produced in the village. This third good, called the "global good" and denoted δ, is imported in the village by resellers (think for example of beer, manufactured goods, or electronic devices such as mobile phones).

[6] Agricultural household models characterize the economy of farming households in developing countries, by taking into account the fact that households are both consumers and suppliers of their own production, and by considering their specific market environment (See Taylor and Adelman (2003) for a good review).

[7] This figure summarizes the self-reported information provided by 22 demobilized ex-combatants and 9 GdP/MC/AA which were interviewed in 2010. Respondents could give a maximum of three answers

Figure 2: DDR grants spendings by ex-combatants



Households: Without loss of generality, let us consider the decision problem of a risk-neutral household ak (which is symmetric to the decision problem of households bk). We assume a log-linear instantaneous utility function:

$$u_t^{ak} = \ln c_{\alpha,t}^{ak} + \ln c_{\beta,t}^{ak} + \rho \ln c_{\delta,t}^{ak}. \tag{1}$$

where $c_{\alpha,t}^{ak}$ is the quantity of the good α consumed by the household ak at time t, $c_{\beta,t}^{ak}$ is the quantity of the good β it consumes at time t, and $c_{\delta,t}^{ak}$ is the quantity of the global good it consumes at time t. The parameter ρ measures the relative taste for the global good. The global good is desirable ($\rho > 0$).

We assume that household ak produces a constant quantity f per period, from which a quantity $c_{\alpha,t}^{ak}$ is self-consumed, and a quantity $S_{\alpha,t}^{ak}$ is sold. This leads to the following feasability constraint:

$$f = c_{\alpha,t}^{ak} + S_{\alpha,t}^{ak} \tag{2}$$

Markets, trade and prices: The village is a small open economy characterized by two different types of markets. On the one hand, households may buy and sell the goods α and β in the local market. In this local market, local producers and local buyers compete and negotiate prices. The price of the goods α and β in the local market is denoted p_t[8].

On the other hand, households may buy and sell the goods α, β and the global good δ in the global market. Trade in the global market is organized by resellers who compete to

[8]The prices of the goods α and β are the same as the set-up is symmetric.

sell and buy the three goods[9]. We denote $p_w > 0$ the price of the three goods in the capital city, and $\tau > 0$ the transport costs per unit of good between the village and the capital city. Assuming no fixed cost and perfect competition between resellers, we obtain that households can sell their production to the resellers at the price $p_w - \tau$. Similarly, they can buy goods from resellers at the price $p_w + \tau$ (see Appendix B.1 for a formal derivation).

In sum, for their purchases, households have two possibilities: they can buy the goods α and β in the local market at price p_t and buy the goods α, β and δ to resellers at price $p_w + \tau$. Similarly, for their sales, households have two possibilities: households a (resp. b) can sell their production of the good α (resp. β) in the local market at the price p_t, or to the resellers at the price $p_w - \tau$. Because buyers, sellers and resellers compete, all exchanges of goods α and β will take place at the same price (the determination of the price is explained in detail in sections 3.2 and 3.3).

Money and saving rate: Money holdings of households are explicitly introduced in the model. The amount of money held by the household ak at the beginning of period t is denoted m_t^{ak}. We assume a constant and positive saving rate, denoted s[10].

At time t, the amount available to the household ak is given by the sum of its money holdings m_t^{ak} and the value of its sales $p_t S_{\alpha,t}^{ak}$. A share s of this amount is saved, and the rest is used by the household ak to purchase the good β and the global good δ. This is summarized in the following budget constraint:

$$(1-s)(m_t^{ak} + p_t S_{\alpha,t}^{ak}) = p_t c_{\beta,t}^{ak} + (p_w + \tau) c_{\delta,t}^{ak} \tag{3}$$

At each t, the evolution of the money holdings of the household ak is reduced by the amount used for its purchase and increase by the value of its sales. The evolution of money holdings of ak is therefore given by:

$$\dot{m}_t^{ak} = -(1-s)(m_t^{ak} + p_t S_{\alpha,t}^{ak}) + p_t S_{\alpha,t}^{ak} \tag{4}$$

3.2. Individual choice and equilibrium price

In this section, we solve the maximization problem for the case in which the local demand for goods equals the local supply such that the local market clears. In this case, the resellers only sell the global good. Other cases are discussed in section 3.3.

Without loss of generality, let us focus on the maximization problem of household ak. At each t, the household ak has to choose its self-consumption $c_{\alpha,t}^{ak}$, its purchases $c_{\beta,t}^{ak}$ and $c_{\delta,t}^{ak}$, and its sales $S_{\alpha,t}^{ak}$ in order to maximize its utility. The feasibility constraint (2) and the

[9]Contrary to Taylor and Adelman (2003), all goods are tradable. This assumption is realistic in the context of rural Burundi, where 85% of households are farmers or breeders.

[10]This implies that the money held by one household is non-negative at all time (no borrowing possibilities).

budget constraint (3) should be satisfied for all t. The maximization gives its optimal level of consumption and sales as a function of the price p_t and his money holdings $m_t^{\alpha k}$:

$$\begin{cases} c_{\alpha,t}^{ak} = \dfrac{m_t^{\alpha k} + f p_t}{(2+\rho)p_t} & (5) \\ c_{\beta,t}^{ak} = \dfrac{(1-s)(m_t^{ak} + f p_t)}{(2+\rho)p_t} & (6) \\ c_{\delta,t}^{ak} = \dfrac{(1-s)\rho(m_t^{ak} + f p_t)}{(2+\rho)(p_w+\tau)} & (7) \\ S_{\alpha,t}^{ak} = f - \dfrac{m_t^{\alpha k} + f p_t}{(2+\rho)p_t}. & (8) \end{cases}$$

In the local market, buyers and sellers are in competition. Let us define the local equilibrium price p_t^* as the price such that the local demand for goods α (resp. β) equals the local supply of goods α (resp. β), that is, such that:

$$\forall t \geq 0 \begin{cases} \sum_{k=1}^{N} c_{\alpha,t}^{bk} = \sum_{k=1}^{N} S_{\alpha,t}^{ak} & (9) \\ \sum_{k=1}^{N} c_{\beta,t}^{ak} = \sum_{k=1}^{N} S_{\beta,t}^{bk}. & (10) \end{cases}$$

By introducing the results of the individual maximization into these market clearing conditions and by remembering that the set-up is symmetric in terms of a and b, we can compute the local equilibrium price:

$$p_t^* = \frac{(2-s)}{(s+\rho)f} \frac{\sum_{k=1}^{N} m_t^{ak}}{N} = \frac{(2-s)}{(s+\rho)f} \bar{m}_t \quad (11)$$

This equation shows that the equilibrium price is proportional to the average amount of money holdings in the village economy.

3.3. The three states of the local economy

In practice, the local market price p_t is not necessarily equal to its equilibrium value p_t^*. This is because the resellers' buying price $p_w - \tau$ and resellers' selling price $p_w + \tau$ bound the prices that households face in the local market. Intuitively, sellers will never find buyers in the local market if they propose a price above the resellers' selling price $p_w + \tau$. Conversely, producers will never sell their production at a price lower than the resellers' buying price $p_w - \tau$, as at this price, they can sell their entire production to the resellers[11].

Therefore, three cases have to be distinguished, depending on whether the equilibrium price p_t^* is above $p_w + \tau$ (State H), between $p_w + \tau$ and $p_w - \tau$ (State I), or below $p_w - \tau$

[11]The existence of such price band $[p_w - \tau, p_w + \tau]$ was already suggested in Key et al. (2000), Taylor and Adelman (2003) and Janvry and Sadoulet (2006).

(State L). Given the fact that the equilibrium price p_t^* is proportional to the average amount of money in the economy $\bar{m}_t$ (equation (11)), the three cases are ultimately determined by the average amount of money in the economy $\bar{m}_t$. Let us examine in detail these three cases.

State H: In State H, the average amount of money in the economy is high, such that the equilibrium price p_t^* is above the resellers' selling price $p_w + \tau$. Given equation (11), this happens if the following condition is satisfied:

$$\bar{m}_t > \frac{(s+\rho)(p_w+\tau)f}{(2-s)} = m_H. \tag{12}$$

In this case, the price on the local market is bounded by the resellers' selling price $p_w + \tau$. Indeed, if local sellers would propose a price higher than $p_w + \tau$, local buyers would prefer buying goods to the resellers at the price $p_w + \tau$ and the resellers would capture the whole demand. If the condition (12) is satisfied, prices are therefore set at $p_w + \tau$. Quantities consumed and exchanged in State H are given by the equations (5) to (8) when p_t is replaced by $p_w + \tau$. These values are derived in Appendix B.2. It is worth noting that in State H, the local market does not clear, as the local demand is higher than the local supply. Resellers satisfy this excess demand.

Let us study how the amount of money held by households evolves when the economy is in State H. In state H, the equation (4) governing the evolution of the money of the household ak becomes:

$$\dot{m}_t^{ak} = \frac{-[1+(1-s)(1+\rho)]m_t^{ak} + fs(1+\rho)(p_w+\tau)}{2+\rho} \tag{13}$$

Equation (13) shows that for a household ak, $\dot{m}_t^{ak}$ may be positive (resp. negative) if m_t^{ak} is low (resp. high). However, for the village as a whole, the evolution of average money holdings $\dot{\bar{m}}_t^a$ is always strictly negative in State H [12]. Indeed, the money used to satisfy the excess demand and the demand for the global good δ escapes the village economy, without being counterbalanced by any influx of money. In State H, the average amount of money decrease continuously until reaching the intermediate state, State I.

State I: In State I, the average amount of money in the economy is intermediate, such that the equilibrium price p_t^* is between the resellers' buying and selling prices $p_w - \tau$ and $p_w + \tau$. Given equation (11), this happens if the following condition is satisfied:

$$m_L = \frac{(s+\rho)(p_w-\tau)f}{(2-s)} \leq \bar{m}_t \leq \frac{(s+\rho)(p_w+\tau)f}{(2-s)} = m_H. \tag{14}$$

[12] We have $\dot{\bar{m}}_t = \frac{-[1+(1-s)(1+\rho)]\bar{m}_t + fs(1+\rho)(p_w+\tau)}{2+\rho}$. Then, $\dot{\bar{m}}_t < 0 \Leftrightarrow \bar{m}_t > \frac{s(1+\rho)(p_w+\tau)f}{1+(1-s)(1+\rho)}$, which is always true if condition (12) is satisfied.

If this condition is satisfied, the local market price p_t is set at its equilibrium p_t^* given by equation (11); the local market is cleared. Quantities consumed and exchanged in State I are derived in Appendix B.2. In State I, resellers only provide the global good δ, as the local demands of α and β are equal to their local supplies.

In state I, the equation (4) governing the evolution of the money of household ak becomes:

$$\dot{m}_t^{ak} = \frac{(2-s)s(1+\rho)(\bar{m}_t - m_t^{ak})}{(2+\rho)(s+\rho)} - \frac{(1-s)\rho m_t^{ak}}{s+\rho} \tag{15}$$

Equation (15) shows that for a household ak, $\dot{m}_t^{ak}$ may be positive (resp. negative) if m_t^{ak} is low (resp. high) compared to $\bar{m}_t$. However, for the village as a whole, the evolution of average money holdings is always negative:

$$\dot{\bar{m}}_t = -\frac{(1-s)\rho m_t^{ak}}{s+\rho} < 0 \tag{16}$$

Indeed, the money used to purchase the global good δ escapes the village economy, without being counterbalanced by any influx of money. We conclude that State I is unstable: the average amount of money in the local economy decreases permanently to the threshold m_L defining the limit between State I and State L.

State L: In State L, the average amount of money in the economy is low, such that the equilibrium price p_t^* is below the resellers' buying price $p_w - \tau$. Given equation (11), this happens if the following condition is satisfied:

$$\bar{m}_t < \frac{(s+\rho)(p_w - \tau)f}{(2-s)} = m_L. \tag{17}$$

In this case, the prices on the local market are bounded below by the resellers' buying price $p_w - \tau$. Because of the low amount of money in the economy, the demand for consumption goods is low and competition pushes local market prices downwards. However local sellers will never propose a price lower than $p_w - \tau$, as they have the possibility to sell their production to the resellers at this price. Therefore, if the condition (17) is satisfied, prices are set at $p_w - \tau$. Quantities consumed and exchanged in State L are given by the equations (5) to (8) when $p_t = p_w - \tau$. These values are derived in Appendix B.2. It is worth noting that in State L, the local market does not clear, as the local supply is higher than the local demand. Resellers buy this excess supply at the price $p_w - \tau$.

In state L, the equation (4) governing the evolution of the money becomes:

$$\dot{m}_t^{ak} = \frac{-[1+(1-s)(1+\rho)]m_t^{ak} + fs(1+\rho)(p_w - \tau)}{2+\rho} \tag{18}$$

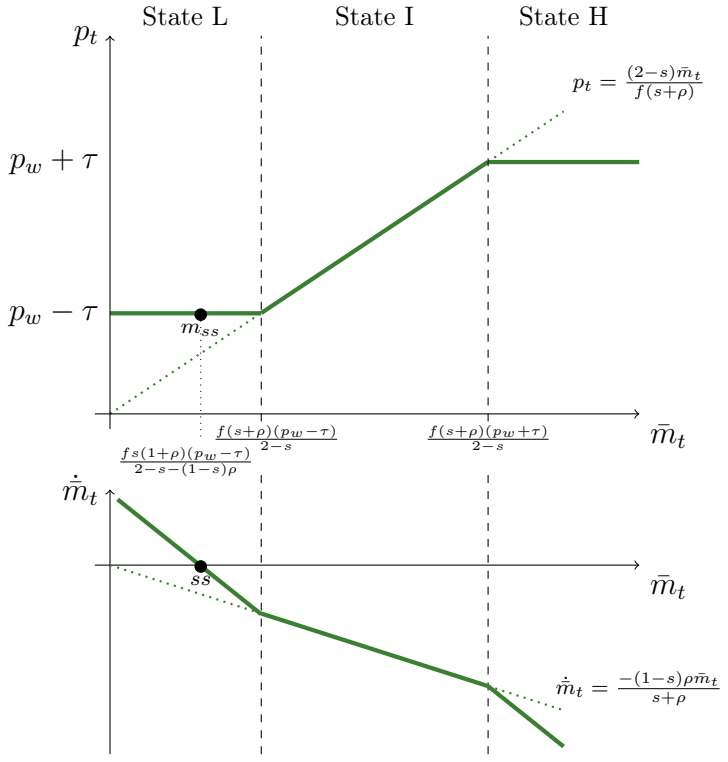
Equation (18) shows that for a household ak, $\dot{m}_t^{ak}$ is negative (resp. positive) if m_t^{ak} is higher (resp. lower) than $m_{ss} = \frac{s(1+\rho)(p_w-\tau)f}{1+(1-s)(1+\rho)}$. In words, in State L, the money holdings

of each household converge to a steady state given by m_{ss}. For the village as a whole, the evolution of average money holdings $\dot{\bar{m}}_t^a$ follows the same pattern: $\dot{\bar{m}}_t < 0$ when $\bar{m}_t > m_{ss}$ and $\dot{\bar{m}}_t > 0$ when $\bar{m}_t < m_{ss}$. We conclude that in State L, the average amount of money in the economy converges to the steady-state value m_{ss}.

At the steady state, the money used to buy the global good δ is exactly counterbalanced by the influx of money coming from the sales of the excess supply to the resellers. When the economy is at the steady state, the average amount of money is low, constant and equally distributed. Quantities consumed and exchanged at the steady state are derived in Appendix B.2. We conclude that the steady state is the only stable state of the economy.

Long-run evolution: Figure 3 shows how the price p_t and the average money holdings $\bar{m}_t$ evolve over time, from one state to another. The upper graph represents the relationship between average money holdings in the economy and the price of the goods α and β. The lower graph displays the evolution of average money holdings for each State (equations (13), (15) and(18) when $m_t^{ak} = \bar{m}_t$).

Figure 3: Determination of the price p_t (upper-chart), and evolution of the average money stock (lower-chart)



In State H, average money holdings are high and prices stuck at their higher bound $p_w + \tau$. Because the local demand for goods α and β is in excess, resellers sell both the locally produced goods α and β, and the global good δ. The money from resellers' sales

escapes the economy, which explains that the growth rate of average money holdings $\dot{\bar{m}}_t$ is negative. When $\bar{m}_t$ reaches m_H, the economy switches to State I.

In State I, the local market clears and the equilibrium price is determined by equation (11). In State I, the resellers only sell the global good. Consequently, money holdings continue to run out but at a smaller pace. When $\bar{m}_t$ reaches m_L, the economy switches to State L.

In State L, local market prices are stuck at their lower bound $p_w - \tau$, which causes an excess of local supply. In State L, the resellers therefore buy this excess supply, which leads to an incoming flow of money in the economy. When $\bar{m}_t > m_{ss}$, money keeps running out as these inflows are lower than the outflows of money from the sales of the global good. At the steady state, the resellers' purchases of locally produced goods are exactly worth their sales of the global good.

3.4. Scenario 1: DDR allowances spent in consumption goods

This section analyzes the impact of few villagers benefiting from DDR allowances and spending them in consumption goods. In this section, the DDR allowances have no impact on households' productivity. Before the DDR program, the village economy is at the steady state. In the village, n households a and n households b receive a reinsertion allocation m_{ddr} at time $t = 0$.

As beneficiary households receive the cash transfer, the average money holdings $\bar{m}_0$ at $t = 0$ increases and the economy leaves the steady state. Depending on the size of the allocations, the village economy jumps to State H, I or L. The impact of the monetary shock on beneficiaries and non-beneficiaries depends on the state of arrival. The intuition of the mechanisms at play is as follows.

On the one hand, if the increase in money holdings is small, the economy jumps to State L. In this case, the local market prices of the goods α and β are stuck at their lower bound $p_w - \tau$. The short-run impact on beneficiary households is positive as their money holdings have increased. In the long run, the consumption level of beneficiary households returns to its steady state, as they run out of money. As prices remain unchanged, the impact of the DDR program on non-beneficiaries is null both in the short and in the long run.

On the other hand, if the increase in money holdings is large enough for the economy to jump to the I or H, the prices of the goods α and β increase on the local market. This affects consumption in three ways. First, it reduces the real value of savings. Second, it increases earnings per unit sold. Third, it reduces the relative price of the good δ. The total impact of these three effects varies depending on whether households benefited from the DDR allowances or not. For beneficiary households, the impact on consumption is positive in the short run as they benefit from the allowances. For non-beneficiaries, the immediate impact is negative as the real value of their savings is reduced. In the short run, however, the impact of the DDR program on non-beneficiaries becomes positive as their revenue increases and as

the relative price of the good δ decreases. In the long run, consumption of beneficiary and non-beneficiary households returns to its steady state level. The two following propositions summarize this reasoning (formal proofs are presented in the appendix Appendix B.3).

Proposition 3.1 (Direct impact on beneficiaries). *For beneficiary households, the impact of the cash allowances is positive in the short run, regardless of whether the economy jumps to State H, State I or State L. In the long run, the consumption level of beneficiary households returns back to its steady-state level.*

Proposition 3.2 (Indirect impact on non-beneficiaries). *The impact of cash allowances on non-beneficiary households depends on the magnitude of the monetary shock. If the monetary shock is small such that the economy remains in State L, the consumption level of non-beneficiary households is not affected.*

If the monetary shock is large such that the economy jumps to States H or I, the immediate impact of the DDR program on non-beneficiary households is negative. In the short run however, the impact becomes positive. In the long run, the consumption level of non-beneficiary households returns back to its steady-state level.

In this model, we assume perfect competition among resellers, leaving them with zero profit. In reality, we could expect that resellers retain a share of each transaction as remuneration for their service. In this case, their revenue would be proportional to their turnover. In order to assess the impact of the DDR cash allowances on resellers, let us examine how their turnover is affected by a monetary shock.

By increasing average money holdings $\bar{m}_t$, the DDR monetary shock is expected to have three effects on resellers' turnover. First, it increases self-consumption, which reduces the excess supply usually bought by resellers (equation (B.1)). Second, it increases the consumption of the good δ which is sold by resellers. Third, it increases the purchases of locally produced goods, which are partly sold by the resellers if the monetary shock is large such that the economy jumps to State H (equation (B.2)). Resellers' turnover is reduced by the first effect, but increased by the second and the third effects. The resulting total effect will be negative if the share of the global good in consumption is low and if the monetary shock is small. In this case, the first effect dominates the second (and the third effect is absent because the monetary shock is small). In contrast, if the monetary shock is large or if the share of the global goods in consumption is large, the impact of the monetary shock on resellers' turnover will be positive. This reasoning is summarized in the following proposition.

Proposition 3.3 (Impact on resellers' turnover). *If $\rho < \frac{2-s}{1-s}$, the turnover of resellers is a U-shaped function of average money holdings in the village. In this case, a small monetary shock would reduce resellers' turnover in the short run; a large monetary shock would increase their turnover in the short run (thresholds are derived in appendix). In the long run, resellers' turnover goes back to its steady-state value.*

If $\rho > \frac{2-s}{1-s}$, the turnover of resellers is an increasing function of average money holdings in the village. In this case, any monetary shock increases their turnover. In the long run, resellers' turnover returns to its steady-state value.

In reality, the condition $\rho < \frac{2-s}{1-s}$ is expected to be satisfied in rural Burundi (this condition is always satisfied if $\rho < 2$). Indeed, in poor rural areas, it is reasonable to assume that the amount of money spent by households is higher for locally produced goods than for imported goods, which is the same as assuming $\rho < 1$. We therefore conclude that it is the first part of proposition 3.3 which is most likely to be true in rural Burundi, implying that the turnover of resellers is a U-shaped function of average money holdings in the village.

Up to now, we have assumed that resellers face no fixed cost for their activities. This assumption implies that the resellers' selling and buying prices are constant and given by $p_w + \tau$ and $p_w - \tau$ respectively. If this assumption is relaxed, that is, if resellers face a positive fixed cost for their activities, the price they offer for their service depends on their turnover for this activity (see Appendix B.1 for a mathematical derivation). In particular, the resellers' selling price for the global good δ becomes a decreasing function of average money holdings. This decrease in the global good's price will amplify the positive impact of the DDR allowances on both beneficiaries and non-beneficiaries.

Before discussing two alternative scenarios, let us summarize the mechanism presented in this section. In this first scenario, it was assumed that ex-combatants spend their allowance in consumption goods. According to this scenario, we expect the consumption of ex-combatants to increase in the short run. If the money shock is large enough, the demand increase following the DDR program will induce an increase in prices in the local market. The immediate impact of the price increase is to reduce the purchasing power of non-beneficiary households by decreasing the value of their savings. This negative immediate impact is expected to be marginal in poor rural areas where savings institutions are scarce. In the short run, however, households will indirectly benefit from the DDR program as higher prices increase the revenue from their sales. In the long run, the positive impact on the consumption of beneficiaries and non-beneficiaries vanishes as the money reserves of beneficiary households run low. These mechanisms are summarized in the first row of table 1.

3.5. Scenario 2: DDR allowances invested in productive assets

In the second scenario, ex-combatants invest their allowance in productive assets. As productivity increases, we expect the impact on their standards of living to be positive in the short and in the long run. The enhanced productive capacity of ex-rebel households induces an increase in supply. If the economy is at the steady state before the DDR program, prices of locally produced goods are at their minimum $p_w - \tau$. This implies that the supply increase following investments does not translate into a price decline. In this case, we expect no impact on non-beneficiaries.

If DDR allowances are partly spent in consumption goods, such that the economy jumps to a higher state, the supply increase following investment in productive assets may soften price increase predicted in section 3.4. To be precise, the price increase will be attenuated if the new equilibrium price is between $p_w - \tau$ and $p_w + \tau$. Indeed, equation (11) shows that the equilibrium price is a decreasing function of the average productivity f. These mechanisms are summarized in the second row of table 1.

3.6. Scenario 3: DDR allowances invested in land

In the last scenario, ex-combatants invest the money of the demobilization in agricultural land plots. Their economic situation should therefore improve in the short run following their enhanced production capacity (if they cultivate the land). This positive impact is expected to last in the long run. It could eventually grow if the investment generates extra revenue, which can in turn be invested.

The purchase of land plots induces a transfer of money to the former land owners. The impact of this money transfer on former land owners and on other non-beneficiary households depends on how the money transferred is spent. On the one hand, if the money is spent in consumption goods, we are in the situation described in the first scenario. In this case, the consumption of former land owners will rise in the short run, prices will increase and the value of savings will decrease. However, in the short run, the value of sales in the local market increases, which thereby increases consumption of all households. In the long run, the situation of the former land owners is expected to deteriorate as they sold part of their productive capacities (if land plots were cultivated). The economic situation of other non-beneficiary households returns back to the steady state.

On the other hand, if former land owners invest the revenue of land sales in productive assets, as in the second scenario, their situation should improve in the short and in the long run if the increase in productivity induced by the investment outweighs the productivity loss due to the sale of land. In this case, prices of locally produced goods remain stuck at their lower bound $p_w - \tau$, implying that other non-beneficiary households are not affected.

These mechanisms are summarized in the third row of table 1. In particular, the living standards of ex-combatant households should improve both in the short and in the long run, following their land acquisition, and the corresponding enhanced production capacity. The impact on non-beneficiaries is more complex, and is a mixture between the expected impact on former land owners and the expected impact on other non-beneficiary households. In particular, the short-run impact on non-beneficiaries will be positive because former land owners spent part of their revenue from land sales in consumption goods. In the long run, this economic boom vanishes as former land owners run out of money. The final economic situation of non-beneficiary households may be better or worse than their situation before the DDR, depending on whether part of the money transferred to former land owners was invested well.

Table 1: Direct and indirect impact of the demobilization program

	Beneficiaries of the DDR			Non-Beneficiaries of the DDR			Prices		
	Short run β_2, σ_2	Evol-ution η_2	Long run λ_2	Short run β_3, σ_3	Evol-ution η_3	Long run λ_3	Short run	Evol-ution	Long run
Consumption goods	+	$\searrow$	0	+	$\searrow$	0	+	$\searrow$	0
Productive investment	+	$\longrightarrow$ / $\nearrow$	+	0	$\longrightarrow$	0	0	$\longrightarrow$	0
Land	+	$\longrightarrow$ / $\nearrow$	+	+	$\searrow$	-/+	0/+	$\longrightarrow$	0
In-kind grant	0	$\nearrow$	+	0	$\longrightarrow$	0	0	$\longrightarrow$	0
Total impact	+	$\searrow$/$\nearrow$	+	+	$\searrow$	-/+	+	$\searrow$	0

Note: the greek letters refer to the coefficients of the empirical model presented later in the paper (equations (20) and (21)).

3.7. Summary of theoretical predictions

In this section, we introduced three scenarios explaining how DDR allowances are expected to affect the local economy in the short and in the long run. Based on figure 2, we showed that the expected impact of the DDR program differs depending on whether the DDR allowances are consumed, invested in productive assets or invested in land plots. In reality, the three scenarios are intermingled: ex-combatants used their money for buying land plots, for consuming and for investing in their productive activity. We therefore expect the global impact of the reinsertion phase of the DDR program to relate to a mixture of the three scenarios.

Furthermore, in addition to the cash allocation studied in the three scenarios, the CNDD ex-rebels, for whom demobilization started in 2004, received in-kind reintegration grants one year after receiving the cash reinsertion allowances. For these in-kind allowances, ex-combatants could choose between training, building materials, stocks for starting a small business or agro-pastoral support. Globally, these grants should have contributed to increase the standards of living of ex-combatants. This is summarized in the fourth row of table 1.

The last row of table 1 presents the expected aggregate effect of the DDR program. Ex-combatants' situation should improve both in the short and in the long run. If most money is spent in consumption goods rather than invested, consumption should fall gradually as grants run low. Conversely, if grants are invested in productive assets, the situation of ex-combatants may improve over time. Changes are similar for non-recipient households, but the size of the effects is expected to be smaller. In the short run, non-beneficiary households should benefit from the economic boom induced by the large inflow of money in the villages. However, this favorable situation may not last in the long run, especially for households who sold part of their land or who did not invest efficiently the money earned during the boom. In the short run, the impact on prices is positive because of the increased demand. In the long run, however, prices are expected to converge back to their steady-state value. In the following section, this theoretical framework is tested empirically.

4. Empirical analysis

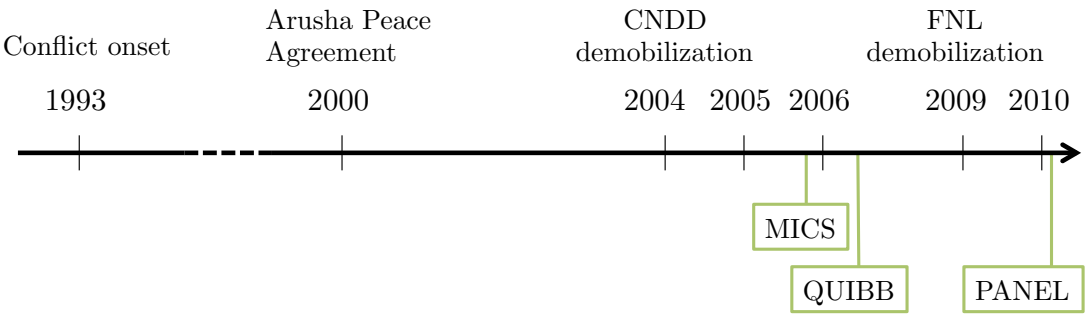
4.1. The Data

The analysis draws on different types of data. The first dataset consists of a panel of households. The second dataset is a community questionnaire, collected at the village level. The third dataset consists of administrative data from the National Demobilization Authority.

The panel dataset

The first dataset constitutes a three-round household survey undertaken in Burundi. Figure 4 shows the timing of data collection, together with the major events of the DDR program. The first round is a Multiple Indicator and Cluster Survey (MICS) undertaken in September 2005. The second round, known as the "Questionnaire des Indicateurs de Base du Bien-être" (QUIBB), was collected in February 2006. It did not aim at building longitudinal data but nevertheless used the same sample as the MICS survey. The last round, undertaken by the authors in April 2010, only retained 3 provinces of the MICS/QUIBB sample: Bubanza, Bujumbura Rural and Cibitoke, located in the North-West of the country. The choice of these provinces is justified by the concentration of FNL combatants in these three provinces, interlinked with high level of violence in the region over the last years, as well as by budgetary constraints.

Figure 4: Timeline



The first round of the panel, the MICS survey, mostly focuses on health and gender issues, and contains little information about economic outcomes. Our main analysis will therefore focus on the second and the third round of the panel which contain rich and comparable information on consumption, assets, production and labor.

The survey is characterized by a 2-stage cluster sampling. In the first stage, 88 hills were sampled and in the second stage, 15 households were interviewed in each primary unit. It resulted in 1320 households in the MICS survey in our three provinces. Attrition reduced this number to 1284 households in the QUIBB survey. For the 2010 survey, interviewers

received instruction to track these 1320 households in the sampled hills and re-interview them[13]. In addition, they also interviewed the newly formed households of the sons and daughters of the head of household (the split-offs), as it is current practice in panel surveys in Africa (Verwimp and Bundervoet, 2009; Beegle et al., 2011). During this third-round survey, 1222 households were interviewed in 85 hills[14]. Those include not only the one sampled in 2005-2006 but also 158 split-offs, who account for 13% of our sample. Compared to the 2005 survey, we traced 80.6% of the households that were interviewed in the first round. Table 2 shows a significant difference in purchases when comparing our sample to the households that we were not able to trace. The attritors seem to have purchased more than the non-attritors, but they relied less on their stocks. Current spending was higher among the attritors. The latter also owned less cattle. These differences suggest that they were somewhat richer. There are no significant differences between traced and untraced households in terms of socio-demographic characteristics, except for household size indicators. Moreover, at the household level, the untraced households were also the ones living in the hills where the conflict was significantly more intense. Importantly, there are no difference in both groups when looking at ex-rebel returns at household level. In sum, this suggests that these untraced families, richer and smaller, may have fled to escape violence. The problem of attrition is examined in detail in section 4.3.

Community questionnaire

During the 2010 survey, the interviewers also undertook a community survey in each hill, in which they collected information on population and violence. This community data provides contextual information and controls for each hill surveyed. In particular, the data on violent events will be used as a control variable in our econometric model. We will also use population data, based on the 2008 census, in order to scale the number of ex-combatants in each hill.

Official demobilization registers

At the time of the 2010 survey, we worked with the Center of Operations of the DDR program in Burundi. They provided us with registers of ex-combatants by hill and movement, along with their sex, age, grade, hill of origin and of return, as well as the date of their demobilization. The data provides precise information about each demobilized ex-combatant

[13]In order to maximize the reliability of the data, we trained interviewers for a week, not only on the questionnaire but also on the DDR program and the historical context of the conflict. After the training, interviewers were selected on the basis of an exam and simulated interviews. The questionnaire was tested during a pilot study in an out-of-sample hill. We assigned teams of five interviewers, each including a team leader and at least two women. We also included six ex-rebels from the FNL in our teams. Each of them was assigned to one team in order to facilitate the survey. Each interviewer did two interviews per day on average. The questionnaires were then controlled for accuracy and entered in a CS-PRO program by data entry agents.

[14]There were three hills in which we could not track households, all located in Bujumbura Rural. In two hills, the villagers reported not to know the tracked households, either because they had migrated or were invented by 2005 interviewers. The remaining hill was not secure enough to conduct the survey.

Table 2: Descriptive statistics

	Sample mean (sd)			T-test p-value	
	2010	2006	Attrition	2010/ 2006	2006/ attrition
Economic outcomes					
Consumption per AE	14387	16101	17706	0.00	0.15
	(11349)	(10996)	(14716)		
Cons. expenditure per AE	7971	8828	11314	0.01	0.00
	(7045)	(7765)	(11155)		
Cons. from stock per AE	6566	7246	6114	0.08	0.09
	(9281)	(8181)	(8679)		
Current spending	7834	4442	6114	0.00	0.00
	(6802)	(4023)	(5658)		
TLU	0.09	0.16	0.09	0.00	0.03
	(0.16)	(0.19)	(0.19)		
Demographic characteristics					
Adult equivalent (AE)	2.90	2.66	2.48	0.00	0.00
	(0.92)	(0.88)	(0.80)		
HH size	5.89	5.37	4.91	0.00	0.00
	(2.34)	(2.34)	(2.21)		
Sex Head	0.78	0.80	0.81	0.13	0.94
	(0.42)	(0.40)	(0.40)		
Age Head	46	42	41	0.00	0.37
	(14)	(14)	(16)		
Head education					
No school	0.37	0.36	0.34	0.78	0.49
	(0.48)	(0.48)	(0.47)		
Primary school	0.38	0.36	0.41	0.47	0.22
	(0.49)	(0.48)	(0.49)		
Secondary school	0.04	0.03	0.04	0.20	0.43
	(0.20)	(0.18)	(0.20)		
Coranic school	0.21	0.24	0.21	0.08	0.29
	(0.41)	(0.43)	(0.41)		
Head marital status					
Single	0.02	0.03	0.04	0.70	0.20
	(0.15)	(0.16)	(0.20)		
Married	0.76	0.79	0.76	0.07	0.28
	(0.43)	(0.40)	(0.43)		
Divorced	0.02	0.02	0.03	0.25	0.25
	(0.15)	(0.13)	(0.17)		
Widow	0.19	0.16	0.16	0.09	0.97
	(0.39)	(0.37)	(0.37)		
Occupation					
Agriculture	0.73	0.22*	0.21*	0.00*	0.60
	(0.44)	(0.42)	(0.41)		
Trade	0.06	0.04	0.05	0.01	0.60
	(0.24)	(0.19)	(0.21)		
Construction	0.03	0.05	0.09	0.15	0.03
	(0.18)	(0.21)	(0.29)		
Colline characteristics (village level)					
Violent events (last 4 years)	0.44	1.14		0.00	
	(0.86)	(1.63)			
Ex-combatant Return, per 1000	3.76	2.99		0.31	
	(5.43)	(4.48)			

* This sharp difference stems from the fact that the questions asked in 2006 and in 2010 were different. In 2006, the questionnaire asked if the household head was engaged in paid work during the last year, while in 2010, the questionnaire asked about the main income generating activity. In our empirical analysis, we use 2010 definition. Note that all statistics on economic outcomes are computed excluding outliers.

as well as the exact number of demobilized soldiers in each hill. The large variation in the number of demobilized ex-combatants per hill will allow identifying the spillovers of the DDR program in Burundi.

4.2. Variables of interest

In this section, we review in detail the variables which will be used in the econometric analysis.

Economic outcomes

Five dependent variables will be considered in the econometric analysis: total consumption per adult equivalent, consumption expenditures per adult equivalent, consumption taken from the stocks per adult equivalent, non-food spending per adult equivalent, and tropical livestock units (TLU).

The three first economic outcomes relate to consumption. In particular, total household consumption is separated into two measures: consumption purchases and consumption goods taken from stocks. These measures consist of the aggregation of purchases and consumption from stocks of mainly food-items, but also some non-food items such as wood or candles, and this during the two weeks preceding the survey. We computed such indicators per adult equivalent, in constant 2010 prices. The construction of consumption aggregates is described in Appendix A.

The fourth variable used as dependent variable is an indicator of non-food spending. This measure includes current spending in terms of clothing, housing, leisure, transport and transfers during the last year. It is also scaled per adult equivalent.

The fifth dependent variable we consider is a measure of asset holdings, the tropical livestock units. This indicator aims at quantifying a wide range of livestock types and sizes. Conversion factors used are the following: cattle (0.50), sheep and goats (0.10), pigs (0.20), poultry and rabbits (0.01) (Harvest Choice, 2012).

Descriptive statistics for these five indicators are presented in table 2. The first four indicators are expressed in 2010 Burundese francs[15]. In table 2, the recall period for consumption indicators is 15 days. The average daily consumption per adult equivalent was worth US$ 0.98 in 2006 and decreased to US$ 0.87 in 2010. All indicators of consumption show a significant decrease between 2006 and 2010, while current spending have increased.

Ex-combatants and demobilization (direct impact)

Our identification strategy aims at disentangling the short- and long-run direct impact of the demobilization program on ex-rebel households. The short-run direct impact of demobilization will be captured by two dummy variables. The first dummy, $R_{i,t}^{FNL}$, is equal to 1 in

[15]Note that US$ 1 was about 1,100 Burundese francs in 2010.

2010 if the respondent reported the presence of an ex-FNL living in the extended household. By extended household, we mean the original household and the split-off households issued from the original household. The second dummy, $D_{i,t}^{FNL}$, is equal to 1 if a member of the extended household benefited from the reinsertion allowances in 2009.

Similarly, the long-run direct impact of demobilization is captured by two dummies. The dummy, $R_{i,t-1}^{CNDD+}$, is equal to 1 in 2006 if an ex-combatant who stopped fighting in 2003-2004 was reported to live in the extended household. The notation $CNDD+$ is justified by the fact that the CNDD-FDD was not the only armed faction to lay down weapons and benefit from the first round of the demobilization program (figure 2). The notation $CNDD+$ therefore encompasses ex-FABs, ex-CNDDs and a small number of ex-combatants from other factions. The dummy, $D_{i,t-1}^{CNDD+}$, is equal to 1 if an ex-CNDD+ of the extended household benefited from the reinsertion allowances.

As explained in section 4.1, both the third round of the panel dataset collected in 2010 and the official demobilization registers contain information about the demobilization status of individuals. The dummies accounting for the return of an ex-combatant in the extended household, $R_{i,t}^{FNL}$ and $R_{i,t-1}^{CNDD+}$, and the dummies accounting for the presence of an ex-combatant who benefited from the reinsertion allowances, $D_{i,t}^{FNL}$ and $D_{i,t-1}^{CNDD+}$ were constructed following different steps. The construction of these variables is summarized in table 3.

The return dummies, $R_{i,t}^{FNL}$ and $R_{i,t-1}^{CNDD+}$, are based on self-reported data from the 2010 panel survey. These dummies are equal to 1 if the household declared to have one member having ties with the factions. This could go from an informal link, to being a demobilized soldier. This category therefore includes households with registered ex-combatants, households associated with the factions, known as "gardien de la paix", "adultes associés" or "militant combatant" and people without any status but that declared themselves as member of a rebel faction.

The demobilization dummies, $D_{i,t}^{FNL}$ and $D_{i,t-1}^{CNDD+}$, were constructed according to three different definitions of demobilization. We started from the list of persons having declared to be an ex-combatant and to have a demobilization card. Then, this data was cross-checked with the official registers in order to identify the ex-rebels for whom we are sure that they received the reinsertion allowances. We identified ten such ex-combatants. These are recorded in the registers, and fall under the first definition. Second, in order to account for potential underreporting, we undertook a matching exercise, using generalized Levenshtein edit distance. We matched the names, age, sex and hill of origin and return of the ex-combatants listed in the official demobilization registers with the household information available in our panel dataset. Eight potential ex-rebels were identified through this matching process and added to the first category of demobilized ex-combatants to form our second definition. Then, we defined a third category, composed of the ex-combatants who declared to have received the DDR grants. This includes the ones that are recorded in the official registers (as in the first definition), and the ones for which we did not find any record. As self-reported

Table 3: Construction of ex-rebel household variables

	CNDD+	FNL	Total	Variable of interest CNDD+	Variable of interest FNL
Member declared having ties with the factions					
but did not receive anything	8	10	18		
and to be GdP/MC/AA	6	4	10		
Demobilized ex-combatant member					
Member declared to be demobilized	14	9	25	$D_{i,t-1}^{CNDD+3}$	$D_{i,t}^{FNL3}$
And not recorded in official registers	8	5	13		
And recorded in official registers	6	4	10	$D_{i,t-1}^{CNDD+1}$	$D_{i,t}^{FNL1}$
Not declared but matched with registers	1	7	8		
Total matched with registers (declared or not)	7	11	18	$D_{i,t-1}^{CNDD+2}$	$D_{i,t}^{FNL2}$
Totals					
Households belonging to a faction (without matches)	28	21*	49	$R_{i,t-1}^{CNDD+1}$	$R_{i,t}^{FNL1}$
Households belonging to a faction (with matches)	29	28	57	$R_{i,t-1}^{CNDD+2}$	$R_{i,t}^{FNL2}$

* For two households, there was more than one person reporting to have ties with the FNL. In one household, two persons declared to be demobilized in 2009 but none was recorded. In another household, there was one recorded ex-combatant, while his brother did not received anything. The dummies of consideration take the value one for each case.

information is expected to be noisy, the significance and the size of estimated parameters may be reduced when this definition is used. In addition to headcounts, table 3 provides the definition of dummies in which each type of ex-rebel falls. The three different indicators created will be compared in the empirical analysis.

Ex-combatants' aggregates (indirect impact)

On top of the direct effect of demobilization, the return of ex-combatants in their villages of origin has led to an influx of a significant amount of money into the local economy. As a result, non-recipient households may have been indirectly affected by the demobilization program.

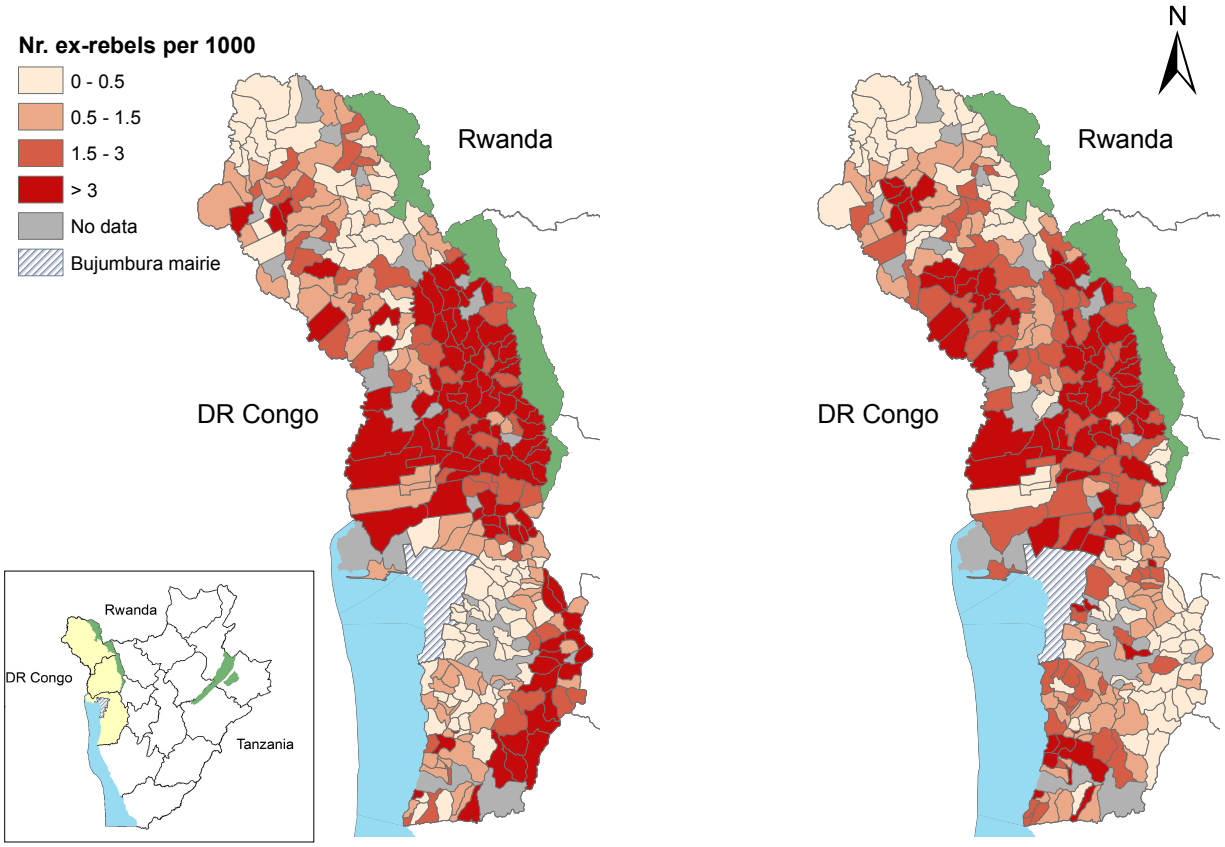
We measure the indirect impact of the demobilization program by looking at the proportion of ex-combatants of each faction living in each hill, per 1000 inhabitants[16]. The variables of interest are denoted $S_{i,t}^{FNL}$ for the proportion of ex-combatants demobilized between 2004 and 2006, and $S_{i,t-1}^{CNDD+}$ for the proportion of ex-combatants demobilized after 2009. On average, in the hills of our sample, there were 3.8 ex-combatants per 1000 inhabitants that came back following the first wave of the program, starting by the end of 2004.

[16]Note that this indicator is computed at the hill level, which is one admin level above the villages sampled ("sous-colline"). We therefore consider ex-combatant returns in the village of the household, as well as in neighboring villages. While the villages may be connected to each other, the hills are not. Given the size of hills and the difficulites to move in the country, it is very unlikely that the returns in one hill have affected neighboring hills.

The FNL demobilization process of 2009 led to an average of 3 ex-combatant returns per 1000 inhabitants.

There are substantial differences between hills, which are highlighted in figure 5 for our provinces of interest. These maps present the distribution of ex-combatants over each hill, scaled by their population. In our sample, Bubanza is the province with most returns. In this province, average returns reach 6.2 and 5.2 ex-combatants per 1000 inhabitants for the CNDD and FNL factions respectively. Another interesting feature about their geographic distribution is the relative absence of CNDD in Bujumbura Rural, with 0.8 ex-combatants only compared to 3.4 FNL per 1000.

Figure 5: Demobilized ex-combatants per 1000 inhabitants in Bujumbura Rural, Bubanza and Cibitoke provinces



(a) CNDD per 1000 (b) FNL per 1000

The classification relies on the distribution of the FNL ex-combatants, for which quantiles defines the categories. As distributions were alike, the FNL one was chosen for the sake of clarity.

Control variables

In the empirical analysis, we control for time varying characteristics that are not affected by the demobilization program. First, violent events four years before the survey are accounted for. There are large differences across time and space, as illustrated in figure 6. On average, violence decreased a lot between 2002 and 2009. Second, we include a binary variable indicating that the head of household changed between the two rounds. This could be because the former head died or migrated.

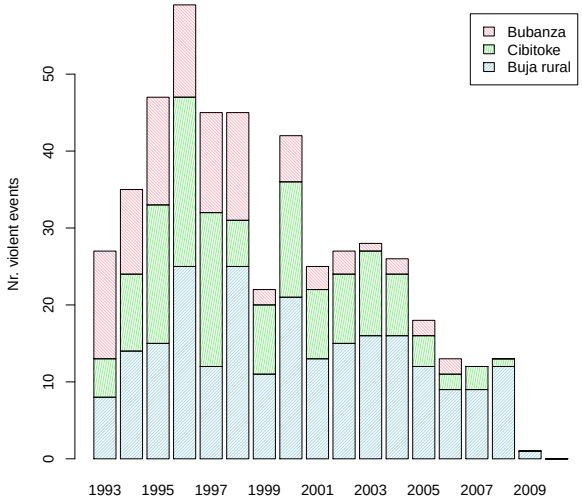


Figure 6: Timeline: violent events per province (1993-2010)

4.3. Identification strategy

As explained in sections 4.1 and 4.2, reliable information about economic outcomes is only available for the second and the third rounds of the panel. The identification strategy is therefore based on econometric methods for panels of two periods. We consider both the lagged dependent variable model and the fixed effects model, which rely on different assumptions regarding the data generating process. Estimates from both models are expected to bound the true parameters (Angrist and Pischke, 2008).

Lagged dependent variable model

The lagged dependent variable model assumes that, conditional on the lagged dependent variable and controls, economic outcomes in the absence of the demobilization program would have evolved similarly for households affected and not affected by the program. Formally, let us denote $Y^0_{i,t}$, the outcome of interest in the absence of the treatment and $D_{i,t}$, the vector of treatment variables[17]. The lagged dependent variable model assumes:

[17] $D_{i,t} = (R^{FNL}_{i,t}, D^{FNL}_{i,t}, S^{FNL}_{i,t}, R^{CNDD+}_{i,t-1}, D^{CNDD+}_{i,t-1}, S^{CNDD+}_{i,t-1})$

$$E(Y^0_{i,t}|Y^0_{i,t-1}, X_{i,t}, D_{i,t}) = E(Y^0_{i,t}|Y^0_{i,t-1}, X_{i,t}). \tag{19}$$

According to this, the lagged dependent variable model proposes to estimate the following equation:

$$\begin{aligned} Log(Y)_{i,t} =& \delta Log(Y)_{i,t-1} + \beta_0 + \beta_1 R^{FNL}_{i,t} + \beta_2 D^{FNL}_{i,t} + \beta_3 S^{FNL}_{i,t} \\ &+ \eta_1 R^{CNDD+}_{i,t-1} + \eta_2 D^{CNDD+}_{i,t-1} + \eta_3 S^{CNDD+}_{i,t-1} + X_{i,t-1} + \epsilon_{i,t}, \end{aligned} \tag{20}$$

where $Log(Y)_{i,t-1}$ is the lagged dependent variable. The short-run direct impact of the DDR program is measured by the dummies $R^{FNL}_{i,t}$ and $D^{FNL}_{i,t}$. In particular, the coefficient β_1 measures the impact of the return of an FNL ex-combatant in the household. The coefficient β_2 measures the impact of having benefited from the FNL reinsertion allowance. In this estimation, and the ones that follow, we therefore compare the demobilized ex-combatants, which have received the grant, to the reference group of ex-combatants that returned but did not benefit from the grants. In table 4, we show descriptive statistics of the dependent variables disaggregated by demobilization status (returned and demobilized) and factions (CNDD+ and FNL), and for civilians. There were no significant differences in consumption, spendings or TLU between the returned and the demobilized ex-combatants in 2006, which suggest that they were similar at baseline.

According to the model presented in section 3, we expect β_2 to be positive as ex-combatants could use the DDR allowances to buy land, consume more or invest in productive assets. The impact of return is ambiguous, and it is difficult to predict the sign of β_1. On the one hand, an ex-combatant returning home without funds is one extra mouth to feed. On the other hand, he brings labor to the household, enhancing means of production (if the production-possibility frontier is not reached) or earning his own revenue (if he finds a job). Turning to the indirect impact, the coefficient β_3, associated the proportion of ex-FNL beneficiaries in the hill, should be positive. Following the model, recall that in the short run, the return of ex-combatants has an overall enhancing effect on the local economy.

The coefficients β_1, β_2 and β_3 are unbiased if condition (19) is satisfied, that is, if in the absence of demobilization program and if the lagged dependent variable and controls are accounted for, households living with ex-FNLs or living in hills with a high proportion of ex-FNLs would have evolved similarly to non-rebel households and to households living in hills with few ex-FNLs.

The variables $R^{CNDD+}_{i,t-1}$, $D^{CNDD+}_{i,t-1}$ and $S^{CNDD+}_{i,t-1}$ capture the long-run impact of the demobilization program. We need to carefully consider the timing of the demobilization of CNDD rebels, FAB and other small factions, which started before the first survey, at the end of 2004 (figure 2). Then, they benefited from the in-kind reintegration grants between both surveys. It implies that by the time of the QUIBB survey, which is used as baseline,

Table 4: Descriptive statistics by demobilization status

	CNDD			FNL			Civilians
	Return	Demob	p-value	Return	Demob	p-value	All
Panel A. 2006							
Total consumption	17051	21871	0.41	14906	15541	0.94	16077
	(8919)	(11155)		(9966)	(12695)		(11066)
Consumption expenditures	11017	10728	0.94	8673	11887	0.70	8767
	(7911)	(7987)		(7022)	(12198)		(7769)
Consumption from stocks	6034	11142	0.22	6233	3654	0.14	7282
	(7301)	(7567)		(5464)	(1622)		(8256)
Current spendings	5098	4613	0.75	5007	5716	0.87	4416
	(3369)	(2842)		(4737)	(6284)		(4027)
TLU	0.11	0.22	0.42	0.16	0.35	0.43	0.11
	(0.17)	(0.24)		(0.23)	(0.31)		(0.19)
Panel B. 2010							
Total consumption	14927	6613	0.01	14037	21411	0.18	14422
	(9497)	(3491)		(9816)	(6602)		(11456)
Consumption expenditures	9104	3214	0.01	9436	15053	0.13	7895
	(6826)	(2489)		(7530)	(4198)		(6978)
Consumption from stocks	6543	3399	0.27	5454	6358	0.68	6657
	(7485)	(4637)		(6227)	(2541)		(9461)
Current spendings	8050	3266	0.01	9347	13113	0.17	7777
	(6287)	(2364)		(7495)	(2854)		(6752)
TLU	0.08	0.01	0.07	0.05	0.05	0.90	0.09
	(0.18)	(0.01)		(0.08)	(0.08)		(0.16)

the majority of these ex-combatants had already benefited from the reinsertion allowances. Hence, we are not able to measure the long-term impact of the program for the CNDD ex-rebels. What we can assess however, is the evolution of their economic outcomes. Let us explain this argument formally.

In an ideal scenario in which we had data before the peace agreement, denote σ the short-run impact of the demobilization program, that is, the one-year impact between the reception of the allowances and the QUIBB survey. Similarly, λ denotes the measure of the long-run impact of the demobilization program, that is, the five-year impact between the reception of the allowances and the 2010 panel survey. Unfortunately, we are not able to measure σ and λ separately. However, we can capture the difference $\eta = \lambda - \sigma$, which can be thought of as the long-run evolution of the economic outcomes of CNDD ex-soldiers[18]. More specifically, the coefficient η_1 measures the long-run evolution of the return of an ex-combatant in the household, η_2 measures the long-run evolution of having benefited from the reinsertion allowances before the QUIBB survey, and the coefficient η_3 measures the long-run evolution of externalities on non-beneficiaries. Contrary to the short-run impact of the DDR program, the direction of the long-run evolution is ambiguous and depends on how ex-combatants spent the reinsertion grants and used their in-kind reintegration allocations. Two forces are at play. First, the DDR program gave beneficiaries the opportunity to invest in productive assets, which we expect to lead to non-negative long-run evolution in their economic outcomes. Second, if cash allocations induced an increase in consumption in the short-run for beneficiaries, which they are not able to sustain in the long-run as they run out of cash, their short-run evolution is expected to be negative.

The variable $X_{i,t}$ regroups several control variables that may explain changes in economic outcomes between the two rounds of the panel. It includes a dummy which accounts for a change of household head, and two variables measuring the number of violent events that occurred in the hill before and after the baseline survey (figure 6). Variables that are expected to have been affected by the demobilization program, such as production, land or other assets, are excluded from the regression (they are "bad controls" (Angrist and Pischke, 2008)).

Fixed effect model

The second econometric model we use to evaluate the impact of demobilization program is the fixed effects model. It assumes that the unobserved characteristics included in the error term and correlated with the variables of interest are constant over time. Let us denote α_i these unobserved and time-invariant confounding factors. The model we want to estimate becomes :

[18]The coefficient η has been introduced in the theoretical framework in table 1.

$$\begin{cases} Log(Y)_{i,t} = \beta_0 + \beta_1 R^{FNL}_{i,t} + \beta_2 D^{FNL}_{i,t} + \beta_3 S^{FNL}_{i,t} \\ \qquad\qquad + \lambda_1 R^{CNDD+}_{i,t-1} + \lambda_2 D^{CNDD+}_{i,t-1} + \lambda_3 S^{CNDD+}_{i,t-1} + X_{i,t} + t + \alpha_i + \epsilon_{i,t}. \\ Log(Y)_{i,t-1} = \beta_0 + \sigma_1 R^{CNDD+}_{i,t-1} + \sigma_2 D^{CNDD+}_{i,t-1} + \sigma_3 S^{CNDD+}_{i,t-1} + X_{i,t-1} + \alpha_i + \epsilon_{i,t}. \end{cases}$$

In order to avoid the omitted variable bias due to the unobservability of α_i, the model is estimated in first-difference:

$$\begin{aligned} \Delta Log(Y)_{i,t} = \beta_1 \Delta R^{FNL}_{i,t} + \beta_2 \Delta D^{FNL}_{i,t} + \beta_3 \Delta S^{FNL}_{i,t} \\ + \underbrace{(\lambda_1 - \sigma_1)}_{-\eta_1} \Delta R^{CNDD+}_{i,t} + \underbrace{(\lambda_2 - \sigma_2)}_{-\eta_2} \Delta D^{CNDD+}_{i,t} + \underbrace{(\lambda_3 - \sigma_3)}_{-\eta_3} \Delta S^{CNDD+}_{i,t} \\ + \Delta X_{i,t} + t + \Delta \epsilon_{i,t}. \end{aligned} \tag{21}$$

This last equation shows that the coefficient of the lagged dependent variable model and the fixed effects model are expected to be of opposite sign for variables related to the first wave of the demobilization program. Apart for this difference in sign, the interpretation of coefficients is similar to the lagged dependent variable model. However, the assumptions surrounding these models are sharply different.

The main assumption underlying the fixed effects model is that all unobserved confounding factors are constant over time. This is summarized by the following condition:

$$E(Y^0_{i,t} | \alpha_i, X_{i,t}, D_{i,t}) = E(Y^0_{i,t} | \alpha_i, X_{i,t}). \tag{22}$$

The fixed effects model requires the counterfactual trend behavior of treatment and control groups to be the same when changes in control variables are controlled for. This assumption can be tested by estimating equation (21) with data collected prior to the demobilization program. To achieve this, we use the information included in the 2005 and 2006 rounds of the panel. As explained in section 4.1, the first round of the panel, collected in 2005, contains little information on economic outcomes. However, it contains data on asset holdings such as livestock, mosquito bed nets, chairs and bicycles. Table 5 reports the estimation of equation (21) with 2005 and 2006 data. If condition (22) is satisfied, the coefficient associated with the variables $R^{FNL}_{i,t}$, $D^{FNL}_{i,t}$ and $S^{FNL}_{i,t}$ should not be significant as, in 2006, FNL rebels had not yet benefited from the demobilization. It turns out that the coefficient of $S^{FNL}_{i,t}$ is small but significant when the dependent variable is the change in total livestock units or the change in the number of mosquito bed nets held by the household[19]. This suggests that the condition (22) may not be fully satisfied.

[19]In the fourth regression (bicycle), the coefficient associated with $D^{FNL}_{i,t}$ is also significant. This result is misleading and due to the small number of ex-FNLs in the sample. Between 2005 and 2006, 4% of households bought a bicycle, 5% sold a bicycle and 91% observed no change in their number of bicycles. All 4 ex-FNL households accounted for in table 5 exhibit no change in their number of bicycle between 2005 and 2006. Therefore, the positive coefficient associated with the variable $D^{FNL}_{i,t}$ is only due to the fact that among non-FNL households, slightly more household sold a bicycle rather than bought a new one.

Table 5: Test of the common trend assumption

	(1) Δ TLU	(2) Δ Bednets	(3) Δ Chairs	(4) Δ Bicycle
Ex-combatant return in household				
CNDD+ factions ($\Delta R_{i,t-1}^{CNDD+}$)	-0.272	-0.053	0.602	-0.180
	(0.315)	(0.134)	(0.496)	(0.165)
FNL factions ($\Delta R_{i,t}^{FNL}$)	-0.026	-0.031	-0.153	-0.182
	(0.047)	(0.067)	(0.470)	(0.114)
Demobilized in household				
CNDD+ factions ($\Delta D_{i,t-1}^{CNDD+}$)	0.594	0.552	-2.113	0.083
	(0.413)	(0.513)	(1.390)	(0.192)
FNL factions ($\Delta D_{i,t}^{FNL}$)	0.162	0.373	3.666	0.234**
	(0.192)	(0.409)	(2.262)	(0.111)
# of demobilized in the hill (per 1000 inhab.)				
CNDD+ factions ($\Delta S_{i,t-1}^{CNDD+}$)	-0.000	0.005	-0.004	-0.002
	(0.002)	(0.005)	(0.019)	(0.002)
FNL factions ($\Delta S_{i,t}^{FNL}$)	0.002***	-0.010***	0.002	-0.000
	(0.001)	(0.003)	(0.011)	(0.001)
Constant	0.002	0.154***	0.360***	0.006
	(0.015)	(0.034)	(0.108)	(0.010)
Observations	1274	1274	1274	1274
R^2	0.010	0.010	0.010	0.012

Clustered-robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In order to cope with these drawbacks, we will rely on the bracketing property of fixed effect and lagged dependent variable estimations, as discussed by Angrist and Pischke (2008). They show that fixed effects and lagged dependent variable models estimations are upper and lower bounds of the true impact. Following Angrist and Pischke (2008), if the lagged dependent variable model is correct, but we mistakenly use fixed effects, estimates of a positive demobilization effect will tend to be too low. On the other hand, if the fixed effects model is correct and we mistakenly estimate the model with lagged dependent variable, estimates of a positive demobilization effect will tend to be too high[20]. We will therefore present the estimations of both fixed effects and lagged dependent variable models.

[20]This argument relies on the fact that the ex-combatants were richer at baseline. According to our data, FNL rebels were consuming on average 30% more than the control group of non-combatants in 2006, that is, three years before their demobilization.

Standard errors are clustered at the hill level to account for intracluster correlation due to the 2-stage cluster sampling strategy. Sampling weight are accounted for. Furthermore, split-off households are excluded from our main analysis as Verwimp and Bundervoet (2009) showed they are sharply different from their original counterparts. Outliers are excluded from the regressions (see Appendix A for more details).

Table 6: Differential Attrition

Dependent variable: Probability to be sampled in 2010					
	(1)	(2)	(3)	(4)	(5)
# of demobilized in the hill (per 1000 inhab.)					
CNDD+ factions ($S_{i,t-1}^{CNDD+}$)	-0.029	0.136	-0.110	0.120	-0.023
	(0.169)	(0.143)	(0.077)	(0.153)	(0.017)
FNL factions ($S_{i,t}^{FNL}$)	-0.069	-0.137	0.026	0.044	0.012*
	(0.103)	(0.109)	(0.069)	(0.087)	(0.006)
Controls					
Lagged dep. var.	-0.086	-0.057	0.031	0.004	0.728*
	(0.080)	(0.086)	(0.057)	(0.076)	(0.435)
Violent events 2002-2005	-0.081	-0.084	-0.076	-0.081	-0.084
	(0.060)	(0.059)	(0.058)	(0.060)	(0.060)
Interactions					
CNDD+ * Lagged dep. var.	0.008	0.016	-0.003	-0.014	0.179
	(0.011)	(0.012)	(0.009)	(0.016)	(0.118)
FNL * Lagged dep. var.	0.002	-0.017	0.012	-0.004	-0.073***
	(0.018)	(0.016)	(0.009)	(0.009)	(0.023)
CNDD+ * Violent events	-0.000	-0.002	0.002	-0.000	0.008
	(0.006)	(0.006)	(0.007)	(0.011)	(0.008)
FNL * Violent events	0.009	0.010	0.010	-0.003	-0.008
	(0.013)	(0.014)	(0.013)	(0.016)	(0.017)
Constant	1.911**	1.600**	0.859*	1.006	0.978***
	(0.762)	(0.744)	(0.495)	(0.652)	(0.093)
Observations	1190	1202	1115	1234	1237

Differential attrition has been tested for consumption (Column (1)), consumption expenditures (Column (2)), consumption from stocks (Column (3)), non-food spending (Column (4)), and TLU (Column (5)).
Clustered-robust standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Before presenting the results, let us discuss the problems that can arise following the presence of attrition. The analysis of table 2 suggests that attrited households purchase more, have fewer stocks, are smaller and more affected by the conflict. Attrition could bias the estimations through a selection bias, calling into question the randomness of the sample. In our case, attrition is a problem only if it is differential, this is, if an effect could be attributed to an unequal loss of households across the hills with more or less demobilized ex-rebels. In order to test if attrition is differential, we constructed a dummy measuring the probability of being sampled in both rounds. The dummy takes the value 1 if the household was interviewed in 2006 and 2010, and 0 if the household was interviewed in 2006 only. For the five dependent variables considered in this paper, we regressed this dummy on the lagged dependent variable, the demobilization variables and the control variables, as well as on the interactions between them[21]. Attrition is expected to bias the OLS estimation of our models if the coefficients associated with the interaction terms are significantly different from zero. The results of this regression are presented in table 6. The coefficients associated with the interaction terms are mostly not significant, which supports the use of OLS estimators. One coefficient, associated to the interaction between FNL ex-rebels' return and TLU owning in 2006, is however significant. An interpretation of such negative effect is that households owning livestock and living in areas affected by the conflict were more likely to have moved to prevent theft of livestock, which was a common practice by rebel groups. Therefore, in what follows, OLS estimations including TLU as a dependent variable must be treated with caution[22].

4.4. Results

The estimations of the lagged dependent variable model are presented in tables 7 and 8. Results from the fixed effects estimations are summarized in tables 9 and 10.

Lagged dependent variable estimations

Table 7 presents the estimation of the lagged dependent variable model when the dependent variable is the logarithm of the consumption per adult equivalent (consumption expenditures and consumption from stocks). Column (1) only looks at the return of rebels claiming that they belonged to an ex-rebel group and at externalities of the DDR program on non-beneficiaries. In addition to column (1), columns (2) to (4) report the coefficient estimates for having received the reinsertion grant for the three definitions presented in table 3. Column (2) includes ex-combatants who reported to have benefited from the DDR program and are recorded in the official demobilization registers ($D_{i,t-1}^{CNDD1}$ and $D_{i,t}^{FNL1}$). Column (3) adds to this last category the households who did not report any ex-rebels in their household but who include a member whose name, age and sex was matched with the official

[21] In this regression, we have to exclude the variables for which no information is available for the attritors. The variables measuring the direct effect of the demobilization program and the control variable measuring a change of household head as these variables are constructed with 2010 data and therefore excluded.

[22] We did estimate both models (for all dependent variables) using inverse probability weighting (IPW) method, and it led to similar results (not shown in the paper).

demobilization registers ($D_{i,t-1}^{CNDD2}$ and $D_{i,t}^{FNL2}$). Column (4) is based only on self-reported information. It includes ex-combatants who declared having benefited from the demobilization program, even if we were not able find their record in the official demobilization registers ($D_{i,t-1}^{CNDD3}$ and $D_{i,t}^{FNL3}$).

Table 7 shows that the return of ex-rebels has no significant impact on their household consumption per adult equivalent. In contrast, having benefited from the demobilization program seems to have had a large impact on household consumption. In line with the theoretical framework, having a household member who benefited from the FNL demobilization program is associated with higher consumption. The coefficient of the variable $D_{i,t}^{FNL}$, which measures this short-run direct effect, is positive, significant and strikingly high when self-reported information about demobilization status is cross-checked with official demobilization registers (column (2) and (3)). It suggests that the consumption of demobilized FNL households is between 74.3% and 143.7% higher[23] than their consumption levels if they had not been demobilized.

This result is not surprising as demobilized ex-combatants received the equivalent of 18-months salary in cash in a context where savings institutions are poorly functioning. This can explain why their consumption increased by a substantial amount. This result is in line with the findings of Verwimp and Bundervoet (2009) who highlighted the positive short-run impact of the CNDD+ demobilization in 2004-2005 on ex-rebel households. As expected, when the variable $D_{i,t}^{FNL}$ is based on self-reported information (column (4)), the direct impact measured is lower and less significant, which suggests the presence of noise due to misreporting.

What is more surprizing is that the long-run evolution of consumption turns out to be negative for ex-combatants who benefited from the first wave of the DDR program in 2004 and 2005. The coefficient of the variable $D_{i,t-1}^{CNDD+}$ which measures the long-run evolution after having benefited from the CNDD+ demobilization program, is significant and negative. These estimates suggest that, in 2010, the consumption of households who benefited from the demobilization program between 2004 and 2005 is between 39.5% and 47.7% lower than their consumption levels if they had not been demobilized. This suggests first that the short-run positive impact of the cash transfer found by Verwimp and Bundervoet (2009) vanishes in the long run as the money reserve of ex-combatants runs low; and second, that the reintegration phase of the demobilization program, which took place between 2006 and 2008 for CNDD+ ex-combatants, was not strong enough to allow beneficiaries to sustain their level of consumption in the long run.

[23]The dependent variables of the regressions are expressed in log. If the coefficients associated to the explanatory variables are small, the interpretation of the coefficients in terms of percentage is a good approximation. If the coefficients associated to the explanatory variables are large, the interpretation of the coefficients in terms of percentage should be corrected according to the formula: $e^{\text{coef.}} - 1$. In table 7, for example, the coefficients associated to the variable $D_{i,t}^{FNL}$ are large. The correct percentage interpretation is $e^{0.556} - 1 = 74.3\%$ and $e^{0.891} - 1 = 143.7\%$.

Table 7: Lagged dependent variable model - Consumption

Dependent variable: Log cons. per AE in 2010

	(1)	(2)	(3)	(4)
Ex-combatant return in HH				
CNDD+ factions ($R_{i,t-1}^{CNDD+}$)	0.011	0.145	0.125	0.289
	(0.130)	(0.146)	(0.139)	(0.180)
FNL factions ($R_{i,t}^{FNL}$)	0.179	0.019	0.087	0.065
	(0.168)	(0.214)	(0.192)	(0.257)
Demobilized in HH				
CNDD+ factions ($D_{i,t-1}^{CNDD+}$)		-0.648***	-0.502**	-0.549**
		(0.222)	(0.201)	(0.233)
FNL factions ($D_{i,t}^{FNL}$)		0.891**	0.556***	0.307
		(0.371)	(0.126)	(0.369)
# of demobilized in the hill (per 1000 inhab.)				
CNDD+ factions ($S_{i,t-1}^{CNDD+}$)	-0.011*	-0.011*	-0.012*	-0.011
	(0.006)	(0.006)	(0.006)	(0.007)
FNL factions ($S_{i,t}^{FNL}$)	0.011**	0.012**	0.012**	0.012***
	(0.004)	(0.005)	(0.005)	(0.004)
Controls				
Lagged dep. var.	0.172***	0.179***	0.185***	0.177***
	(0.033)	(0.038)	(0.039)	(0.037)
Violent events 2002-2005	-0.029	-0.037	-0.036	-0.035
	(0.027)	(0.029)	(0.028)	(0.028)
Violent events 2006-2009	0.070*	0.070	0.071	0.070
	(0.041)	(0.043)	(0.043)	(0.043)
Different HH head	0.068	0.067	0.057	0.066
	(0.070)	(0.071)	(0.075)	(0.072)
Constant	7.647***	7.588***	7.528***	7.595***
	(0.315)	(0.363)	(0.368)	(0.355)
Observations	980	969	969	969
R^2	0.050	0.052	0.053	0.049

Column (1) reports the OLS estimates for the impact of having ties with the factions and having returned home, as well as the spillovers effects, on consumption per adult equivalent. Column (2) to (4) report, in addition to column (1), the coefficient estimates for having received the reinsertion grant according to the three definitions presented in table 3: column (2) includes recorded ex-combatants ($D_{i,t-1}^{CNDD1}$ and $D_{i,t}^{FNL1}$), column (3) includes recorded and matched ex-combatants ($D_{i,t-1}^{CNDD2}$ and $D_{i,t}^{FNL2}$) and column (4) includes self-declared ex-combatants, recorded or not ($D_{i,t-1}^{CNDD3}$ and $D_{i,t}^{FNL3}$). Clustered-robust standard errors are in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7 also highlights the evidence of spillovers of the DDR program affecting non-recipient households. As predicted by the theoretical framework, the coefficient associated with the proportion of ex-FNLs in the hill, $S_{i,t}^{FNL}$, is positive and statistically significant. This suggests that households living in hills with a large number of demobilized ex-rebels benefited from externalities.

By contrast, the coefficient of the variable $S_{i,t-1}^{CNDD+}$ is negative and significant at the 10% level. This shows that in the long run, households living in areas with numerous CNDD+ ex-combatants consume on average less in 2010 than households who had a similar standard of living in 2006 and who live in areas with few CNDD+ ex-combatants. The size of the coefficients associated with the variables $S_{i,t}^{FNL}$ and $S_{i,t-1}^{CNDD+}$ are similar, but of opposite sign (F-test p-value = 0.71). This suggests that the positive spillovers of the DDR program vanish in the long run, as the economy returns to its steady state. Section 5 discusses possible channels for the spillovers.

Finally, the coefficient associated with the lagged dependent variable is positive but lower than one. This shows that consumption growth was higher for households who were worst-off in 2006. This can be explained by a catch-up effect, which is in line with the convergence literature. Coefficients associated with the violence variables are not significant, which may reflect the fact that the conflict was less violent from 2005 onwards (figure 6). The positive coefficient of the variable measuring the number of violent events in the hill between 2006 and 2009 is positive and non significant. The positive sign may be due to reverse causality, as forcible extortion of money or goods by rebel groups sometimes occurred.

Table 8 displays the estimates of the lagged dependent model for the four other economic outcomes we measured. This table relies on the first definition of demobilized ex-combatants, that is, the one using self-reported information cross-checked with the official demobilization registers ($D_{i,t-1}^{CNDD+1}$ and $D_{i,t}^{FNL1}$ in table 3). As in table 7, the use of the other definitions leads to similar results (not shown). When self-reported information is used, the results are weakened by the presence of noise.

The presence of a positive effect of the DDR program is also noticeable in table 8. Consumption expenditures, consumption from stocks and non-food spending increase in households who benefited from the FNL demobilization program. The effects are large and statistically significant. Consumption purchases of ex-FNL households are on average 100% higher than if they had not been demobilized. Similarly, consumption from stocks is 179.5% higher, non-food purchases are 95.8% higher and the total livestock units are 19.4% higher.

The coefficient associated with the long-run direct impact of demobilization variable, $D_{i,t-1}^{CNDD+1}$, exhibits striking patterns. When the dependent variables represents money spending, as for consumption or non-food purchases, the coefficients of the variable $D_{i,t-1}^{CNDD+1}$ are negative, significant and of high absolute value. For these economic outcomes, the coefficient associated with the CNDD+ demobilization are of opposite sign to those associated with FNL demobilization, but of similar size. This suggests that the positive impact of the

Table 8: Lagged dependent variable model - Disagregated consumption, non-food current spendings and Tropical livestock Units (TLU)

	(1) Log cons. expenditures per AE	(2) Log cons. from stocks per AE	(3) Log non-food spending per AE	(4) Log TLU
Ex-combatant return in HH				
CNDD+ factions ($R_{i,t-1}^{CNDD+}$)	0.288	-0.004	0.125	0.017
	(0.197)	(0.277)	(0.229)	(0.042)
FNL factions ($R_{i,t}^{FNL}$)	0.170	-0.368	0.164	-0.060***
	(0.219)	(0.455)	(0.222)	(0.015)
Demobilized in HH				
CNDD+ factions ($D_{i,t-1}^{CNDD+}$)	-1.002***	-0.052	-0.754**	0.017
	(0.280)	(0.526)	(0.313)	(0.043)
FNL factions ($D_{i,t}^{FNL}$)	0.693***	1.028*	0.672***	0.177*
	(0.228)	(0.594)	(0.233)	(0.092)
# of demobilized in the hill (per 1000 inhab.)				
CNDD+ factions ($S_{i,t-1}^{CNDD+}$)	-0.019*	-0.002	-0.025***	-0.003***
	(0.009)	(0.014)	(0.008)	(0.001)
FNL factions ($S_{i,t}^{FNL}$)	0.022***	0.011	0.021***	0.002***
	(0.004)	(0.015)	(0.004)	(0.001)
Controls				
Lagged dep. var.	0.205***	0.138***	0.210***	0.139**
	(0.038)	(0.042)	(0.037)	(0.054)
Violent events 2002-2005	0.013	-0.089***	0.009	0.005*
	(0.038)	(0.032)	(0.039)	(0.003)
Violent events 2006-2009	0.092	0.025	0.094	-0.004
	(0.055)	(0.056)	(0.057)	(0.005)
Different HH head	0.131**	0.132	0.113**	-0.004
	(0.052)	(0.108)	(0.052)	(0.016)
Constant	6.743***	7.228***	6.850***	0.066***
	(0.332)	(0.381)	(0.296)	(0.006)
Observations	985	796	986	968
R^2	0.088	0.046	0.093	0.043

Note that this table reports OLS estimates for each economic outcomes using the first definition of the demobilization status. Regressions consider only recorded demobilized ex-combatants ($D_{i,t-1}^{CNDD1}$ and $D_{i,t}^{FNL1}$). Clustered-robust standard errors are in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

DDR program on expenses vanishes in the long run, as the money reserve of ex-combatants runs low. On the contrary, for variables associated with asset holdings, the long-run evolution is close to 0. The coefficients of consumption from stocks, which stands for agricultural production, is low and not significant. Similarly, the coefficient of livestock units is not significant and low. As in our theoretical framework, the consumption boom following the DDR program does not last in the long run as ex-combatants run out of money. However,

this negative evolution is not observed for productive assets, which are durable and therefore still available five years after the demobilization program.

The results we find for the externalities of the DDR program are consistent with this picture. The externalities of the FNL demobilization on non-beneficiaries are positive - around 2% - and significant for consumption expenditures and non-food purchases. Again, the long-run evolution of these externalities, measured by the impact of the CNDD demobilization, is of similar size but of opposite sign (F-test p-value = 0.75 and 0.65). For variables related to productive assets, coefficients are lower, but also positive in the short run. More specifically, the coefficient associated with consumption from stocks is positive and not significant, which suggests that sales of land were marginal, and did not affect significantly the agricultural production of non-beneficiaries. In the long run, there is almost no evolution related to consumption from stocks and total livestock units, which is consistent with this argument.

In summary, the lagged dependent variable model shows that the short-run impact of the demobilization of ex-combatants is positive for recipients, and also, to a lesser extent, for non-recipients. In the long run, the positive impact on purchases seems to vanish as ex-combatants run out of money. In contrast, the positive short-run effect is not counterbalanced by a negative long-run evolution for economic outcomes related to asset holdings, measured by consumption from stocks and livestock units.

Fixed effects estimation

Table 9 and 10 show the results of the fixed effects estimation. Before discussing them, let us come back to the interpretation of coefficients of the first-difference equation (equation (21)). In section 4.3, we have shown that the sign of the coefficients associated with the CNDD+ variables are expected to be of opposite sign compared to the coefficients of the lagged dependent variable model. Indeed, the dummy variables $R_{i,t}^{CNDD+}$ and $D_{i,t}^{CNDD+}$ are equal to 1 in 2006 if a member of the household is an ex-rebels from a CNDD+ armed group, and equal to 0 in 2010. It follows that $\Delta R_{i,t}^{CNDD+}$ and $\Delta D_{i,t}^{CNDD+}$ are equal to -1 when the household hosts an ex-CNDD+. Therefore, a positive coefficient associated with these variables implies a negative evolution between 2006 and 2010. The intuition is similar for the construction of $\Delta S_{i,t}^{CNDD+}$: a positive coefficient associated with this variable implies a negative evolution of the externalities of the DDR program between 2006 and 2010. For the coefficients of the variables $\Delta R_{i,t}^{FNL}$, $\Delta D_{i,t}^{FNL}$ and $\Delta S_{i,t}^{FNL}$, the interpretation is as usual, and similar to the lagged dependent variable model: a positive coefficient implies a positive short-run effect of the DDR program.

Having made these points, let us analyze the results of table 9 and 10 and compare them to the lagged dependent variable model.

Overall, the fixed effects model leads to similar conclusions than the lagged dependent variable model. Table 9 shows that the coefficient associated with the FNL demobilized dummy $\Delta D_{i,t}^{FNL}$ is large and positive when self-reported demobilization was cross-checked with official registers (column (2) and (3)). Given time-invariant unobserved heterogeneity,

Table 9: Fixed effects model - Consumption

Dependent variable: Δ *Log cons. per AE*

	(1)	(2)	(3)	(4)
Δ *Ex-combatant return in household*				
CNDD+ factions ($\Delta R_{i,t-1}^{CNDD+}$)	-0.293	0.089	0.080	0.045
	(0.460)	(0.164)	(0.165)	(0.252)
FNL factions ($\Delta R_{i,t}^{FNL}$)	0.133	0.061	0.068	0.193
	(0.301)	(0.330)	(0.329)	(0.416)
Δ *Demobilized in household*				
CNDD+ factions ($\Delta D_{i,t-1}^{CNDD+}$)		0.776***	0.662**	0.415
		(0.277)	(0.268)	(0.350)
FNL factions ($\Delta D_{i,t}^{FNL}$)		0.776	0.837**	0.018
		(0.662)	(0.353)	(0.495)
Δ *# of demobilized in the hill (per 1000 inhab.)*				
CNDD+ factions ($\Delta S_{i,t-1}^{CNDD+}$)	0.014***	0.013**	0.014**	0.012**
	(0.005)	(0.005)	(0.006)	(0.005)
FNL factions ($\Delta S_{i,t}^{FNL}$)	-0.002	-0.002	-0.002	-0.003
	(0.004)	(0.004)	(0.004)	(0.004)
Δ *Controls*				
Violent events	0.026	0.061**	0.059**	0.059**
	(0.024)	(0.027)	(0.027)	(0.027)
Different HH head	0.082	-0.023	-0.036	-0.026
	(0.089)	(0.067)	(0.072)	(0.067)
Constant	9.340***	9.317***	9.314***	9.320***
	(0.025)	(0.025)	(0.025)	(0.025)
Observations	2240	2217	2217	2217
R^2	0.010	0.029	0.035	0.026

Column (1) reports the fixed effect estimates for the impact of having ties with the factions and having returned home, as well as the spillovers effects, on consumption per adult equivalent. Column (2) to (4) report, in addition to column (1), the coefficient estimates for having received the reinsertion grant according to the three definitions presented in table 3: column (2) includes recorded ex-combatants ($D_{i,t-1}^{CNDD1}$ and $D_{i,t}^{FNL1}$), column (3) includes recorded and matched ex-combatants ($D_{i,t-1}^{CNDD2}$ and $D_{i,t}^{FNL2}$) and column (4) includes self-declared ex-combatants, recorded or not ($D_{i,t-1}^{CNDD3}$ and $D_{i,t}^{FNL3}$). Clustered-robust standard errors are in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

the consumption of households who benefited from the demobilization program in 2009 is between 117.3% and 130.9% higher than if they had not been demobilized. Again, the results are hampered when the estimation is based only on self-reported information, confirming the presence of noise. The impact of the DDR program is also positive and large for the

Table 10: Fixed effects model - Disagregated consumption, non-food current spendings, Tropical livestock Units (TLU)

	(1) Δ Log cons. exp. per AE	(2) Δ Log cons. stocks per AE	(3) Δ Log non-food exp. per AE	(4) Δ Log TLU
Δ *Ex-combatant return in household*				
CNDD+ factions ($\Delta R_{i,t-1}^{CNDD+}$)	-0.024	-0.007	0.071	-0.007
	(0.193)	(0.320)	(0.241)	(0.046)
FNL factions ($\Delta R_{i,t}^{FNL}$)	0.231	-0.343	0.367	-0.083
	(0.440)	(0.524)	(0.477)	(0.053)
Δ *Demobilized in household*				
CNDD+ factions ($\Delta D_{i,t-1}^{CNDD+}$)	0.739***	0.292	0.375	-0.001
	(0.264)	(0.782)	(0.315)	(0.094)
FNL factions ($\Delta D_{i,t}^{FNL}$)	0.409	1.132**	0.302	0.062
	(0.590)	(0.555)	(0.605)	(0.146)
Δ *# of demobilized in the hill (per 1000 inhab.)*				
CNDD+ factions ($\Delta S_{i,t-1}^{CNDD+}$)	0.023***	-0.003	-0.006	0.003*
	(0.005)	(0.011)	(0.010)	(0.002)
FNL factions ($\Delta S_{i,t}^{FNL}$)	0.000	-0.002	0.026***	0.001
	(0.003)	(0.007)	(0.009)	(0.001)
Δ *Controls*				
Violent events	-0.017	0.109***	-0.156***	-0.005
	(0.024)	(0.035)	(0.036)	(0.004)
Different HH head	-0.004	0.119	0.358***	0.001
	(0.078)	(0.112)	(0.081)	(0.023)
Constant	8.665***	8.277***	8.355***	0.083***
	(0.024)	(0.030)	(0.044)	(0.007)
Observations	2235	2005	2264	2242
R^2	0.016	0.014	0.133	0.008

Note that this table reports fixed effects estimates for each economic outcomes using the first definition of the demobilization status. Regressions consider only recorded demobilized ex-combatants ($D_{i,t-1}^{CNDD1}$ and $D_{i,t}^{FNL1}$). Clustered-robust standard errors are in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

four other economic outcomes (table 10). However, the statistical significance of estimated coefficients is reduced because of increased standard errors. This reduced precision is due to loss of variation in the variable of interest after first differencing (Angrist and Pischke, 2008).

The long-run direct impact we measure with the fixed effects method is consistent with the results of the lagged dependent variable model. The positive short-run impact of the DDR program seems to vanish in the long run. Given time-invariant unobserved heterogeneity, the consumption of households who benefited from the demobilization program in 2004

or 2005 is between 48.3% and 54% lower on average than if they had not been demobilized. Table 10 shows that the long-run evolution is also negative for other economic outcomes, especially for consumption purchases, which is consistent with the view that ex-rebels are not able to sustain their high level of consumption in the long run as their money reserve exhausts over time.

Externalities of the demobilization program are also captured by the fixed effects estimator. The coefficient associated with externalities of the DDR program in the short run, $\Delta S_{i,t}^{FNL}$, is only significant for non-food spending (and positive). The long-run evolution of the DDR externalities is negative and significant for the consumption aggregate, as well as for consumption purchases.

Overall, the lagged dependent model and the fixed effects model lead to similar findings. The demobilization program which took place in Burundi has a positive impact in the short run, both on beneficiaries and non-beneficiaries. However, this positive impact seems to vanish in the long run, especially for economic outcomes related to money holdings. The DDR program in Burundi seems to have generated a short-run economic boom in villages hosting numerous ex-combatants. However, this positive economic environment has become sluggish over time, as the surplus of money brought by demobilized ex-combatants gradually fled outside the local economy. Going back to the theoretical framework, these results suggest that the consumption scenario prevails over the other scenarios. The effect of the reintegration phase of the program seems to be marginal for the CNDD+. In general, the results of lagged dependent variable model are more clear-cut because the increased variation in the variables of the model reduces standard errors. According to the bracketing property of lagged dependent variable and fixed effects estimators, the real value of the parameters is expected to range between the estimates of the two models (Angrist and Pischke, 2008).

5. Channels

In this section, the econometric analysis is extended to identify through which channels of transmission the externalities affect the non-beneficiaries of the DDR program. The channels depend on how the money of the DDR program is spent, as discussed in section 3. We will first discuss how prices have evolved following the demobilization of ex-combatants in table11. Then, table 12 presents how the impact differs according to the occupation of the head of household, distinguishing shopkeepers, farmers and construction workers.

Prices

The theoretical framework predicts that the impact of the program on prices of locally produced goods is positive in the short run. In hills with numerous demobilized ex-combatants, prices of locally produced goods should have risen following an increase in demand for consumption goods. The impact on the prices of imported goods is unknown, and ultimately depends on the cost structure and the competition faced by resellers. In the longer run, prices should converge to their steady-state level.

Table 11 reports OLS estimates for the impact of the demobilization program on the price paid per kg for different products. When analyzing the impact of the program on prices, we will only concentrate on the indirect effect, which may have been induced by a change in prices on the market. In particular, we would like to know how prices have evolved given the intensity of return in the villages. The estimates are reported at the hill level. Starting from a database in which one observation is one purchase of one household, we computed the median of the log price paid per kg in each hill for each product. Aggregating information at the hill level using median prices increases the likelihood of having data for both years[24] and reduces noisy information due to measurement errors. The estimation in column (1) includes all products; it relies on a lagged dependent variable model with product fixed effects. Column (3) to (10) present the estimates of the lagged dependent variable model for the most consumed goods.

The results presented in column (1) of table 11 suggest that prices were slightly (but significantly) higher in the hills with more demobilized FNL ex-combatants. In contrast, prices are lower in hills with more CNDD+ demobilized ex-combatants.

Let us turn to an analysis by product, and distinguish goods that are produced locally (columns (2) to (9)) from those that are imported from capital Bujumbura (column (10)). For locally produced goods, our estimates interestingly suggest that the price of traditional drinks drives the positive effect of the proportion of FNL rebels in hills on prices. For hills of similar price level in 2006, one additional FNL ex-rebel per 1000 population translates into a 2.9% higher price for traditional drinks. This suggests that traditional drinks were bought by ex-combatants following the sudden increase in cash on hand. The price of meat also seems to be higher in hills with a high proportion of demobilized ex-FNLs, although this relationship is only weakly significant. Turning to CNDD+ demobilization, in column (3) to (6), we observe that prices are lower in hills where CNDD+ were demobilized. The prices of fish, meat and rice were particularly lower in hills where CNDD+ ex-rebels live. This may reflect the fact that prices of locally produced goods return to their steady state after the short-run economic boom induced by the DDR program in 2004-2005.

The impact of the DDR program on the prices of imported goods seems to be of opposite sign. Beer is the only good which is not produced locally for which we have a decent number of observations. The last column shows that the price of beer is on average lower in hills with a high proportion of demobilized FNLs. The low number of observations may explain the low significance associated with this coefficient. In contrast, in hill with a high proportion of ex-CNDD+ ex-combatants, the price of beers is on average higher.

The opposite price reaction between locally produced goods and goods that are imported from the capital may be explained by an enhanced competition between resellers of imported goods. First, resellers may have reduced their prices in order to grab the increased demand

[24]Performing these estimations at the household level implies excluding the households that did not consume a product one or the other year.

Table 11: Channels - Indirect effect and price effect (Price paid per kg)

Dependent variable: Log price paid per kg in 2010

	(1) All products	(2) Traditional drinks	(3) Manioc	(4) Rice	(5) Beans	(6) Tomatos	(7) Sweet potatoes	(8) Fish	(9) Meat	(10) Beers
# of demobilized in the hill (per 1000 inhab.)										
CNDD+ factions ($S_{i,t-1}^{CNDD+}$)	-0.005**	0.006	-0.001	-0.019***	-0.006*	-0.014+	-0.004	-0.024**	-0.018**	0.044**
	(0.002)	(0.008)	(0.004)	(0.004)	(0.003)	(0.010)	(0.008)	(0.010)	(0.007)	(0.021)
FNL factions ($S_{i,t}^{FNL}$)	0.003**	0.029***	0.002	0.002	-0.001	-0.003	0.002	0.006	0.007+	-0.021+
	(0.002)	(0.010)	(0.003)	(0.003)	(0.003)	(0.008)	(0.007)	(0.008)	(0.005)	(0.016)
Controls										
Log price paid per kg in 2006	0.060***	0.057	-0.001	0.285***	0.104	0.050	0.035	0.038	0.034	0.074
	(0.018)	(0.097)	(0.069)	(0.098)	(0.093)	(0.064)	(0.069)	(0.089)	(0.077)	(0.097)
Violent events 2002-2005	-0.004	-0.036*	0.007	-0.014+	-0.005	-0.029	0.013	0.010	-0.055**	-0.065
	(0.006)	(0.021)	(0.014)	(0.012)	(0.010)	(0.031)	(0.025)	(0.029)	(0.021)	(0.056)
Violent events 2006-2009	0.041***	0.036	0.013	0.032+	0.036*	-0.043	0.081+	0.052	0.086**	0.173**
	(0.012)	(0.049)	(0.025)	(0.024)	(0.020)	(0.061)	(0.050)	(0.059)	(0.041)	(0.081)
Constant	6.394***	5.361***	6.351***	5.042***	6.142***	6.272***	5.552***	8.355***	7.950***	6.498***
	(0.120)	(0.544)	(0.390)	(0.636)	(0.573)	(0.367)	(0.354)	(0.635)	(0.553)	(0.615)
Product FE	Yes	No	No	No	No	No	No	No	No	No
Observations	2080	78	80	77	84	80	78	83	81	50
R^2	0.852	0.219	0.017	0.331	0.130	0.075	0.080	0.114	0.187	0.164

These regressions are performed at the hill level, using the median of the log price paid per kg by households in each hill. Note that for some products, there were no purchases in certain hills, which implies less observations. Clustered-robust standard errors are in parentheses.
$^{+}$ $p < 0.25$,* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

for imported goods following the DDR program. Second, some demobilized ex-combatants reported having invested their DDR allowance in a small shop, which may also have increased competition and thereby reduced prices.

In sum, the results of table 11 suggest that prices of locally produced goods increased in the short run following the higher demand induced by the DDR program. In line with the consumption story of our theoretical framework, prices of locally produced goods are expected to converge to their initial level in the long run as the money of the DDR program escapes the local economy. In contrast, the prices of goods that are imported from Bujumbura may have decreased in the short run following the higher demand due to the DDR cash inflow. This may be due to an enhanced competition between resellers. Again, prices of imported goods are expected to return to their steady state as the money of the DDR program runs low.

Occupation

In this section, we investigate whether there is a difference in impact according to households' main occupation. Recall that the allowances of the DDR program were mostly spent in consumption goods, land or productive assets. In the theoretical model, we have discussed the impact following such choice for both farming households and resellers (section 3). We highlighted that the indirect impact of the DDR program on non-beneficiaries may vary according to households' main occupation.

We grouped households according to five categories of occupations: farming, shopkeeper, construction, public sector and extractive activity. We define main occupation as the occupation of the household member who generated the highest income during the last year. For the sake of comparison, column (1) of table 12 reproduces the results obtained with the lagged dependent variable model for total consumption (table 7, column (2)). Column (2) additionally adds the dummies capturing the main occupation of households. The dummy for farming activity - which comprises 78% of households - is omitted. This regression shows that households working in construction are on average richer in 2010 than farming households who had a similar standard of living in 2006. Similarly, shopkeepers and households with a member working in the public sector consume on average more, although these relationships are only weakly significant.

Column (3) additionally includes the interaction terms between the occupational status of households and the proportion of demobilized ex-combatants in each hill. Introducing these interactions allows us to capture the differential impact of the DDR program on non-beneficiaries, depending on the main income generating activity of households. This regression highlights the heterogeneous impact of the DDR program on non-beneficiaries through spillovers. In the short run, non-recipient households consumed on average more in villages where FNL returns were higher, with the notable exception of shopkeeper households. The coefficient associated with the interaction between shopkeeper activity and the proportion of FNL ex-combatants is negative and significant at the 10% level. An F-test cannot reject

Table 12: Channels - Indirect effect and sector of activity

Dependent variable: Log consumption per AE in 2010

	(1)	(2)	(3)
Ex-combatant return in HH			
CNDD+ factions ($D_{i,t-1}^{CNDD+}$)	0.145	0.140	0.119
	(0.146)	(0.150)	(0.156)
FNL factions ($D_{i,t}^{FNL}$)	0.019	0.030	0.008
	(0.214)	(0.227)	(0.231)
Demobilized in HH			
CNDD+ factions ($S_{i,t-1}^{CNDD+}$)	-0.648***	-0.744***	-0.749***
	(0.222)	(0.221)	(0.264)
FNL factions ($S_{i,t}^{FNL}$)	0.891**	0.807*	0.647^{+}
	(0.371)	(0.413)	(0.478)
# of demobilized in the hill (per 1000 inhab.)			
CNDD+ factions ($R_{i,t-1}^{CNDD+}$)	-0.011*	-0.011*	-0.014**
	(0.006)	(0.006)	(0.006)
FNL factions ($R_{i,t}^{FNL}$)	0.012**	0.013***	0.014***
	(0.005)	(0.004)	(0.004)
Occupation of the head of HH			
Shop keeper		0.205^{+}	0.183
		(0.139)	(0.176)
Construction		0.440***	0.362**
		(0.131)	(0.180)
Extractive activities		-0.145	-0.171
		(0.229)	(0.322)
Public services		0.147	-0.143
		(0.144)	(0.161)
Channel			
CNDD+ * Shop keeper			0.031^{+}
			(0.027)
CNDD+ * Construction workers			-0.054
			(0.083)
CNDD+ * Extractive act.			0.030
			(0.035)
CNDD+ * Public			0.059^{+}
			(0.041)
FNL * Shop keeper			-0.019*
			(0.010)
FNL * Construction			0.075
			(0.105)
FNL * Extractive act.			-0.008
			(0.014)
FNL * Public			0.003
			(0.045)
Constant	7.588***	7.493***	7.505***
	(0.363)	(0.458)	(0.448)
Observations	969	969	969
R^2	0.052	0.073	0.078

Clustered-robust standard errors in parentheses

$^{+}$ $p < 0.25$, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

the null hypothesis of no indirect impact on shopkeepers (F-test p-value = 0.47). Again, in the long run, the results are reversed. A higher proportion of CNDD+ demobilized ex-combatants is associated with a lower consumption in 2010 for farming households and for households working in construction. In contrast, the coefficient associated with the interaction between shopkeeper activity and the proportion of CNDD+ ex-combatants is positive but only weakly significant. An F-test cannot reject the null hypothesis of no indirect impact on shopkeepers in the long run (F-test p-value = 0.51). These results suggest that shopkeepers were not able to grab the benefits from the DDR program. Interestingly, public sector employees seem to be better off in hills characterized by a higher proportion of ex-CNDD+. This is not surprising if we remember that the actual president of Burundi, Pierre Nkurunziza, is the former leader of the CNDD-FDD rebel group; public employees working in hills with numerous CNDD+ ex-combatants may have been favored following his election in 2005.

The broad picture that emerges from this analysis is consistent with the theoretical model and with prices regressions. In the short run, the return of demobilized ex-combatants increased the demand for consumption goods. Following this increase in demand, the price of locally produced goods increased, which thereby increased the revenue of farming households. In contrast, the prices of goods that are imported from Bujumbura have decreased because of an enhanced competition between the resellers of these goods. The total impact of the increased demand for imported goods and their price drop on resellers' revenue is unknown. By contrast, for farming households, the resulting impact of the DDR program is a consumption increase and a rise in their purchasing power as their revenue increases more than prices. In the long run, the effects are reversed as the money received by ex-combatants escapes the local economy and the economy converges to its steady state.

6. Concluding remarks

Burundi is recovering from a civil war that lasted more than a decade. The armed conflict ended in 2009 by the voluntary demobilization of the last Hutu rebel group, the Palipehutu-FNL. In exchange for laying down their arms, ex-combatants received reinsertion allowances equivalent to an 18-month salary. Four years before, another Hutu rebel group, the CNDD-FDD, had benefited from the same allocations, and additionally received in-kind payments between the two peace agreements.

In this paper, we assessed the impact of this disarmament, demobilization and reintegration program implemented in post-conflict Burundi. First, we developed a theoretical model in order to predict the impact of demobilization cash transfers on beneficiary and non-beneficiary households. Then, we used a panel dataset collected in 2005, 2006 and 2010 in three rural provinces heavily affected by the conflict. Our objectives was to assess the short- and long-run impacts of the demobilization program on ex-rebel economic outcomes, but also to measure the externalities that may have affected civilian households.

Our empirical analysis highlights the positive and significant impact of the demobilization program on ex-combatant households in the short run. We also show that the large amounts of money which were introduced in the local economy through the demobilization program have generated an economic boom in the short run. Thereby, households who did not participate actively in the conflict also gained, indirectly, from the demobilization program. These positive spillovers may have favored the acceptance of ex-combatants in their host communities, which is crucial for peace to sustain. In the long run, however, the positive impact of the DDR on beneficiaries and the positive externalities on non-beneficiaries seem to vanish, as the money reserve of demobilized ex-combatants runs low.

Our study supports the reinsertion program implemented in post-conflict countries as a short-run strategy to reduce the risk of relapse into conflict by alleviating poverty of both recipient and non-recipient households. It further encourages communities to support the return of ex-combatants. However, our results suggest that the reinsertion phase is not sufficient for creating a virtuous circle towards development and peace as the positive impact of cash transfers is short-lived. Further work is needed in order to understand why the reintegration phase fails to help ex-combatants to engage in a productive activity, and thereby, to reduce their chances to take up arms.

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Appendix A. The construction of consumption aggregates

In this appendix, we describe how we cleaned the data, and constructed the relevant consumption aggregates for our analysis. First, we introduce the construction of the reference price vector and the local price vectors associated to each household. Second, we explain in detail how we corrected typing mistakes, how we treated missing and vague information and how we dealt with outliers. Finally, we describe the construction of our main consumption measure which is a consumption aggregate per adult equivalent calculated using constant prices.

Appendix A.1. Prices

Prices faced by households are crucial in each stage of our analysis. First, in the data cleaning process, prices are determinant to fill missing information as well as to detect and correct outliers. Second, in the construction of consumption aggregates, prices are used to make consumption data comparable across space and time. Following Deaton and Zaidi (2002), the harmonization of consumption data is done by scaling consumption value by a Paasche index of prices. Finally, finding a price increase in primary units where demobilized ex-combatants are numerous would corroborate the hypothesis that positive spillovers of the DDR program are due to a local economy effect.

We distinguish two sets of prices. On the one hand, the reference price matrix, denoted p^0, is a 47×1 vector such that each line is a reference price for one of our 47 consumption products. This matrix is common for all households and both periods of time. We used the 2010 panel survey as the reference year. For each one of the 47 products, the reference price was computed as follows. First, the most widely used unit of measurement was selected by considering the entire sample. In this process, we excluded vague[25] and wrong[26] units of measurement whose conversion into kilos is ambiguous. Second, the median price per unit was computed for this most used unit, and converted into kilos.

On the other hand, hill prices faced by each household are denoted p^h. These 47×1 vectors are different for each one of the 85 hills and for each periods of time. These local prices were computed as follows. Our survey distinguishes 4 levels of administrative subdivision: the whole survey area is divided into 3 provinces, 22 communes and 85 hills. For each hill and for each one of the 47 consumption products, the most used measurement unit was selected (still by excluding vague and wrong units of measurement). If this unit was used 10 times or more at the hill level, we computed the median price per unit, further converted into a median price per kilo. Conversely, if the most used unit was reported less than 10 times at the hill level, we followed the same procedure but at the commune level. Again, if the most used unit at the commune level was reported less than 10 times, the procedure was adapted at the province level. If less than 10 households reported a similar unit at the province level, then the procedure was done for the whole sample, even if no unit was used more than 10 times.

[25] For example a basket, a pile or a pan.

[26] For example, a stere of meat or a liter of batteries.

Appendix A.2. Correction of errors and outliers

In the correction process, we distinguished three types of manipulations: the correction of mistakes, the completion of missing data and the treatment of outliers. First, we deeply reviewed the data manually in order to find and correct typical mistakes such as the double entry of a number or the inversion between the code of the unit and the quantity. For few ambiguous cases, we replaced the suspicious information by a missing value.

Second, missing information was extrapolated in two cases. On the one side, if the amount spent for one consumption good was available and if the quantity or the unit (or both) were missing, the quantity consumed per kilo was calculated by dividing the amount spent by the local price per kilo p^h. On the other side, if both the quantity and the measurement unit were reported but the amount paid was missing, this amount was imputed by multiplying the quantity consumed by the local price p^h expressed in the same unit. All other cases were considered as zero.

Finally, we looked for outliers and we corrected them. In order to identify the outlying observations, we computed the price paid per kilo for each household and each product by dividing the amount paid by the quantity consumed previously converted into kilos. By denoting Q1, Q2 and Q3 the first quartile, the median and the third quartile respectively, we define an outlier as an observation whose price paid per kilo lies outside the following fences (Hubert and Vandervieren, 2008):

$$[Q_1 - k_1(Q_2 - Q_1); Q_3 + (Q_3 - Q_2)] \text{ with } k_1 = k_2 = 3. \tag{A.1}$$

For such observations, we then identified whether the amount paid or the quantity consumed was responsible for this extreme deviation from the median. On the one hand, if the amount paid was identified as extreme, it was replaced by multiplying the quantity consumed by the local price. On the other hand, if the quantity consumed was identified as the outlier, then the quantity consumed was replaced by the amount paid divided by the local price per kilo.

Appendix A.3. Construction of consumption aggregates

In order to construct consumption aggregates and to render these comparable between households in the two surveys, we constructed for each household what Deaton and Zaidi (2002) call a money metric utility. This consumption measure, denoted u^h, corresponds to the minimum cost for reaching a certain level of utility. Following Deaton and Zaidi (2002), the money metric utility u^h can be approximated by the inner product of reference prices p^0 and the quantity consumed q^h, or equivalently, by adding up all the household's expenditures and dividing by a Paasche index of prices P_P^h:

$$u_m^h \approx p^0 \cdot q^h = \frac{x^h}{P_P^h} \text{ with } P_P^h = \frac{p^h \cdot q^h}{p^0 \cdot q^h}. \tag{A.2}$$

In order to construct this consumption indicator, we proceeded in three steps. First, we computed household's total expenditures by adding up food expenses to the value of self-consumption and gifts. For each good, our questionnaire asked the quantity self-consumed and the quantity received as a gift, but not an estimate of their value. Hence, the value of self-consumption and gifts were calculated by multiplying the quantity converted into kilos by its local price.

In the second step, we built the Paasche index P_P^h whose goal is to deflate household expenditures through the use of reference prices, therefore allowing comparisons across space and time. In order to construct the Paasche index, we used the following approximation (Deaton and Zaidi, 2002):

$$\ln P_P^h \approx \sum w_k^h ln(\frac{p_k^h}{p_k^0}), \tag{A.3}$$

where w_k^h is the share of household h's budget devoted to good k.

In the third step, the money metric utility at the household level is calculated by dividing household's total expenditures by the Paasche index. In order to obtain a measure of individual purchases, the household money metric utility has to be adjusted by taking into account household size. If each household member would consume an equal share of the household total expenditures, we could think about dividing consumption by household size. There are however differences between adults and children consumption. We should also correct for economies of scale inside the households, arising from the distinction between private consumption such as food consumption, and public good enjoyment such as housing expenditures. Still following Deaton and Zaidi (2002), we computed different equivalence scales, which will be confronted against each other for robustness checks.

Adult equivalents are calculated according to the following formula:

$$AE = [(1 + \beta(A - 1)) + \alpha K]^\theta, \tag{A.4}$$

where A is the number of adults and K the number of children in the household. The parameter α is the cost of a child relative to that of an adult. It is assumed to be low in developing countries because expenditures are mainly associated to food consumption. The parameters β and θ both account for economies of scale in household expenditures. On the one side, the parameter β assigns a weight to all adults but one, which is weighted as 1. On the other side, θ measures the elasticity of adult equivalents with respect to effective household size. As suggested in Deaton and Zaidi (2002), we use the following benchmark values for the parameters: $\alpha = 0.3$, $\beta = 1$ and $\theta = 0.9$. The final money metric utility per adult equivalent used in our main empirical analysis is simply equal to the household money metric utility divided by the number of adult equivalents.

Appendix B. Mathematical appendix

Appendix B.1. Competition between resellers and price band

Trade in the global market is organized by resellers who compete to sell and buy the three goods. The price of the three goods in the capital city is denoted $p_w > 0$; $\tau > 0$ stands for the transport costs per unit of good traded between the village and the capital city.

Resellers' sales: Without loss of generality, let us focus on a reseller i who sells the global good δ in the village. At time t, the profit of reseller i for this particular activity is given by:

$$\pi^i_{\delta,t} = S^i_{\delta,t}[p^i_{\delta,t} - (p_w + \tau)] - C_{\delta,t}$$

where $S^i_{\delta,t}$ is the quantity sold, $p^i_{\delta,t}$ is the price of good δ and $C^i_{\delta,t}$ is the fixed cost resellers face at each period for trading the global good δ.

Assuming perfect competition between resellers ($\pi^i_{\delta,t} = 0$), we obtain $p^i_{\delta,t} = \frac{C_{\delta,t}}{S^i_{\delta,t}} + (p_w + \tau)$. If they face a strictly positive fixed cost, the price set by resellers is a decreasing function of the quantity they sell. If the fixed cost is equal to zero, $p^i_{\delta,t} = p_w + \tau$.

Resellers' purchases: Similarly, let us focus on a reseller i who buys good α and β in the village. At time t, the profit of reseller i for this particular activity is given by:

$$\pi^i_{\alpha,\beta;t} = B^i_{\alpha,\beta;t}[p_w - p^i_t - \tau] - C_{\alpha,\beta;t}$$

where B^i_t is the quantity he buys, p^i_t is the price he faces, and $C^i_{\alpha,\beta;t}$ is the fixed cost resellers face at each period for trading goods α and β.

Assuming perfect competition between resellers ($\pi^i_{\alpha,\beta;t} = 0$), we obtain $p^i_t = (p_w - \tau) - \frac{C_{\alpha,\beta;t}}{B^i_{\alpha,\beta;t}}$. If the fixed cost is strictly positive, the price proposed by resellers is an increasing function of the quantity they buy. If the fixed cost is equal to zero, $p^i_t = p_w - \tau$.

Appendix B.2. Quantities consumed and sold in each state

State H: In State H, the quantities consumed and sold by the household ak are as follows:

$$c^{ak,H}_{\alpha,t} = \frac{m^{\alpha k}_t + f(p_w + \tau)}{(2+\rho)(p_w + \tau)} \qquad c^{ak,H}_{\beta,t} = \frac{(1-s)[m^{ak}_t + f(p_w + \tau)]}{(2+\rho)(p_w + \tau)}$$

$$c^{ak,H}_{\delta,t} = \frac{(1-s)\rho[m^{ak}_t + f(p_w + \tau)]}{(2+\rho)(p_w + \tau)} \qquad S^{ak,H}_{\alpha,t} = f - \frac{m^{\alpha k}_t + f(p_w + \tau)}{(2+\rho)(p_w + \tau)}.$$

In state H, the local market does not clear; there is an excess demand given by[27]:

[27] By symmetry: $\sum_{k=1}^{N} m^{ak}_t = \sum_{k=1}^{N} m^{bk}_t = N\bar{m}_t$.

$$\sum_{k=1}^{N} c_{\alpha,t}^{bk,H} - \sum_{k=1}^{N} S_{\alpha,t}^{ak,H} = \sum_{k=1}^{N} \frac{(1-s)[m_t^{bk} + f(p_w+\tau)]}{(2+\rho)(p_w+\tau)} - \sum_{k=1}^{N}(f - \frac{m_t^{\alpha k} + f(p_w+\tau)}{(2+\rho)(p_w+\tau)})$$
$$= N\frac{(2-s)\bar{m}_t - (s+\rho)(p_w+\tau)f}{(2+\rho)(p_w+\tau)} \tag{B.1}$$

The excess demand is positive for $\bar{m}_t > m_H$, which, by definition, is always true in State H.

State I: In State I, the quantities consumed and sold by the household ak are as follows:

$$c_{\alpha,t}^{ak,I} = \frac{f}{2+\rho} + \frac{(s+\rho)m_t^{\alpha k} f}{(2+\rho)(2-s)\bar{m}_t} \qquad c_{\beta,t}^{ak,I} = \frac{f(1-s)}{2+\rho} + \frac{(1-s)(s+\rho)m_t^{\alpha k} f}{(2+\rho)(2-s)\bar{m}_t}$$
$$c_{\delta,t}^{ak,I} = \frac{(1-s)\rho[(2-s)\bar{m}_t + m_t^{\alpha k}(s+\rho)]}{(2+\rho)(s+\rho)(p_w+\tau)} \qquad S_{\alpha,t}^{ak,I} = \frac{(1+\rho)f}{2+\rho} - \frac{(s+\rho)m_t^{\alpha k} f}{(2+\rho)(2-s)\bar{m}_t}.$$

In state I, the local market clears: $\sum_{k=1}^{N} c_{\alpha,t}^{bk,I} - \sum_{k=1}^{N} S_{\alpha,t}^{ak,I} = 0$.

State L: In State L, the quantities consumed and sold by the household ak are as follows:

$$c_{\alpha,t}^{ak,L} = \frac{m_t^{\alpha k} + f(p_w-\tau)}{(2+\rho)(p_w-\tau)} \qquad c_{\beta,t}^{ak,L} = \frac{(1-s)[m_t^{ak} + f(p_w-\tau)]}{(2+\rho)(p_w-\tau)}$$
$$c_{\delta,t}^{ak,L} = \frac{(1-s)\rho[m_t^{ak} + f(p_w-\tau)]}{(2+\rho)(p_w+\tau)} \qquad S_{\alpha,t}^{ak,L} = f - \frac{m_t^{\alpha k} + f(p_w-\tau)}{(2+\rho)(p_w-\tau)}.$$

In state L, the local market does not clear; there is an excess supply given by:

$$\sum_{k=1}^{N} S_{\alpha,t}^{ak,L} - \sum_{k=1}^{N} c_{\alpha,t}^{bk,L} = \sum_{k=1}^{N}(f - \frac{m_t^{\alpha k} + f(p_w-\tau)}{(2+\rho)(p_w-\tau)}) - \sum_{k=1}^{N} \frac{(1-s)[m_t^{bk} + f(p_w-\tau)]}{(2+\rho)(p_w-\tau)}$$
$$= N\frac{(s+\rho)(p_w-\tau)f - (2-s)\bar{m}_t}{(2+\rho)(p_w-\tau)} \tag{B.2}$$

The excess supply is positive for $\bar{m}_t < m_L$, which, by definition, is always true in State L.

Steady State: At the steady state, the quantities consumed and sold by the household ak are as follows:

$$c_{\alpha,t}^{ak,ss} = \frac{f}{[1+(1+\rho)(1-s)]} \qquad c_{\beta,t}^{ak,ss} = \frac{f(1-s)}{[1+(1+\rho)(1-s)]}$$
$$c_{\delta,t}^{ak,ss} = \frac{f(1-s)\rho(p_w-\tau)}{[1+(1+\rho)(1-s)](p_w+\tau)} \qquad S_{\alpha,t}^{ak,ss} = f - \frac{f}{[1+(1+\rho)(1-s)]}.$$

At the steady state, the local market does not clear, as the steady state is a special case of State L; there is an excess supply equal to: $N\frac{f(1-s)}{[1+(1+\rho)(1-s)]} > 0$.

Appendix B.3. Proofs

Let us prove the propositions 3.1 and 3.2 in a single gesture.

Proposition 3.1 (Direct impact on beneficiaries). *For beneficiary households, the impact of the cash allowances is positive in the short run, regardless of whether the economy jumps to State H, State I or State L. In the long run, the consumption level of beneficiary households returns back to its steady-state level.*

Proposition 3.2 (Indirect impact on non-beneficiaries). *The impact of cash allowances on non-beneficiary households depends on the magnitude of the monetary shock. If the monetary shock is small such that the economy remains in State L, the consumption level of non-beneficiary households is not affected.*

If the monetary shock is large such that the economy jumps to States H or I, the immediate impact of the DDR program on non-beneficiary households is negative. In the short run however, the impact becomes positive. In the long run, the consumption level of non-beneficiary households returns back to its steady-state level.

Proof Jump to State L: If the economy remains in State L following the DDR program (low monetary shock), prices remain unchanged. In State L, the evolution of money holdings of household ak only depends on his money holdings, given by differential equation (18), which resolution gives:

$$m_t^{ak} = m_{ss} + (m_0^{ak} - m_{ss})e^{-\frac{1+(1-s)(1+\rho)}{2+\rho}t} \tag{B.3}$$

The money holdings of household ak converges to m_{ss}. For civilian households that do not benefited from the DDR program, $m_0^{ak} = m_{ss}$ and $m_t^{ak} = m_{ss} \forall t$. For ex-combatant households that benefited from DDR allowances, $m_0^{ak} = m_{ss} + m_{ddr} > m_{ss}$ and $m_t^{ak} > m_{ss} \forall t$. Following Appendix B.2, we have that, in State L, consumption of households only depends on their own money holdings. Therefore, civilian households are unaffected by the DDR program if the economy remains in State L. The impact of DDR allowances on the consumption ex-rebels households is positive.

Jump to State I: If the economy jumps to State I following the DDR program (intermediate monetary shock), the price of locally produced goods, given by (11), increases. As a consequence, the evolution of money holdings of a household ak depends on both his money holdings and the average money holdings in the village (differential equation (15)). Let us denote $\bar{m}_t^{demob}$ (resp. $\bar{m}_t^{civil}$) the average money holdings of beneficiary (resp. non-beneficiary) households at time t. Given this notation, we have $\bar{m}_t = \frac{n\bar{m}_t^{demob} + (N-n)\bar{m}_t^{civil}}{N}$. Introducing this in the differential equation (15) for beneficiary and non-beneficiary households gives the following systems of differential equations:

$$\begin{cases} \dot{\bar{m}}_t^{demob} = \left[\frac{(2-s)s(1+\rho)n - [1+(1-s)(1+\rho)]N(s+\rho)}{(2+\rho)(s+\rho)N}\right]\bar{m}_t^{demob} + \left[\frac{(2-s)s(1+\rho)(N-n)}{(2+\rho)(s+\rho)N}\right]\bar{m}_t^{civil} & \text{(B.4)} \\ \dot{\bar{m}}_t^{civil} = \left[\frac{(2-s)s(1+\rho)(N-n) - [1+(1-s)(1+\rho)]N(s+\rho)}{(2+\rho)(s+\rho)N}\right]\bar{m}_t^{civil} + \left[\frac{(2-s)s(1+\rho)n}{(2+\rho)(s+\rho)N}\right]\bar{m}_t^{demob} & \text{(B.5)} \end{cases}$$

The resolution of these differential equations for $\bar{m}_0^{civil} = m_{ss}$ and $\bar{m}_0^{demob} = m_{ss} + m_{ddr}$ gives:

$$\begin{cases} \bar{m}_t^{demob} = \dfrac{N-n}{N} e^{-\frac{1+(1-s)(1+\rho)}{(2+\rho)}t} m_{ddr} + (\dfrac{n}{N} m_{ddr} + m_{ss}) e^{-\frac{(1-s)\rho}{(s+\rho)}t} & \text{(B.6)} \\ \bar{m}_t^{civil} = \dfrac{-n}{N} e^{-\frac{1+(1-s)(1+\rho)}{(2+\rho)}t} m_{ddr} + (\dfrac{n}{N} m_{ddr} + m_{ss}) e^{-\frac{(1-s)\rho}{(s+\rho)}t} & \text{(B.7)} \end{cases}$$

In State I, the price of locally produced goods and the average amount of money in the village economy decrease overtime:

$$\bar{m}_t = \frac{\sum_{k=1}^{N} m_t^{ak}}{N} = (\frac{n}{N} m_{ddr} + m_{ss}) e^{-\frac{(1-s)\rho}{(s+\rho)}t} \quad \text{(B.8)}$$

$$p_t = p_t^* = \frac{(2-s)}{(s+\rho)f} (\frac{n}{N} m_{ddr} + m_{ss}) e^{-\frac{(1-s)\rho}{(s+\rho)}t} \quad \text{(B.9)}$$

Given equation (B.9) we have that prices of locally produced goods decrease overtime until they reach their lower bound $p_w - \tau$. The economy switches to State L when $\bar{m}_t = m_L$. This occurs when:

$$t = \underbrace{-\frac{s+\rho}{(1-s)\rho} \log \left(\frac{f(s+\rho)(p_w - \tau)}{(\frac{n}{N} m_{ddr} + m_{ss})(2-s)} \right)}_{t_L}. \quad \text{(B.10)}$$

We denote this threshold t_L.

Beneficiary households: Let us first focus on the consumption of the good α of a demobilized household ak. By introducing equations (B.6) and (B.9) in equation (5), we obtain that $c_{\alpha,t}^{ak,I}$ is decreasing overtime and converging toward $\frac{f}{2-s}$:

$$c_{\alpha,t}^{ak,I} = \frac{f}{2-s} + \frac{f(s+\rho)(N-n)m_{ddr}}{(2-s)(2+\rho)[n m_{ddr} + N m_{ss}]} e^{-\frac{(2-s)s(1+\rho)}{(2+\rho)(s+\rho)}t} \quad \text{(B.11)}$$

The threshold $\frac{f}{2-s}$ is higher than the steady-state level of good α consumption, implying that beneficiary households a consume more α following the demobilization. This is also the case for the good β, as $c_{\beta,t}^{ak} = (1-s)c_{\alpha,t}^{ak}$. For the good δ, we proceed in the same way. By introducing equations (B.6) and (B.9) in equation (7), we obtain that $c_{\delta,t}^{ak,I}$ is decreasing overtime and converging towards 0:

$$c_{\delta,t}^{ak,I} = \frac{(1-s)\rho}{N(2+\rho)(p_w+\tau)(s+\rho)} \left((2+\rho)[n m_{ddr} + N m_{ss}] e^{-\frac{(1-s)\rho}{s+\rho}t} + (s+\rho)(N-n) m_{ddr} e^{-\frac{1+(1-s)(1+\rho)}{2+\rho}t} \right) \quad \text{(B.12)}$$

We can show that $c_{\delta,t}^{ak,I}$ is higher than the level of δ's consumption at the steady state for $t < t_L$ ($c_{\delta,t}^{ak,I}$ is a decreasing function of t, and $c_{\delta,t}^{ak,I} > c_{\delta,t}^{ak,ss}$ for $t = t_L$). When the village economy switches to State L, beneficiary households are richer than at the steady state (equation B.6), but prices are at their steady-state level. Therefore, the consumption of beneficiary households is also higher after switching to State L.

Non-beneficiary households: The impact of the DDR program on non-beneficiary households is more complex. First, let us examine the impact on $c_{\alpha,t}^{ak,I}$ for a non-beneficiary household ak. By introducing equations (B.7) and (B.9) in equation (5), we obtain that in State I, $c_{\alpha,t}^{ak,I}$ is increasing overtime and converging towards $\frac{f}{2-s}$:

$$c_{\alpha,t}^{ak,I} = \frac{f}{2-s} - \frac{f(s+\rho)nm_{ddr}}{(2-s)(2+\rho)[nm_{ddr}+Nm_{ss}]}e^{-\frac{(2-s)s(1+\rho)}{(2+\rho)(s+\rho)}t} \tag{B.13}$$

In $t = 0$, $c_{\alpha,t}^{ak,I}$ is smaller than $c_{\alpha,t}^{ak,ss}$. In the short run, $c_{\alpha,t}^{ak,I}$ oversteps its steady-state level. This occurs at time:

$$t = -\frac{(2+\rho)(s+\rho)}{(2-s)s(1+\rho)}\log\left(\frac{(nm_{ddr}+Nm_{ss})((s+\rho)f(p_w-\tau)+(2-s)m_{ss})}{nm_{ddr}(s+\rho)f(p_w-\tau)}\right) < t_L. \tag{B.14}$$

When $t = t_L$, the economy switches to State L and converges to steady state. At time $t = t_L$, $c_{\alpha,t}^{ak,L}$ decreases as money holdings decrease and prices remain constant (equation (B.3)). The immediate negative impact and the short-run positive impact also characterize $c_{\beta,t}^{ak}$, as $c_{\beta,t}^{ak} = (1-s)c_{\alpha,t}^{ak}$.

Similarly, we introduce equations (B.7) and (B.9) in equation (7) to obtain $c_{\delta,t}^{ak,I}$:

$$c_{\delta,t}^{ak,I} = \frac{(1-s)\rho}{N(2+\rho)(p_w+\tau)(s+\rho)}\left((2+\rho)[nm_{ddr}+Nm_{ss}]e^{-\frac{(1-s)\rho}{s+\rho}t} - (s+\rho)nm_{ddr}e^{-\frac{1+(1-s)(1+\rho)}{2+\rho}t}\right) \tag{B.15}$$

This sum of two exponential functions defines an inverted U-shaped function of t. Indeed, the derivative of $c_{\delta,t}^{ak,I}$ admits one unique root in terms of t, $c_{\delta,t}^{ak,I}$ tends to 0 when t tends to infinity, and in $t = 0$, we have that $c_{\delta,0}^{ak,I} > c_{\delta,t}^{ak,ss}$. Similarly, in $t = t_L$, we have that $c_{\delta,t_L}^{ak,I} > c_{\delta,t}^{ak,ss}$. As $c_{\delta,t}^{ak,I}$ is an inverted U-shaped function of t, this implies that $c_{\delta,t}^{ak,I} > c_{\delta,t}^{ak,ss}$ in State I. We conclude that both the immediate and the short-run effect of the DDR program on $c_{\delta,t}^{ak,I}$ is positive. When the economy reaches State L at time t_L, money holdings of non-beneficiary households are higher than at the steady state, but prices are at their steady-state level. After switching to State L, $c_{\delta,t}^{ak,L}$ is therefore higher than $c_{\delta,t}^{ak,ss}$.

Jump to State H: If the economy jumps to State H, the proof is similar except that the price rise of locally produced goods is bounded at $p_w+\tau$. The positive impact on beneficiary households is higher as they received more money. The fact that local prices are bounded limits the immediate negative impact on non-beneficiary households. Again, in the short run, the impact on non-beneficiary households becomes positive. □

Proposition 3.3 (Impact on resellers' turnover).

If $\rho < \frac{2-s}{1-s}$, the turnover of resellers is a U-shaped function of average money holdings in the village. In this case, a small monetary shock would reduce resellers' turnover in the short run; a large monetary shock would increase their turnover in the short run (thresholds are derived in appendix). In the long run, resellers' turnover goes back to its steady-state value.

If $\rho > \frac{2-s}{1-s}$, the turnover of resellers is an increasing function of average money holdings in the village. In this case, any monetary shock increases their turnover. In the long run, resellers' turnover returns to its steady-state value.

Proof Let us study how the turnover of resellers changes when the average amount of money in the village increases. In other words, we will compute the derivative of resellers' turnover with respect to $\bar{m}_t$, and this for each one of the three states.

In State H, resellers' turnover is the aggregate sum of their sales, which can be decomposed between the sales of the excess demand of goods α and β and the sales of the global good, all sold at price $p_w + \tau$:

$$T_H^w = \underbrace{\left[2\left(\sum_{k=1}^{N} c_{\alpha,t}^{bk} - \sum_{k=1}^{N} S_{\alpha,t}^{ak}\right)\right.}_{\substack{\text{Excess demand} \\ \text{of } \alpha \text{ and } \beta}} + \underbrace{\left.2\sum_{k=1}^{N} c_{\delta,t}^{ak}\right]}_{\substack{\text{Sales} \\ \text{of } \delta}} (p_w + \tau) = 2N \frac{[1 + (1+\rho)(1-s)]\bar{m}_t - fs(1+\rho)\,(p_w + \tau)}{2+\rho}$$

The derivative of T_H^w with respect to $\bar{m}_t$ is positive: $\frac{\partial T_H^w}{\partial \bar{m}_t} = 2N\left(\frac{1+(1+\rho)(1-s)}{2+\rho}\right) > 0$.

In State I, resellers only sells the global good at price $p_w + \tau$. Their turnover is given by:

$$T_I^w = \underbrace{\left(2\sum_{k=1}^{N} c_{\delta,t}^{ak}\right)}_{\substack{\text{Sales} \\ \text{of } \delta}} (p_w + \tau) = \frac{2N(1-s)\rho\bar{m}_t}{s+\rho}$$

The derivative of T_I^w with respect to $\bar{m}_t$ is positive: $\frac{\partial T_H^w}{\partial \bar{m}_t} = \frac{2N(1-s)\rho}{s+\rho} > 0$.

Finally, in State L, resellers sell the global good at the price $p_w + \tau$, and buy the excess supply of households at the price $p_w - \tau$. Their turnover is given by:

$$\begin{aligned} T_L^w &= \overbrace{2\left(\sum_{k=1}^{N} S_{\alpha,t}^{ak} - \sum_{k=1}^{N} c_{\alpha,t}^{bk}\right)}^{\substack{\text{Excess supply} \\ \text{of } \alpha \text{ and } \beta}} (p_w - \tau) + \overbrace{2\left[\sum_{k=1}^{N} c_{\delta,t}^{ak}\right]}^{\substack{\text{Sales} \\ \text{of } \delta}} (p_w + \tau) \\ &= 2N \frac{f[s(1-\rho) + 2\rho]\,(p_w - \tau) - [1 + (1-s)(1-\rho)]\bar{m}_t}{2+\rho} \end{aligned}$$

The derivative of T_L^w with respect to $\bar{m}_t$ is given by: $\frac{\partial T_L^w}{\partial \bar{m}_t} = \frac{-2N[1+(1-s)(1-\rho)]}{2+\rho}$. This derivative is strictly positive for $\rho > \frac{2-s}{1-s}$ and strictly negative for $\rho < \frac{2-s}{1-s}$.

If $\rho < \frac{2-s}{1-s}$, resellers' turnover is a decreasing function of $\bar{m}_t$ for $0 < \bar{m}_t < m_L$, and an increasing function of $\bar{m}_t$ for $\bar{m}_t > m_L$; resellers' turnover is U-shaped, with a minimum in $\bar{m}_t = m_L$. It is worth noting that $\frac{\partial T_H^w}{\partial \bar{m}_t} > \frac{\partial T_I^w}{\partial \bar{m}_t}$. The impact of the DDR program on resellers' turnover therefore depends on the size of the DDR monetary shock.

At the steady state, the turnover of resellers is given by: $T_{ss}^w = \frac{4fN(1-s)\rho(p_w-\tau)}{1+(1-s)(1+\rho)}$. Similarly, for $\bar{m}_t = m_L$, the turnover of resellers is given by: $T_{m_L}^w = \frac{2fN(1-s)\rho(p_w+\tau)}{2-s}$. If $T_{ss}^w > T_{m_L}^w$, the turnover of resellers after the monetary shock exceeds its steady-state value if $T_H^w(\bar{m}_0) > T_{ss}^w$, that is, if the following condition is satisfied:

$$\bar{m}_0 > \frac{f[2(1-s)(p_w-\tau)(2+\rho) - s(1+\rho)(p_w-\tau)(1+(1-s)(1+\rho))]}{[1+(1-s)(1+\rho)]^2} \tag{B.16}$$

If $T_{ss}^w < T_{m_L}^w$, the turnover of resellers after the monetary shock exceed its steady-state value if $T_I^w(\bar{m}_0) > T_{ss}^w$, that is, if the following condition is satisfied:

$$\bar{m}_0 > \frac{2f(s+\rho)(p_w-\tau)}{[1+(1-s)(1+\rho)]} \tag{B.17}$$

In the short run, the impact of the DDR program on resellers' turnover is negative if the income shock is small, that is, if conditions (B.16) and (B.17) are not satisfied. In contrast, the short-run impact of the DDR program on resellers' turnover is positive if the income shock is large, that is, if the condition (B.16) or the condition (B.17) is satisfied. In the long run, resellers' turnover goes back to its steady state.

If $\rho > \frac{2-s}{1-s}$, the turnover of resellers is increasing function of $\bar{m}_t$ for each one of the three states. In this case, the increase of average money holding due to the DDR program is always expected to increase resellers' turnover in the short run. In the long run, their turnover goes back to its steady state. □