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of the Christian-Albrechts-Universität Kiel

Unconditional Cash Transfer Programs and Spillover Effects on the Local Economy : Evidence from Mali

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Abstract

Extreme poverty is predominantly concentrated in sub-Saharan Africa. Its reduction is challenged by the region's high population growth, climate change, and armed conflicts. These recent years, social safety net programs have been considered as development policy tools to address poverty and improve households' welfare. However, despite the growing interest in social safety net policies, impact studies do not look at all aspects of the contribution of cash transfer programs. This study attempts to fill in the gap by providing more comprehensive insights into the role of unconditional cash programs in the West African context. Many methodological approaches were applied, and the main data used for empirical analyses come from a panel data survey conducted in Mali in 2014, 2016 and 2018. The dissertation is a collection of five essays. The first essay investigates the causal relationship between the Unconditional Cash Transfers (UCT) program and school-aged children's time allocation. It takes advantage of a Randomized Control Trial design where the program beneficiaries were randomized to treatment and control groups. The results showed that the program has no significant effect on school enrolment for children aged 7-16 but increases domestic work by 3.1 percentage points. Disaggregating by gender and age, the program increases girls school enrolment at primary school by 4.3 percentage points. The second essay explores the impact of armed conflict on agricultural investment and investigates the capacity of an unconditional cash transfer program to influence the outcomes. It combines the control function approach with the correlated random effect (CRE) model to address the households' time-invariant unobserved heterogeneity and the endogeneity problem of conflict variable. It further takes advantage of the randomized rollout of a national cash transfer program and analyzes if there is any differential impact of conflict for households who benefit from the government cash transfer program. The results show that conflict has a negative and statistically significant effect on the probability of use and expenditures on fertilizers, pesticides, and machinery. However, the cash program has no significant impact in mitigating the negative effects of conflict. The third essay analyses whether the Income Generating Activities (IGAs) as UCT exit strategy contribute to keeping households out of poverty after leaving the program. The essay combines the Multinomial Endogenous Treatment Effects (METE) model with a propensity score matching technique to control for the selectivity biases and the endogeneity of the exit strategy choices. Findings mainly indicate that animal fattening and rearing as IGAs are more likely to increase the household consumption per capita than those who choose no IGA. We conclude that IGAs are positively associated with the welfare of households exiting the cash program. The fourth essay explores the capacity of an exogenous transfer to generate a multiplier effect in the local economy. It uses household survey data to estimate a Social Accounting Matrix (SAM) at the village level to analyze the multiplier effect of the program. The results show that exogenous cash transfer to extremely poor households has a multiplier effect on the local economy. These income multipliers result from an increase in cash beneficiaries' expenditures on goods supplied from markets in the village, which in turn stimulate production in both poor and non-poor households. The last essay analyzes the local general-equilibrium effects that are shaped by the economic behavior of

the program beneficiaries and non-beneficiaries. It uses the local economy-wide impact evaluation model which integrates a micromodel of agricultural household with general-equilibrium methods to simulate welfare effects for non-beneficiary households. Results show that the project generates a positive welfare effect for non-beneficiary households. The findings of this dissertation induced some implications for policy and future research. First, Governments in sub-Saharan Africa should increase their efforts to encourage cash programs to vulnerable households. Cash programs should become part of the social policy agenda and development strategies of the Governments. Social safety nets and cash programs should be brought to scale and sustained. Second, when designing those programs, policymakers should consider income-generating activities as exit strategy options.

Zusammenfassung

Extreme Armut konzentriert sich hauptsächlich auf Subsahara-Afrika. Ihre Reduzierung wird durch das hohe Bevölkerungswachstum der Region, den Klimawandel und bewaffnete Konflikte erschwert. In den letzten Jahren wurden Programme für soziale Sicherheitsnetze als entwicklungspolitische Instrumente betrachtet, um Armut zu bekämpfen und das Wohlergehen der Haushalte zu verbessern. Trotz des wachsenden Interesses an der Politik des sozialen Sicherheitsnetzes untersuchen Wirkungsstudien jedoch nicht alle Aspekte des Beitrags von Geldtransferprogrammen. Diese Studie versucht, die Lücke zu schließen, indem sie umfassendere Einblicke in die Rolle bedingungsloser Cash-Programme im westafrikanischen Kontext liefert. Viele methodische Ansätze wurden angewendet, und die wichtigsten Daten für empirische Analysen stammen aus einer Paneldatenerhebung in Mali in den Jahren 2014, 2016 und 2018. Die Dissertation ist eine Sammlung von fünf Aufsätzen. Der erste Aufsatz untersucht den kausalen Zusammenhang zwischen dem Programm Unconditional Cash Transfers (UCT) und der Zeitaufteilung von Kindern im Schulalter. Es nutzt das Design einer randomisierten Kontrollstudie, bei der die Programmbegünstigten in Behandlungs- und Kontrollgruppen randomisiert wurden. Die Ergebnisse zeigten, dass das Programm keine signifikanten Auswirkungen auf die Einschulung von Kindern im Alter von 7-16 Jahren hat, jedoch die Hausarbeit um 3,1 Prozentpunkte erhöht. Aufgeschlüsselt nach Geschlecht und Alter erhöht das Programm die Einschulung von Mädchen in die Grundschule um 4,3 Prozentpunkte. Der zweite Aufsatz untersucht die Auswirkungen bewaffneter Konflikte auf landwirtschaftliche Investitionen und untersucht die Fähigkeit eines bedingungslosen Geldtransferprogramms, die Ergebnisse zu beeinflussen. Es kombiniert den Kontrollfunktionsansatz mit dem korrelierten Zufallseffekt (CRE)-Modell, um die zeitinvariante unbeobachtete Heterogenität der Haushalte und das Endogenitätsproblem der Konfliktvariablen zu adressieren. Darüber hinaus nutzt es die randomisierte Einführung eines nationalen Bargeldtransferprogramms und analysiert, ob es unterschiedliche Auswirkungen von Konflikten auf Haushalte gibt, die vom staatlichen Bargeldtransferprogramm profitieren. Die Ergebnisse zeigen, dass Konflikte einen negativen und statistisch signifikanten Einfluss auf die Einsatzwahrscheinlichkeit und die Ausgaben für Düngemittel, Pflanzenschutzmittel und Maschinen haben. Das Cash-Programm hat jedoch keine wesentlichen Auswirkungen auf die Abschwächung der negativen Auswirkungen von Konflikten. Der dritte Aufsatz analysiert, ob die Income Generating Activities (IGAs) als UCT-Ausstiegsstrategie dazu beitragen, Haushalte nach dem Ausscheiden aus dem Programm vor Armut zu bewahren. Der Aufsatz kombiniert das Multinomial Endogenous Treatment Effects (METE)-Modell mit einer Neigungs-Score-Matching-Technik, um die Selektivitätsverzerrungen und die Endogenität der Exit-Strategieentscheidungen zu kontrollieren. Die Ergebnisse deuten hauptsächlich darauf hin, dass die Tiermast und -aufzucht als IGA den Haushaltsverbrauch pro Kopf eher erhöht als diejenigen, die keine IGA wählen. Wir kommen zu dem Schluss, dass IGAs positiv mit dem Wohlergehen von Haushalten verbunden sind, die das Cash-Programm verlassen. Der vierte Aufsatz untersuchte die Fähigkeit eines exogenen Transfers, einen Multiplikatoreffekt in der lokalen Wirtschaft zu erzeugen. Es verwendet Haushaltsbefragungsdaten, um eine

Social Accounting Matrix (SAM) auf Dorfebene zu schätzen, um den Multiplikatoreffekt des Programms zu analysieren. Die Ergebnisse zeigen, dass exogene Geldtransfers an extrem arme Haushalte einen Multiplikatoreffekt in der lokalen Wirtschaft haben. Diese Einkommensmultiplikatoren resultieren aus einem Anstieg der Ausgaben der Geldempfänger für Waren, die von den Märkten im Dorf geliefert werden, was wiederum die Produktion sowohl in armen als auch in nicht armen Haushalten ankurbelt. Der letzte Aufsatz analysiert die lokalen Allgemeingleichgewichtseffekte, die durch das wirtschaftliche Verhalten der Programmbegünstigten und Nichtbegünstigten geprägt sind. Es verwendet das gesamtwirtschaftliche Wirkungsbewertungsmodell, das ein Mikromodell landwirtschaftlicher Haushalte mit Methoden des allgemeinen Gleichgewichts integriert, um Wohlfahrtseffekte für nicht begünstigte Haushalte zu simulieren. Die Ergebnisse zeigen, dass das Projekt einen positiven Wohlfahrtseffekt für nicht begünstigte Haushalte erzeugt. Die Ergebnisse dieser Dissertation führten zu einigen Implikationen für die Politik und die zukünftige Forschung. Erstens sollten die Regierungen in Subsahara-Afrika ihre Bemühungen verstärken, um Geldprogramme für gefährdete Haushalte zu fördern. Cash-Programme sollten Teil der sozialpolitischen Agenda und der Entwicklungsstrategien der Regierungen werden. Soziale Sicherheitsnetze und Cash-Programme sollten skaliert und aufrechterhalten werden.

Chapter 1

General introduction

1.1 Problem statement

Poverty remains a pervasive and complex phenomenon in sub-Saharan Africa. Approximately two out of five people live in poverty and because of shocks, many others are vulnerable to falling into poverty (Beegle *et al.*, 2018). Poverty rates have been falling in Africa, however, the decline was not sufficiently rapid to allow Africa to reach the Millennium Development Goal of cutting the poverty rate in half by 2015. Although the region has made substantial progress since the early 1990s, the number of poor has continued to increase because of high population growth (Ahlburg (1996); Christiaensen and Hill (2019)). Climate change, risky environments and conflicts also increase poverty (Hill *et al.*, 2019) and keep many households vulnerable to shocks such as illnesses, weather variations, and civil war. Among Africa's poor, a small positive shock to incomes could lift many out of poverty, but a small negative shock could drive many of the vulnerable into poverty (Beegle *et al.*, 2018). In Africa, an estimated two poor households in five are transiently poor, that is moving into or out of poverty as their income fluctuates and they are exposed to shocks (Beegle *et al.*, 2016). Many of the poor are living only slightly below the poverty line and are thus close to escaping poverty, but others among the non-poor are vulnerable to falling into poverty.

To tackle poverty and households vulnerability, social safety net programs have been promoted in recent years. Also called social assistance programs, they are defined as noncontributory benefits, provided either in cash or in kind, and intended to support the poor or the vulnerable (Beegle *et al.*, 2018). They include cash transfer programs, school feeding programs, public works programs, health interventions, emergency programs, food-based programs and social pensions. Many governments in Africa are increasingly positioning social safety nets as a core instrument in their strategies to address poverty and vulnerability. The average number of social safety net programs per country in Africa is 15 (WorldBank, 2020). As a social safety net,

cash transfer programs are designed to reduce poverty and social exclusion for the most disenfranchised people. They are implemented in 46 countries in Africa, while public work programs are present in 33 countries and school feeding programs in 28 (WorldBank, 2020). Cash transfers could be conditional or unconditional. Unconditional Cash Transfers (UCTs) provide cash to all eligible and registered beneficiaries while Conditional Cash Transfers (CCTs) provide benefits only to beneficiaries who have fulfilled prescribed conditions.

The need to build evidence-based debates on cash transfer programs has led the scientific community to perform many cash program evaluation and to understand the mechanism that drives the reduction of households' poverty and vulnerability. Empirical findings have shown that the cash transfer programs have a positive effect on Food consumption (Miller *et al.* (2011);Seidenfeld *et al.* (2014);Tiwari *et al.* (2016);Brugh *et al.* (2018)), Human capital investments (Benhassine *et al.* (2015);Glewwe and Kassouf (2012);García *et al.* (2019); Dietrich *et al.* (2020)), Women empowerment and intimate partner violence (Buller *et al.* (2018);Waqas and Awan (2019);Iqbal *et al.* (2020);Heath *et al.* (2020)) and Household welfare (Levine *et al.* (2011); Asfaw *et al.* (2017)).

However, the question of whether cash programs contribute to the beneficiary's well-being in presence of armed conflict has not been amply examined. Some studies show the important role of social protection during emergencies, for example the positive impact of food assistance in conflict context (Tranchant *et al.* (2019), Gelli *et al.* (2018), and Aurino *et al.* (2019)). Few studies, including those of (Pena *et al.* (2017),Crost *et al.* (2016), and Edmond *et al.* (2019)) have tried to investigate the effect of cash programs in an armed conflict context, yet their methodology does not account for the potential endogeneity of the conflict variable. In addition, there are knowledge gaps related to whether the cash effects on children's time allocation vary by program features and context. Existing evidence focuses largely on cash transfers to women and is drawn mainly from Latin America. The Mali cash transfer program targeted heads of households who are primarily men with large households. Evidence from Mali's program can help in the design of context-sensitive responses to promote the accumulation of human capital.

Cash programs are designed for some time and help to lift households out of extreme poverty. It is therefore important to find an exit pathway for households that are close to leaving such programs. This will prevent them from falling back into the vulnerability situation. Many countries have introduced Income-Generating Activities (IGAs) to promote self-employment among cash recipients who are about to leave

the program. However, there are no rigorous impact evaluations on the effectiveness of these initiatives (Medellín *et al.*, 2015). Exit strategies that can help extremely poor households who left the cash transfer program to not fall back into extreme poverty still need to be investigated.

Given these knowledge gaps, the following important questions need to be answered: (i) What is the impact of the Mali cash program on children's time allocation ? (ii) Is the program effective in mitigating armed conflict effects on beneficiaries, and (iii) Do IGAs, as exit strategies, maintain a minimum income for the cash beneficiaries that exit Mali's cash program ?

Beyond the estimation of the impacts of cash transfer programs on the treated, general equilibrium (or "spillover") effects are also important. Many sub-Saharan African countries have developed cash transfer programs, informed by a Randomized Control Trial (RCT) design focusing on treated households (Davis *et al.*, 2012). Evidence shows that cash transfer programs affect not only beneficiary households but through local economy effects and spillovers, also non-beneficiary households (Taylor *et al.* (2014);Filipski *et al.* (2017)). Even if the control groups are picked far enough from the treatment groups so that contamination is not possible, the impacts of social cash transfers are likely to be understated if the effect on non-treated households living in the same cluster with the treated households exists. Additional research questions are raised : (i) What are the multiplier effects generated by the cash transfer program on non-cash beneficiary households ? (ii) What are the cash program general equilibrium effects in the local economy ?

The present dissertation tried to fill in those research gaps and to contribute to the empirical literature by investigating the effects of Mali's cash Transfers program on beneficiaries and its spillovers effect on the local economy. The national cash transfer program in Mali offers a unique case study because the cash is targeted to men in the West African context contrary to Latin America and East Africa where the program primarily targets women. The next section presents background information about Mali and its social protection system.

1.2 Background

1.2.1 The profile of Mali

The Republic of Mali is a landlocked country located at the heart of West Africa in the Sahel region. About 65% of the country's total area is covered by the Sahara desert. The country's population was 19.08 million in 2018 and it is classified as a low-income country. Mali was ranked 184th by the United Nations Development Programme (UNDP) Human Development Index (HDI) in 2020. The nominal gross domestic product per capita was \$891 in 2018 according to the International Monetary Fund (IMF). The average life expectancy at birth is 59 years and an average of two years of education per person.

Agricultural productivity is low, and most farmers produce cereals as subsistence crops (millet and sorghum) (USDA, 2009). Production is carried out using a low level of technology, and there is poor access to fertilizer and credit. The country's rapid population growth and climate change pose a threat to agriculture and food security (WorldBank, 2018). The average annual population growth is 2.25% and the fertility rate is about 5.88 children per woman in 2018. Figure 1.1 shows the total population growth from 1960 to 2020. 56.86% in 2019 of the population resides in rural areas and is strongly dependent on agriculture which contributed about 37.32% in GDP in 2019 (WorldBank, 2018).

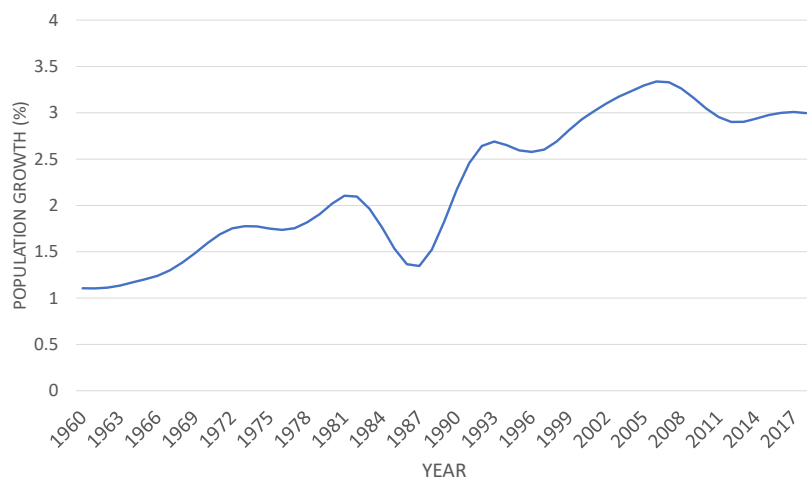


Figure 1.1: Total population growth
Source: FAOSTAT, 2021

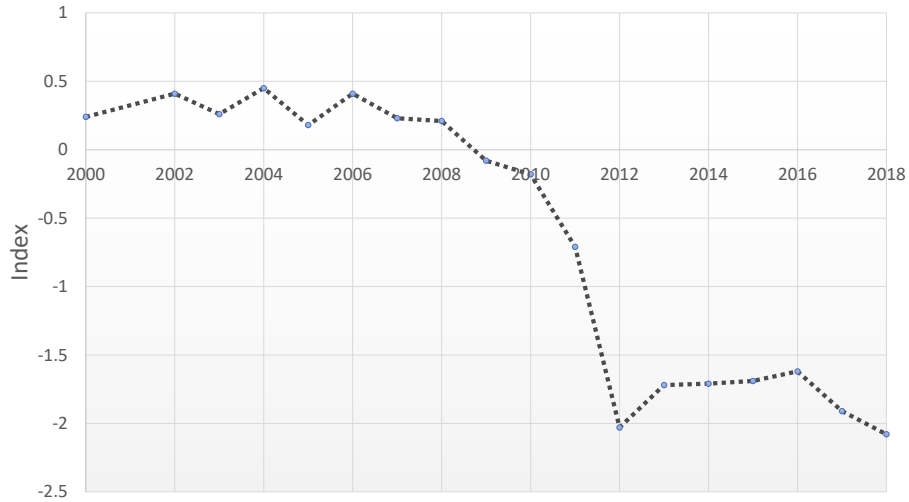


Figure 1.2: Political stability and absence of violence
Source: FAOSTAT, 2021

Figure 1.2 shows the index of political stability and absence of violence in Mali from 2000 to 2018. This index measures the likelihood of a government being destabilized or overthrown by unconstitutional or violent means, including terrorism. Since 2012, the northern part of the country faces a series of violence from different armed groups which interrupted the development programs. This situation, combined with climate change (drought) has created an economic and political fragility. Social safety net programs like cash transfer can then play an important role in helping vulnerable households meet their basic needs and smoothing consumption (Birmingham., 2015).

1.2.2 Social safety nets and Mali’s cash transfer program

For Grosh *et al.* (2008), the term “social safety nets” refers to non-contributory transfer programs targeted in some manner to the poor or vulnerable. The government of Mali defines the social safety net as “the set of measures through which the society intends to protect citizens against social risks” (MDSSPA, 2002). Many different terminologies are used interchangeably for Social safety net: Social protection, social security, social assistance, and social transfers.

In recent years, the number of social safety nets programs is growing and, in several countries, the coverage is expanding at a rapid pace. In Mali, the high levels of vulnerability among the poor population have increased the demand for further social safety net measures. Different types of social safety nets programs exist in

the country, such as cash transfers, in-kind food transfers, general subsidies, public works, and fee waivers for basic services. Cash transfer programs in Mali provide non-contributory cash grants to selected beneficiaries. Like in sub-Saharan Africa, communities are involved in identifying and selecting potential beneficiaries, verifying information about beneficiaries, and addressing grievances.

To improve human capital accumulation and reduce the intergenerational transmission of poverty, the Mali government has introduced in 2014 the program “*Filets Sociaux*” which delivers targeted cash transfers to the poor and vulnerable populations. The program is an integrated model—composed of cash transfers (TM), accompanying measures (MA), and nutrition packages (PNP) targeted to children under 5 years and pregnant women. The program is implemented in six regions (Sikasso, Segou, Mopti, Koulikoro, Kayes, Gao) and the District of Bamako, and the cash transfer component will reach approximately 62,000 poor households. The cash transfer component which is timely, predictable and regular transfer to vulnerable households for three years will allow them to smooth and increase their consumption in addition to protecting their assets from shocks. Predictable transfers also enable households to better plan their investments, allowing households to maximize the use of the cash transfers and helping them to make short-term livelihood investments (e.g., in agriculture) as well as long-term investments in human capital (e.g., investing in their children’s health, nutrition, and education). The second component which is the accompanying measures (AM) are complementary information sessions on health and education that aim to incentivize households to invest in the human capital of their children. The AM is composed of information sessions that promote the adoption of good practices related to health, education, nutrition, family planning, sanitation, savings, and investment. The third component — PNP — is a nutrition package composed of fortified food supplements targeted to pregnant women and children under the age of 5. PNP was only implemented in 20 percent of program participating villages.

1.3 Research objectives

The main objective of this dissertation is to investigate the impact of the Unconditional Cash Transfers (UCT) program (“*Filets Sociaux*”) on beneficiaries and its general equilibrium effect on the local economy. Specifically, this dissertation uses the case of Mali to :

1. Analyze the causal relationship between Unconditional Cash Transfer, Child schooling and Work.
2. Examine the impact of armed conflict on agriculture and the mitigation effects of the Unconditional Cash Transfer program.
3. Assess the impact of different cash transfer program exit strategies on the beneficiaries' welfare.
4. Analyze the multiplier effect of the cash transfer program in the local economy.
5. Model the general-equilibrium effect of the cash transfer program.
6. Provide, based on the pieces of evidences, some policy recommendations regarding the pathways of UCT program impacts as social safety net policies in Mali and West African context.

1.4 Relevance of the study

This dissertation provides a full impact of the cash transfer program by analyzing the impact on the treated (cash receivers) and multiplier effect on non-treated (non-beneficiaries). This generates a comprehensive understanding of the cash transfer program and could contribute to generating information to policymakers on the best options to design, implement and scale up the cash transfer program as social safety net policy.

The role of cash transfer programs in influencing the effect of armed conflict on agriculture has also important implications for policymakers. Most studies that analyze the question have ignored the potential endogeneity of the conflict variable. In addition, we take advantage of the random assignment of the cash transfer to the beneficiary and non-beneficiary in this work, which helps to derive strong evidence.

Since the cash transfer program is for 3 years and it is necessary to guarantee a sustainable income to beneficiary after leaving the program, Mali's government has introduced income generating activities to households that are close to exiting from the program. To the best of our knowledge, this study is the first undertaken to understand the determinants of the different exit strategies options and their impact on the cash beneficiaries' welfare. The issues of whether the proposed exit strategies can have a positive effect on beneficiaries' welfare are also relevant for policy decisions.

Most of cash transfer programs target women in the household, the Malian program primarily targets men. It would therefore help to explore how impacts differ by program features.

1.5 Thesis structure

Chapter 2 investigates the causal relationship between the cash transfer program and child schooling and Work. It used a randomized control design to investigate whether a combined intervention of Unconditional Cash Transfers (UCT) and Accompanying Measures (AM) targeted to men has any effect on school-aged children. Chapter 3 explores the impact of armed conflict on households' investment in productivity-enhancing inputs and investigate the power of unconditional cash transfer program to influence the outcomes. Household-level panel data combined with conflict data were used. Chapter 4 investigates the determinants of exit strategies choices and their impact on the households' welfare. Chapter 5 use household survey data to estimate a village Social Accounting Matrix (SAM) and a linear multiplier model to analyze the capacity of an exogenous transfer to generate multiplier effect in the local economy. Complementary to chapter 5, Chapter 6 use a local economy-wide impact evaluation model to simulate the general equilibrium effect of the cash transfer program in the local economy. Finally, chapter 7 summarizes the main results of this dissertation, makes some policy recommendations based on the results.

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Chapter 2

Unconditional Cash Transfer, child schooling and work :Experimental evidence from Mali¹

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Abstract

Using a randomized experiment in Mali, this study investigates whether a combined intervention of Unconditional Cash Transfers (UCT) and Accompanying Measures (AM) targeted to men and intended to reduce poverty and food insecurity affects the schooling and work of children. Results indicate that the program has no significant effect on school enrolment for children aged 7-16 but increases child participation in domestic work by 3.1 percentage points. Disaggregating by gender and age, results show that the program increases girls school enrolment at primary school by 4.3 percentage points. After discussing results and robustness checks, we explained potential mechanisms through which the UCT program has implications for children.

Keywords: Unconditional cash transfers, child time allocation, RCT, Mali

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2.1 Introduction

The Sustainable Development Goals (SDGs) identify poverty and inequality as important obstacles to improving the health of socially disadvantaged people around the world (UN, 2016). To this end, Sustainable Development Goal 1.3 recommends social protection systems that are fundamental to prevent and reduce poverty across the life cycle.

Adequate access to education contributes to reducing poverty. Basic skills such as reading and writing can have a substantial positive effect on the populations' well-being. Education promotes high private and social returns (Moretti, 2004) and is correlated with income levels (Hall, 1975), while improving health and reproductive choice.

Sub-Saharan African countries have made some efforts in the education sector these last decades. In some regions, gross primary school enrollment rates are now close to 80% or more. Yet, a substantial number of children remains excluded from primary school and many of those enrolled do not complete primary school (Chimombo, 2005). In addition, there is an endemic lack of equity in many education systems in sub-Saharan African countries. Girls tend to attend school less than boys in most countries (PASEC, 2017).

Cash transfers, food distribution, or school feeding are increasingly used today as social safety nets to improve the quality of life of the poor population and to fight poverty in developing countries. Globally, cash transfer programs reach 718 million people in over 130 countries according to the World Bank estimation in 2015 (World-Bank, 2015) and the literature shows that cash transfers have successfully improved consumption (Haushofer and Shapiro, 2016) and food security (Bastagli *et al.*, 2016) and reduced poverty and Intimate Partner Violence (IPV) (Hidrobo *et al.*, 2016).

Conditional Cash Transfers (CCTs) programs have shown their effects on children's education (Baird *et al.*, 2011); (Benedetti *et al.*, 2016); (Ganimian and Murnane, 2016). A review by (Fiszbein, 2009) suggests that CCTs for enrollment are effective in increasing enrollment and attendance, and in middle-income countries where primary enrollment rates are already high, the impacts of CCTs were more significant at the secondary level. Indeed, there are many studies on the impact of CCTs on children's education. However, there is less evidence of the effect of Unconditional Cash Transfers (UCTs) on schooling in sub-Saharan Africa.

The fundamental difference of UCTs compared to CCTs is that for UCTs, the recep-

tion of cash is not linked to a behavior, so the cash can be used across any spending domain which is likely driven by the difficulties households face and how households think the money can best meet their needs. (Baird *et al.*, 2011) compare CCT to UCT in Malawi and find that UCT has a lower impact on schooling but a greater impact on unconditioned outcomes such as reduction in marriage and teenage pregnancy. (Akresh *et al.*, 2013) find no significant difference between a UCT and a CCT conditional on school enrolment in Burkina Faso but larger impacts in the CCT on ‘marginal’ children, those who were most at risk of not going to school.

Most of the existing evidence on the impact of cash transfers programs comes from Latin America and East Africa where the cash is given to women. Less is known about how unconditional cash programs work when the transfers are targeted to household heads – who are primarily men – in a West African context. In Mali, about 75% of children are enrolled in primary school with an observed gap between boys and girls (world Bank, 2018). However, enrollment rates have been decreasing during the time frame of our study. The enrolment in primary school has been decreasing since 2011 from 81.5% in 2011 to 72.1% in 2017 (78.3% for boys compared to 66.0% for girls) (Credd, 2019).

In this paper, we take advantage of the unconditional nature of the national cash transfer program in Mali to generate evidence on the impact on children’s schooling and work in a context where beneficiary households are large, with an average of 10.46 members, of which 55 percent are under the age of 16 years (Hidrobo *et al.*, 2014).

The goal of this study is to see if the program targeted to men has an impact on school-aged children. We use data from a large-scale social experiment involving households that were randomized to treatment and control groups. This solid design allows us to examine the impact of the program on child schooling and labor.

We found that the transfers have no impact on children aged 7-16 while there is an impact on child labor for children aged 7-14. When we break the sample by gender and age, results show that the program increases primary school enrolment for girls. The remainder of the paper is organized as follows. We begin by describing the Malian national cash transfer program and the country’s education system. We explain the evaluation design, the data and the sampling method. Then we show the estimation strategy, the results and the mechanisms. Finally, we discuss the results and draw some conclusions and recommendations.

2.2 The Mali cash transfer program

The Malian Government initiated the “*Programme de Filets Sociaux (Jigisemejiri)*” in 2014 as a national cash transfer program with poverty reduction, food security and human capital development as the main objectives. The program targets extremely poor households and was initially implemented in six regions (Sikasso, Koulikoro, Kayes, Segou, Mopti, Gao) and the district of Bamako.

The program has 3 components which are Cash transfers (CT), Accompanying Measures (AM) and Preventive Nutrition Packages (PNP) targeted to children under 5 years and pregnant women. Recipient households receive 10,000 FCFA (equivalent to 20 U.S dollar) per month. Payments are made every quarter in the beneficiary villages. There are no conditions imposed to receive the money.

The cash is given to the household heads who are men in the large majority of households. The Accompanying Measures (AM) are group counselling sessions conducted by non-governmental organizations (NGOs) in each intervention village. These sessions were not only targeted to cash beneficiaries, but also welcomed any household in the selected communes. There are roughly 15 subthemes organized in 4 thematic groups. Each theme of a group session covers a period of 6 months tackling multiple subthemes. The third component is the PNP that was not implemented at the time of the data used for this study, and thus not a focus of this study. Details on the program components and accompanying measures topics are presented in Appendix A.1.1.

The cash transfer was targeted to extremely poor households based on geographical and community-based targeting. Following steps were used to target households for the cash transfer program : First, quotas were developed at the commune level, based on the percentage malnourished and the percentage of extreme poor households within the commune. These quotas were then split proportionally by village (in terms of village population), to obtain village quotas. Households within villages were chosen on the basis of four criteria related to (1) food security, (2) ownership of agricultural equipment, livestock, and land, (3) “reliability” of income, and (4) household composition (at least 3–10 household members total, with at most 1–2 working adults). These households were selected through a two-stage process: first, village committees created a list of households meeting these criteria; second, commune committees assembled whole villages to validate the list. Preference was given to those who met more than one, until the village quota was met.

2.3 Education system in Mali

The Malian school system is composed of nine years of basic education which includes six years of elementary school (grades 1-6), and three years of junior high school (grades 7-9). After 9 years, students have the possibility to attend technical or general education. General education is a senior high school (grades 10-12) where students who complete all levels are awarded the baccalaureate diploma. Obtaining this diploma allows students to attend university. The technical school is vocational and students are awarded "the Certificat d'Aptitude Professionnelle (CAP)" after 2 years and the "Brevet de Technicien" after four years.

Children are supposed to start the first year of elementary school when they are 6 years old and therefore complete primary school at 12 years old and junior high school at 15 years old. Students at the end of junior high school are awarded a Diploma of Fundamental Studies (DEF). After this diploma, they are allowed to continue either in technical or in general education.

Access to pre-school education is very low in Mali (only 6.1% of children aged 3 to 5 in 2016 - 2017) despite the importance of this segment for the cognitive development of children. Enrolment is higher in urban areas than in rural areas (81.1% versus 54.7% respectively). In rural areas, children enter school at later ages because of poverty, long distances to attend school, cultural beliefs or security. Girls are taken out of school to participate in housework, or if they are not performing well. According to UNESCO data, around 50% of students who were enrolled in elementary school in 2017, only 56 percent continued to junior high school.

In junior high school, enrolment was at 49.2% in 2016-2017, lower than the primary school. Girls are less likely to reach junior secondary school than boys (44.2% compared to 54.4%) (Credd, 2019). The significant drop-out of girls from the education system is due to child marriage, families' poverty or the distance travel to school and lack of sanitation in the school. Voluntary drop-out and failure at school are also other factors.

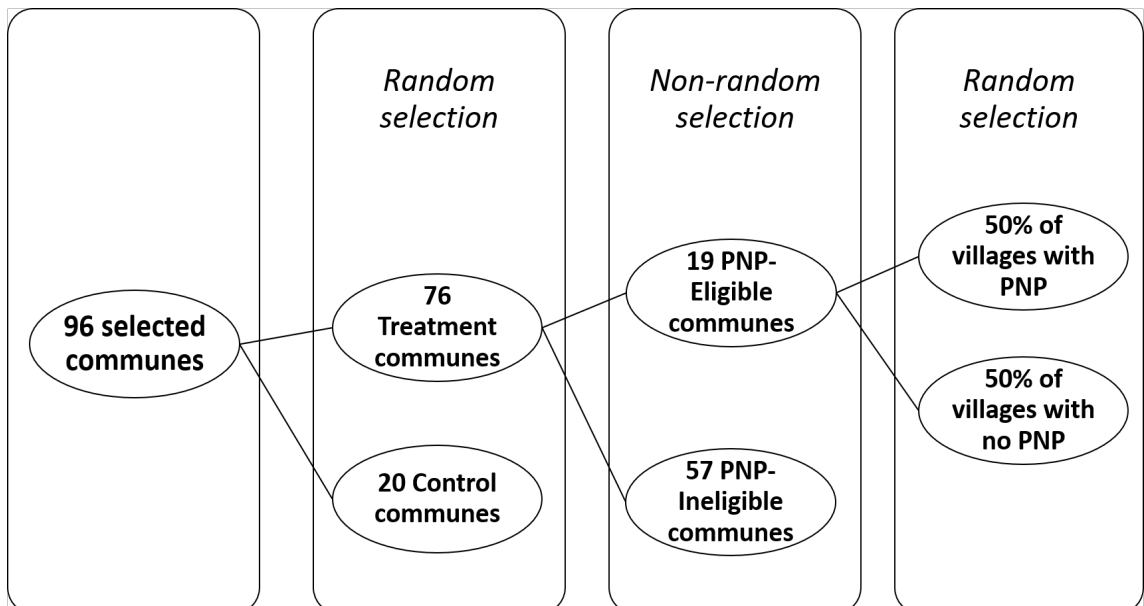
Many constraints prevent children from attending school. Elementary school is free but junior high school is not and households need to pay for school materials. Sometimes, children need to travel long distances before reaching school and at the end of elementary school, children need to move away from home to pursue secondary schooling and this generates additional fees to the households. Moreover, there are safety concerns especially for girls when they have to travel long distances or for children living in conflict-affected areas. Efforts still need to be made to improve

education offer in the country and to make it equitable and accessible to all.

2.4 Evaluation design

The Mali cash transfer program impact evaluation is a two-stage randomized control trial. Within each of the five targeted regions for the evaluation (Sikasso, Koulikoro, Kayes, Segou, Mopti), the communes were randomly assigned to either the treatment or control arm. A total of 76 communes were randomly assigned to the treatment and to receive the cash right after the baseline survey in 2014, and 20 communes were assigned delayed-entry and entered the program in 2016, after the midline survey. Among the 76 treatments communes, 19 communes were non-randomly be selected in collaboration with the national nutrition technical committee to receive the PNP. The randomization was stratified by region, and within each region approximately 20 percent of the eligible communes were randomly assigned to be in the control arm. The randomization process was conducted by the Government of Mali in collaboration with the International Food Policy Research Institute (IFPRI). This process has created transparency and understanding by communities about how the communes have been assigned to treatment and control. The Figure 2.1 shows the two-stage randomized evaluation design.

Figure 2.1: Two-stage randomized evaluation design

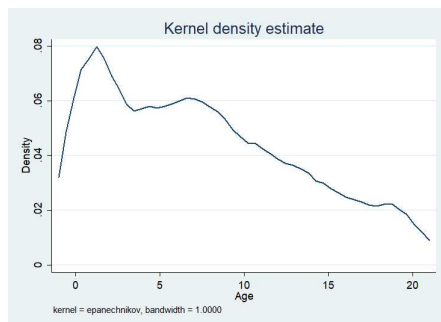


The PNP component had not yet been rolled out at the time of the survey rounds used in this study, only the first-stage randomization (treatment vs. control) is used here. At the first stage of the randomization, 76 communes were randomly assigned to treatment group and 20 to control group.

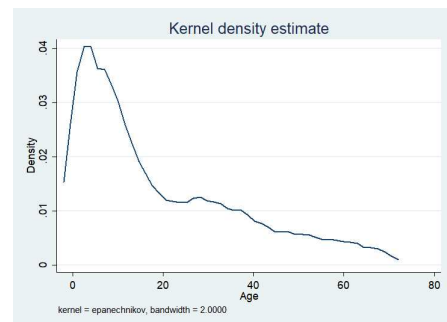
2.5 Data, sample and variables

We use data collected from the Mali cash transfer program that includes quantitative and qualitative components and was collected by the International Food Policy Research Institute (IFPRI) and "Institut de Recherche pour le Development (IRD)". The baseline survey was conducted from September 2014 to February 2015 and the midline survey from August to November 2016. The baseline data was collected before the beginning of the project intervention and the midline 2 years later and before the control group start receiving the intervention. In total, 90 communes out of 96 were surveyed at baseline. Some communes were left out because of the ongoing conflict between armed groups in the northern part of the country. The study selected households that were cash beneficiaries and had a child aged from 6 to 23 months at the time of the baseline survey.

The sample design for the midline survey is based on "power calculations" that help ensure the ability to statistically detect the program's impacts on key outcomes. At the individual level, information was collected on children aged 7 to 16 years old and their participation in schooling and labor activities. Figure 2.2 below shows the distribution of age for household members and children aged 0-20 at baseline. The children density graph shows that children were very young at baseline, their age was between 0-5 years while there are fewer children after 13 years old.



(a) Children age distribution



(b) Household members age distribution

Figure 2.2: Age distribution at baseline

A two-stage probability proportional to size sampling (PPS) method was used at the baseline. The principle of this method is that each eligible beneficiary household in any commune had the same probability of being sampled. The midline sample is a panel of households surveyed at baseline. 3080 households were surveyed at baseline and 2560 at midline. From these households, we restrict our analysis to children 7-16 years old at baseline for a total of 6507 children.

Our outcomes of interest are :

(1) School enrolment which was measured using the information from the household roster on whether children aged 7-16 are currently enrolled in school; our variable uses the answer to the question:” did you enrol in school in the current year? “. It is a dummy equal to 1 if the child is enrolled and 0 otherwise.

(2) School attendance: Proportion of the total school days for which enrolled students are present in the last 7 days. To obtain this outcome in the questionnaire, we divided the question ”in the past 7 days, how many days did the child attend school?” by the question ”during the past 7 days, how many days was the school opened?”

(3) Participate in domestic work: A child aged 7-14 is considered to be engaged in domestic work if s/he spent at least one hour in domestic work in the last 7 days. Domestic work refers to looking after children, cooking, washing clothes, cleaning, taking care of other sick family members, collecting vegetables, collecting firewood, carrying water. It is a dummy equal to 1 if the child is engaged in this kind of activities the last 7 days and 0 otherwise.

(4) Participate in agricultural work: Child aged 7-14 is considered to be engaged in agriculture work (take care of household rearing or help with other agricultural work on household plots) on the household’s land if s/he spent at least 1 hour in agriculture work in the last 7 days. It is a dummy equal to 1 if the child is engaged in this kind of activities the last 7 days and 0 otherwise.

Children aged 7-13 are likely to be in primary school, while children aged 14-16 could be either in primary school or junior high school. Similarly, information about child’s sex, allows us to estimate the impact of the program stratified by child gender. The questionnaire collected child labor data only for the age range 7-14.

We further adjust the analysis for the educational achievement of the household head, whether or not he has attended school or can read; whether the child belongs to a monogamous or polygamous household, the child household size as well as the value of the household’s total per capita consumption.

2.6 Attrition and baseline balance

The main unit of analysis is the individual child. Our study population includes children aged (7-16) years old at baseline. To confirm that the randomization worked in creating a balance between treatment arms, we test for statistical differences in means between the two treatments using OLS regression with controls for regions and standard errors clustered at the commune level. We find evidence for successful randomization, mean household characteristics are balanced between the treatment and control groups. Table 2.1 shows that the randomization was effective at balancing baseline characteristics. There are no significant differences at the 10% level for the study outcomes. Children in our sample are on average 10 years old, half are boys and very few of them can read. Household head are on average 55 years old and less than 10% went to school. 41% of the household head are in monogamous marriage. At baseline, about 40% of children are enrolled in school. Of the 6507 children 7 to 16 years-old at baseline, 5618 were surveyed at midline. An attrition rate of 13 % due to not finding the same child across the survey round. This can be the case if the households move out of project area or in case of child death. If attrition is correlated with treatment assignment, then this could potentially bias the estimates of the impact of transfers on outcomes. As table 2.1 shows, there are no significant differences in attrition between treatment and control arms.

Table 2.1: Baseline characteristics of children (ages 7-16) by treatment status

	N	All	Control	Treated	P-value
Attrition rate	6507	0.137	0.133	0.138	0.40
Children Characteristics					
Age	5618	10.385	10.525	10.343	0.102
Male	5618	0.547	0.542	0.549	0.677
Child can read	5618	0.03	0.026	0.032	0.195
Household Characteristics					
Head age	5618	55.065	54.434	55.252	0.681
Head is widow	5618	0.103	0.092	0.106	0.582
Head went to school	5618	0.085	0.091	0.083	0.509
Head can read	5618	0.03	0.026	0.032	0.195
Head is female	5618	0.104	0.095	0.107	0.826
Head monogamous	5618	0.472	0.486	0.468	0.751
Head polygamous	5618	0.42	0.414	0.421	0.889
Household size	5618	12.833	12.521	12.926	0.018
Number of members aged 0–6	5618	3.509	3.406	3.54	0.90
Number of members aged 7–17	5618	4.46	4.445	4.465	0.739
Number of members aged 18–64	5618	4.418	4.275	4.462	0.567
Number of members aged 65 or older	5618	0.431	0.384	0.445	0.934
Log total per capita consumption	5618	7.965	7.992	7.957	0.278
Outcomes					
Panel A					
School enrolment (7-16)	5618	0.394	0.43	0.383	0.764
Attendance last 7 days (7-16)	5618	0.978	0.98	0.977	0.637
Panel B					
Participate in domestic work (7-14)	5085	0.642	0.619	0.649	0.169
Participate in agricultural work (7-14)	5085	0.347	0.351	0.346	0.940

Standard errors are clustered at the commune level.

Adjust for region (strata) fixed effect

Table 2.2: Baseline summary statistics of children (ages 7-16) by intervention arm and gender status

	Girls					Boys				
	N	All	Control	Treated	P-value	N	All	Control	Treated	P-value
Attrition rate	3134	0.177	0.17	0.18	0.546	3373	0.097	0.094	0.097	0.521
Children Characteristics										
Age	2578	10.594	10.633	10.582	0.302	3040	10.577	10.733	10.531	0.071
Child can read	2578	0.026	0.026	0.025	0.628	3040	0.034	0.024	0.037	0.065
Household Characteristics										
Head age	2578	54.866	54.156	55.084	0.994	3040	55.204	54.452	55.426	0.339
Head is widow	2578	0.1	0.084	0.104	0.847	3040	0.105	0.097	0.107	0.399
Head went to school	2578	0.088	0.086	0.088	0.611	3040	0.083	0.093	0.08	0.394
Head can read	2578	0.007	0.002	0.009	0.011	3040	0.007	0.001	0.008	0.521
Head is female	2578	0.096	0.086	0.099	0.738	3040	0.112	0.105	0.114	0.817
Head monogamous	2578	0.472	0.501	0.463	0.417	3040	0.471	0.468	0.472	0.877
Head polygamous	2578	0.419	0.399	0.426	0.464	3040	0.419	0.427	0.417	0.672
Household size	2578	12.744	12.204	12.909	0.643	3040	12.881	12.768	12.914	0.422
Number of members aged 0-6	2578	3.767	3.541	3.834	0.827	3040	3.762	3.721	3.775	0.948
Number of members aged 7-17	2578	4.941	5.015	4.92	0.114	3040	4.896	4.974	4.872	0.200
Number of members aged 18-64	2578	4.619	4.318	4.709	0.942	3040	4.604	4.569	4.615	0.413
Number of members aged 65 or older	2578	0.426	0.39	0.437	0.935	3040	0.43	0.389	0.443	0.731
Log total per capita consumption	2578	8.002	7.998	8.004	0.167	3040	7.938	7.994	7.922	0.619
Outcomes										
Panel A										
School enrolment (7-16)	2578	0.351	0.357	0.349	0.629	3040	0.425	0.479	0.41	0.524
Attendance last 7 days (7-16)	2578	0.983	0.987	0.982	0.880	3040	0.974	0.976	0.973	0.10
Panel B										
Participate in domestic work (7-14)	2390	0.792	0.755	0.803	0.104	2695	0.515	0.498	0.52	0.436
Participate in agricultural work (7-14)	2390	0.242	0.241	0.242	0.345	2695	0.442	0.455	0.438	0.444

Standard errors are clustered at the commune level. * p 0.1 ** p 0.05 ***p 0.01

Adjust for region (strata) fixed effect

Table 2.2 shows baseline characteristics across the treatment and control groups for the subsamples of boys and girls. For girls, the difference-in-means for the head can read variable is significant at 5 percent level. For boys, two variables of baseline characteristics are significantly different across treatment and control households at the 10 percent level. In particular, boys in the control group seem slightly older and less likely to read. Given the well-documented correlations between these prognostic factors and the study outcomes, we control for these observable differences in our empirical specifications. In addition, Table 2.2 shows that the schooling attendance outcome is high for children at baseline. We think it will not be useful to look at the impact of the intervention on this outcome in our estimations.

To further investigate the attrition, we estimate the following equation for each outcome where $Attri$ is a dummy equal to 1 for those who attrited and 0 otherwise, $Treat$ is the treatment variable. The equation regresses each outcome variable at baseline on the attrition dummy and treatment dummy while controlling for regions fixed effects. The interaction term shows the difference-in-difference estimates.

$$Y_{i0} = \alpha_0 + \alpha_1 Attri_i + \alpha_2 Treat_i + \alpha_3 Attri_i \times Treat_i + \epsilon_i \quad (2.1)$$

Table 2.3 shows the results of the estimation of equation (2.1)

Table 2.3: Attrition

Outcome	Treatment	Attrite	Treatment *Attrite	N
	(1)	(2)	(3)	
School enrolment	-0.012 (0.047)	-0.1* (0.056)	0.055 (0.061)	5618
Participate in agricultural work	-0.008 (0.035)	0.039 (0.045)	0.054 (0.053)	5085
Participate in domestic work	0.056 (0.037)	0.174** (0.048)	-0.146 (0.06)	5085

Standard errors are clustered at the commune level. * p 0.1 ** p 0.05 ***p 0.01
Estimations are adjusted for region (strata) fixed effect

The difference-in-difference coefficients are reported in the third column. There is no significant effect on the outcomes of school enrolment and participation in agricultural and domestic work. Attrition related concern could not bias the impact estimate for these three outcomes.

2.7 Estimation strategy

To estimate the impact of the cash transfer on the listed study outcomes, we take advantage of the randomized experimental design and conduct an intent-to-treat (ITT) analysis. This approach avoids bias that may occur due to selection into and out of the program. We estimate the treatment effect using the Analysis of Covariance (ANCOVA). ANCOVA estimates are preferred to Difference-in-Difference when the autocorrelation of outcomes is low (McKenzie, 2012). We use the following equations:

$$Y_{it} = \beta T_i + \lambda Y_{it-1} + \alpha X_{it-1} + \theta + \epsilon_i \quad (2.2)$$

Y_{it} represents the main outcome of interest measured for each child i at time t . T is a dummy equal to 1 if the child belongs to a household that receives the cash, and 0 otherwise. X_{it-1} is a set of control variables measured at baseline, θ denotes region fixed effects. The vector of control variables (X) includes child's age, household size, marital status of the household head, if the household head went to school, the gender of the child, if the child can read, gender of the household head, log value of aggregate consumption, all as defined at baseline. Standard errors are clustered at the commune level, which is the same level at which treatment was assigned. To see if the effect of the cash varies by child's sex, we estimate equation (2.2) separately for boys and girls. To test whether the interaction between treatment and child's sex is significant, we estimate equation (2.3).

$$Y_{it} = \beta T_i + \beta T_i * Gender_i + \lambda Y_{it-1} + \alpha X_{it-1} + \theta + \epsilon_i \quad (2.3)$$

2.8 Impact of the program

We use equation (2.2) to estimate the causal effect of being assigned to the cash receiver group on child schooling and work.

The coefficient of the cash treatment (T) represents the intent-to-treat (ITT) of the intervention on different outcomes. Table 2.4 presents the impact of the intervention on school enrolment and child labor while controlling for individual and household

characteristics. It is important to notify that since the school attendance rate was already high at the baseline, we didn't analyze the impact of the program on this outcome.

The results reveal, when we consider the pooled sample, that there is no significant impact on school enrolment for children aged 7-16.

Table 2.4: Impact of cash transfer on children schooling and work

	Overall	N	Boys	N	Girls	N
	(1)		(2)		(3)	
Panel A						
Aged 7-16 enrolment						
Cash Treatment (T)	0.013	5618	-0.005	3040	0.034*	2578
	(0.02)		(0.002)		(0.02)	
Aged 7-13 enrolment						
Cash Treatment (T)	0.017	4739	-0.006	2517	0.043***	2222
	(0.02)		(0.002)		(0.02)	
Regions fixed effects	Yes		Yes		Yes	
Households covariates	Yes		Yes		Yes	
Panel B						
Participate in domestic work (7-14)						
Cash Treatment (T)	0.031***	5085	0.032	2695	0.022	2390
	(0.01)		(0.02)		(0.02)	
Participate in agricultural work (7-14)						
Cash Treatment (T)	-0.013	5085	-0.014	2695	-0.016	2390
	(0.02)		(0.02)		(0.03)	
Regions fixed effects	Yes		Yes		Yes	
Households covariates	Yes		Yes		Yes	

Standard errors are clustered at the commune level. Estimations are adjusted for region (strata) fixed effect. For simplicity, coefficient estimates are only reported for cash treatment effects. Covariates include baseline value of children age, household size, marital status, household head went to school, gender of the children, children can read, gender of the household head, age of household head, aggregate consumption and number of household members for different age range .
 * p 0.1 ** p 0.05 ***p 0.01

Table 2.4 also shows that the intervention increases the probability that children aged 7-14 engaged in child labor. The program increases child participation in domestic work by 3.1 percentage points. This is contrary to (de Hoop and Rosati, 2014) study which shows that cash transfer intervention lower child labor. But some studies (Chong and Yanez-Pagans, 2019) provide strong evidence that cash transfers, when families are unconstrained in the use of the transfers received like the case of Unconditional Cash Transfers in Mali, can increase child labor.

To investigate if the impact of the intervention vary by children's gender and age,

we estimate equation (2.2) separately for boys and girls. In addition, for schooling outcome, we estimate equation (2.2) for children at primary school, likely 7-13 years old. We note that the intervention lead to a significant increase in the school enrolment for girls at junior high school (aged 7-16) by 3.4 percentage points and at primary school by 4.3 percentage points. When we consider child labor outcome, we found no significant heterogeneous impact on child labor. For schooling and labor, the program has different impacts according to children’s gender and age.

2.9 Robustness Checks

To explore the robustness of our results, we first show that the coefficient estimates on treatment does not change meaningfully with inclusion of different control variables at their baseline value (Table 2.6 in the Appendix). Next, we examine the attrition corrections. To do this, we first predicted the probability that a child attrited (not observed at follow-up) based on equation (2.2) with the inclusion of all covariates in our baseline characteristics table. We use the inverse of this probability as weights in a new regression to estimate our impact for different outcomes. The findings are robust to correcting for attrition using inverse probability weights (Fitzgerald, Gottschalk, and Moffitt 1998). The weighted point estimates and significance levels are reported in table 2.5 and remain unchanged relative to the original estimates displayed in table 2.4.

Furthermore, we show that our results are robust to using randomization inference (Table 2.5, column (2)) following Fujiwara and Wantchekon (2013). The treatment at the initial level of randomization is reassigned randomly and the impact of this new placebo treatment is estimated using specification (2.2). This procedure is repeated 1,000 times to obtain p-values. We implement this in Stata by using the command “ritest” (Heß, 2017). Lastly, we bound our treatment estimates (Table 2.7 in the Appendix) following Horowitz-Manski bounds (Horowitz and Manski, 1998). The lower and upper bounds are obtained by estimating the regression specification (2.2) on the full sample of children present at baseline, imputing outcome values for the attriters under two scenarios that correspond to assigning the values 0 to all attriters from the treatment group and 1 to all attriters from the control group or vice versa.

Table 2.5: Robustness Checks

	N	Attrition reweighting	Randomization inference
		(1)	(2)
Children enrolment (7-16)	5618	0.015 [0.214]	0.013 [0.742]
Boys enrolment (7-16)	3040	-0.002 [0.563]	-0.005 [0.824]
Girls enrolment (7-16)	2578	0.033* [0.08]	0.034* [0.09]
Children enrolment (7-13)	4739	0.018 [0.170]	0.017 [0.626]
Boys enrolment (7-13)	2517	-0.003 [0.866]	-0.006 [0.778]
Girls enrolment (7-13)	2222	0.041*** [0.001]	0.043*** [0.002]
Domestic work (7-14)	5085	0.03** [0.017]	0.031*** [0.001]
Domestic work boys (7-14)	2695	0.036 [0.270]	0.032 [0.429]
Domestic work girls (7-14)	2390	0.022 [0.170]	0.022 [0.207]
Agricultural work (7-14)	5085	-0.011 [0.17]	-0.013 [0.518]
Agricultural work boys (7-14)	2695	-0.017 [0.270]	-0.014 [0.681]
Agricultural work girls (7-14)	2390	-0.007 [0.230]	-0.016 [0.505]

Standard errors are clustered at the commune level. Estimations are adjusted for region (strata) fixed effect.. Estimations controls for baseline value of children age, household size, marital status, household head went to school, gender of the children, children can read,gender of the household head, age of household head, aggregate consumption and region indicators. P-values in brackets. * p 0.1 ** p 0.05 ***p 0.01

2.10 Mechanisms

We investigate the potential pathways through which the program can impact different outcomes in this study. First, we explore pathways for the effect of the program intervention on school enrolment. According to the literature, CCTs and UCTs have increased enrolment rates mainly because they reduce the financial constraints of education (Baird *et al.*, 2013), but given the differences between these programs, it is not clear the mechanism by which this happens. (Handa *et al.*, 2016) find that the financial costs (transport, uniforms, shoes ...) remain significant in

Zambia for schooling, despite the elimination of formal tuition fees. In addition, they find that physical distances are also more important for secondary schools, and barriers to access school generally affect girls disproportionately.

For children enrolled during the study, we collected at midline, the data on expenditure made by the household on education. This includes school fees, material fees and transportation fees. Using this data, we estimate the effect of the treatment on the education expenditure for the whole sample and separately for boys and girls. This would help to explain how the cash transfer program has led to an increase in school enrolment for girls at primary school. Results for education expenditures are reported in Table 2.8 in the Appendix. The table shows the results for all children in primary and junior high school. Also, we include the result for boys and girls since school enrolment is higher for girls.

Results in Table 2.8 indicate that while coefficients are positives for girls and negatives for the whole sample and boys, there is no significant effect on school expenditures for children in treated households after two years. This means while the transfer slightly increases education expenditures for girls, it is not statistically significant. Hidrobo *et al.* (2019) identified three largest categories of expenses according to households' self-reports on how the program transfer is used in Mali. There are food consumption (65%), health (11%) and agricultural investments (4%). Therefore, less is invested in education and this is likely devoted to girls.

(Bastagli *et al.*, 2016) has explained indirect mechanisms of the effect of cash transfers on the education of children in sub-Saharan Africa. Rural communities tend to be small and well connected, so other households often know the beneficiaries. Therefore, shame could be a factor involved in the effect of cash transfers on education if community members observe household behaviors and believe that households are not using the money appropriately. Similarly, households may initially believe that enrolling their children in school is a requirement of receiving the transfer "Soft condition". To test this fact, (Kilburn *et al.*, 2017) examined the perception that households have of the rules of a UCT program during the follow-up survey to understand if these can serve as a mechanism to explain the impacts of the program on school enrolment. Results showed that 81% thought they had to follow the rules to continue receiving payments. Among those who believed in the rules, the school-related rules listed included: buying school supplies (mentioned by 70%), sending their children to primary school (26%), and sending their children to secondary school (8%).

Because of data limitations we cannot directly test for these mechanisms that might be the channel through which UCT affects children’s school enrolment in Mali. However, our explanations of the mechanisms are not meant to be exhaustive.

For child work outcome, the program leads to an increase of 3.1 percentage points for participation in domestic work for the whole sample. There is no differential effect for boys and girls. (Chong and Yanez-Pagans, 2019) provided strong evidence that cash transfers can increase child labor when families are unconstrained in the use of the transfers received and (Martinez, 2004) showed that rural households tend to invest the unconditional transfers, which then translates in increases in output and then the probability that children engage in labor in rural areas. In our context, 4% of the transfer is invested in agricultural activities (Hidrobo *et al.*, 2019). Furthermore, in the Mali context, children may be involved in labor. For example, boys are more likely to work outside the home and girls to be engaged in domestic work in rural areas.

2.11 Discussion and conclusion

This paper aims to investigate if the combined intervention of Unconditional Cash Transfers (UCT) and Accompanying Measures (AM) targets to household head which are mostly men and living in large households in the West African context has an effects on children schooling and work. This study was motivated by the need to generate rigorous evidence on the effect of a large-scale, unconditional, government-run cash transfer program in Mali and the West African context. We address this question by measuring the impact of the intervention on children’s outcome two (2) years after the transfers started. We try to see if the program has an impact on school-age children. Since this is a UCT program given to smallholder farmers, ultra-poor and credit constrained, the money can be used according to the household desire and then the impact can be seen in any sphere of household’s life.

We use data from a national cash transfer program and take advantage from a Randomized Control trial (RCT) design in which households were randomly assigned to the treatment and control group. The analysis incorporates individual and household characteristics and control for strata fixed effect. We found that the program has no significant effect on the school enrolment of children 7-16 age. However, when looking at the subgroup effect, based on children’s age and gender, we found a significant effect on girls’ enrolment at primary school. Our findings also indicate a positive and significant impact on child participation in domestic work. The

impact on domestic work comes from time spent helping at home with domestic work, household chores, and taking care of sick family members. The literature usually showed a positive impact on schooling (Baird *et al.*, 2014) and no impact on child labor (de Hoop and Rosati, 2014). The *progesa* program increases by 7 percentage points impact the school enrolment in Mexico (de Brauw and Hoddinott, 2011) and Zambia's Child Grant Program (CGP) increases by 7-8 percentage points the school enrolment (Handa *et al.*, 2016) in Zambia. Even there is no impact on school enrolment for children aged 7-16 in our study, we find a positive impact for girls at primary school. Findings in the literature were explained by the fact that cash transfers alleviate income constraints in poor households. In our study, we found a positive but statistically insignificant effect of the program on education expenditure for girls. The impact in our study may also be explained by the shame for not using appropriately the money or the perceptions to follow rules which are enrolling children especially girls to continue receiving the payments. However, the Accompanying Measure (AM) which are training sessions on different topics are also able to explain these results especially when the emphasis is placed on girls school enrolment. The Malian government has policies promoting universal basic education especially for girls. School enrolment during the baseline for children was around 40 percent as suggested by descriptive statistics and there were more boys enrolled than girls. However, enrolment does not guarantee that a child will regularly attend school all the year, complete his grade and progresses to the next grade. So, attendance is required in addition to the enrolment. If the cash in addition to increasing enrolment, increases attendance and the quality of the education, the children may score higher in academic test scores. In our study, the schooling attendance is high for children at baseline (98%) but we miss data to evaluate the quality of the education. The transfers may also improve the household food security and the nutritional status of children and indirectly affect the child's cognitive ability and learning capacity in school. We also find an increase in child labor. Our labor variables are domestic and agricultural activities. The child participation in domestic work seems to come from helping at home. Our findings of a positive impact on child work are also consistent with those from (de Hoop *et al.*, 2019) who find that two government-run unconditional cash transfer programs in Malawi and Zambia not only increased adult labour supply as a result of new productive opportunities, but also increased children's participation in domestic and economic work. Some studies in the literature found that child labor may increase with household farmland in very poor rural contexts (Fors (2012), Dumas (2013), Oryoie *et al.* (2017)). An important point about child engagement in work is the probability to lower school participa-

tion. Nonetheless, the program slightly impacts child labor with no effect on school participation.

There are some limitations to our analysis. The survey instrument was not developed to comprehensively pick up all the detailed information on children's schooling and work, it lacks leisure data for children and agricultural production data to properly evaluate the implication of children in farm activities.

This work highlights that we do not know enough about the implications of a cash transfer program for children. More efforts are needed to identify changes in children's time allocation. Mali's cash transfer program is a 'cash plus' interventions. Indeed, 'cash plus' interventions provide beneficiary households with regular cash transfers linked to other health or educational services and/or including complementary activities to influence beneficiary behaviour or knowledge (Roelen *et al.*, 2017). We could then know if 'cash plus' interventions help to achieve more successful outcomes. It is essential from a political point of view to be aware of these impacts. Moreover, for (de Hoop *et al.*, 2019), child engagement in work may have benefits, such as on-the-job learning. A deeper understanding of the 'Cash Plus' program effects is useful for the long-term impacts and success of the program, and could well inform policy intervention for the design of future programs.

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Appendix

Table 2.6: Impact of cash on schooling and work

	Enrolled [7-16]				Enrolled [7-13]				Domestic work [7-14]				Agricultural work [7-14]			
	Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls	
Cash Treatment (T)	-0.005 (0.023)	-0.043 (0.04)	0.034* (0.024)	0.029* (0.05)	-0.006 (0.025)	-0.0043 (0.050)	0.043** (0.025)	0.040** (0.021)	0.03 (0.024)	0.027 (0.02)	0.032 (0.02)	0.028 (0.031)	-0.014 (0.023)	-0.026 (0.042)	-0.016 (0.03)	-0.014 (0.04)
Age	-0.051** (0.02)		-0.024 (0.023)		-0.061 (0.05)		-0.07 (0.05)		0.09* (0.05)		0.017 (0.06)		0.172*** (0.06)		0.09 (0.07)	
Head is female	0.036 (0.029)		0.034 (0.027)		0.026 (0.03)		0.02 (0.03)		0.045 (0.03)		-0.012 (0.03)		-0.002 (0.041)		-0.006 (0.04)	
Head is polygamous	0.015 (0.02)		0.025 (0.02)		0.015 (0.02)		0.011 (0.02)		0.01 (0.02)		-0.018 (0.02)		-0.04* (0.02)		0.006 (0.02)	
Household size	-0.006 (0.002)		-0.002 (0.002)		-0.001 (0.002)		-0.002 (0.002)		-0.002 (0.002)		-0.006** (0.002)		-0.007 (0.002)		-0.006** (0.002)	
Head went to school	0.04 (0.03)		0.08** (0.03)		0.022 (0.04)		0.078** (0.03)		-0.084** (0.03)		0.017 (0.04)		-0.025 (0.04)		-0.045 (0.002)	
Head age	0.003 (0.004)		0.005* (0.003)		0.004 (0.005)		0.003 (0.004)		0.0001 (0.000)		0.001 (0.005)		0.06 (0.006)		0.01* (0.005)	
Log total per capita consumption	-0.02** (0.009)		-0.01 (0.009)		-0.02* (0.01)		-0.007 (0.01)		-0.003 (0.01)		-0.005 (0.011)		-0.036*** (0.01)		-0.035*** (0.013)	
Controls	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Observations	3040		2578		2517		2222		2695		2390		2695		2390	

Standard errors are clustered at the commune level. Estimations are adjusted for region (strata) fixed effect.

Asterisks denote statistical significance * p 0.1 ** p 0.05 *** p 0.01

Table 2.7: Horowitz-Manski bounds

Horowitz-Manski bounds			
	Lower	Upper	N
Children aged 7-16 enrolment	-0.13*** [0.000]	0.143*** [0.000]	5618
Boys aged 7-16 enrolment	-0.11*** [0.000]	0.1*** [0.000]	3040
Girls aged 7-16 enrolment	-0.15*** [0.000]	0.20*** [0.000]	2578
Children aged 7-13 enrolment	-0.084*** [0.000]	0.10*** [0.000]	4739
Boys aged 7-13 enrolment	-0.088*** [0.000]	0.06*** [0.002]	2517
Girls aged 7-13 enrolment	-0.08** [0.000]	0.150*** [0.000]	2222
Domestic work (7-14)	-0.09*** [0.000]	0.15*** [0.000]	5085
Domestic work boys (7-14)	-0.06*** [0.002]	0.125*** [0.000]	2695
Domestic work girls (7-14)	-0.120*** [0.000]	0.175*** [0.000]	2390
Agricultural work (7-14)	-0.13*** [0.000]	0.11*** [0.000]	5085
Agricultural work boys (7-14)	-0.112*** [0.000]	0.082*** [0.000]	2695
Agricultural work girls (7-14)	-0.16*** [0.000]	0.13*** [0.000]	2390

Table 2.8: Total education expenditures

	7-16 years			7-13 years		
	All	Boys	Girls	All	Boys	Girls
Cash Treatment (T)	-0.107 (0.09)	-0.062 (0.06)	0.046 (0.07)	-0.057 (0.09)	-0.10 (0.099)	0.014 (0.07)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5618	3040	2578	4739	2517	2222

Standard errors are clustered at the commune level. * p 0.1 ** p 0.05 ***p 0.01 Estimations controls for baseline value of children age, household size, marital status, household head went to school, gender of the children, children can read, Gender of the household head, age of household head, aggregate consumption

Chapter 3

Conflict and agriculture : Can social safety nets have a mitigation effect ?

M.F. Eric Sessou, Christian H.C.A. Henning

Abstract

This paper explores the impact of armed conflict on the probability and expenditures of input use. We investigate the capacity of an unconditional cash transfer program to influence the outcomes. Using panel data collected in 2014 and 2016 in Mali, we combine the control function approach with the correlated random effect model to address the time-invariant unobserved heterogeneity in non-linear context and the endogeneity problem of conflict variable. We find that conflict has a negative and statistically significant impact on the probability of use and expenditures on fertilizers, pesticides and machinery. We take advantage of the randomized rollout of a national cash transfer program and find that there is no differential effect of the conflict impact for households who benefit from the government cash transfer program. Future research may be useful to improve decision-making for policy perspectives.

Keywords: Armed conflict, cash transfer, agriculture, panel data, Mali

3.1 Introduction

The agricultural sector is vulnerable to armed conflict, particularly in developing countries. In 2016, more than half of the 815 million undernourished people in the world lived in countries experiencing armed conflicts and violence (RESILIENCE, 2017). Many studies analyze the effects of conflict and found that in the short run, there is a negative impact on the economy in particular the tourism and foreign direct investment sectors (Enders and Sandler, 2011). However, the impact of conflict on agriculture is poorly understood (Martin-Shields and Stojetz, 2019), particularly in the case of moderate violent conflicts with fewer civilian casualties. During conflicts, there is a shortage of production factors like labor supply that can lower productivity and output. Conflict and political instability could therefore negatively affect household food security through the reduction in food production and household income while raising food prices (Martin-Shields and Stojetz, 2019).

Delivering regular and timely assistance like cash transfer and food assistance in the areas affected by conflict is crucial. An inventory of social assistance programs carried out by the World Bank in 2015 shows that about 1.9 billion people participate in this kind of program worldwide (WorldBank, 2015). Programs such as cash transfer and school feeding are becoming prevalent in mitigating poverty during conflict and other crises (FAO, 2017). A national cash transfer program (*Filets Sociaux*) was introduced as a social safety net program designed by the Malian government and partially funded by international donors. The objective of the program was to reduce poverty and improve human capital accumulation. It was an integrated model of Cash Transfers (CT), Accompanying Measures (AM) and Preventive Nutrition Packages (PNP) targeted to children under 5 years and pregnant women. Households received cash of 10,000 FCFA (equivalent to 20 dollar U.S) per month over 3 years.

Safety nets interventions like CTs programs increase food consumption and improve the quantity and quality of food consumed by poor households (Hidrobo *et al.*, 2018). The evidences of CTs programs as anti-poverty interventions have been widely reported in the literature (Bastagli *et al.*, 2016); ODI and for Global Development (2015). However, most of these pieces of evidences are often generated from studies conducted in non-conflict areas. There are few studies on the effectiveness of the safety nets program in conflict-affected regions in sub-Saharan Africa (SSA). In Mali, Tranchant (2019) analyzed the impact of food assistance on food insecure populations during conflict and Aurino *et al.* (2019) assessed the educational im-

pacts of emergency food assistance during the conflict. In this paper, we contribute to the literature by investigating the impacts of conflict on agriculture, and using a recent randomized rollout of the cash transfer to investigate whether the program mitigates any negative impacts of the conflict.

Since 2012, the country is facing multiple security challenges induced by a separatist rebellion led by the National Movement for the Liberation of Azawad (MNLA) and many non-state armed groups. This resulted in a loss of control in several areas by the authority, where the government services and development programs were interrupted. The agricultural sector has been affected through the destruction of communication facilities and physical infrastructure (roads, bridges...). Infrastructure development has been delayed due to limited financial and implementation capacity, and expansion of cultivated areas is hampered by limited access to agricultural inputs and modern irrigation techniques (Davis, 2014). As a result, the need for humanitarian aid is still widespread, particularly in the north, and food insecurity due to conflict and dependence on weather conditions remains a major problem in Mali (Stiftung, 2018).

Using panel data collected in 2014 and 2016 in the five regions of southern Mali, we analyze the effect of conflict on agriculture in presence of a cash transfer program. The analysis takes advantage of the randomized rollout of Mali's national cash transfer program to investigate whether CTs can mitigate any negative impact of conflict on agriculture.

Conflict exposure data is collected from the Armed Conflict Location & Event Data Project (ACLED) website. Specifically, to estimate the effect of conflict on agriculture, we combined the control function approach with a correlated random effect model to control for household time-invariant unobserved heterogeneity and for conflict endogeneity. We then analyze if the conflict effect varies by whether the household is the government national cash transfer receiver or not.

3.2 Conflict in Mali

Mali has faced multiple rebellions in its history. Tensions between the North and the South have a long history (BOUTELLIS and ZAHAR, 2017). Mali has experienced four waves of Tuareg rebellions since the independence of the country in 1962, 1990, 2006 and 2012. In January 2012, the National Movement for the Liberation of Azawad (MNLA), a separatist rebellion group from the northern part of the country,

attacked a military garrison as part of its protests for an independent Azawad. This attack was facilitated by the fall of the Muammar Gaddafi regime in 2011, which led to a massive influx of weapons and the return of Tuareg rebellions from Libya. In addition, the public discontent and the resentment against the Malian authorities in the southern part of the country, gradually weakened the leadership of the Malian government, ultimately leading to the overthrow of the President (Larémont, 2013).

The MNLA joined AQIM (Al-Qaeda in the Islamic Maghreb), Ansar Dine and the Movement for Oneness and Jihad in West Africa (MUJAO) (a splinter group from AQIM), and between January and April 2012 they took control of main towns in the three northern administrative regions. A coalition of the Economic Community of West African States (ECOWAS), Algeria and France facilitated a peace agreement between northern rebels and the Malian government in June 2015. However, violent incidents have occurred involving various non-state armed groups. That violence from different groups has posed a serious threat to the security of the country and a risk to the implementation of the 2015 peace agreement (Stigall, 2015). In addition, the conflict has in recent times spread to the central part of the country (BOUTELLIS and ZAHAR, 2017). Beyond these political crises, there is growing distrust among Northern dwellers who still consider the state army as an "occupying force" (Pezard and Shurkin, 2015). Indiscipline, ineffectiveness, collusion with traffickers and serious human rights violations have tarnished the image of the security forces in Mali (MUNISMA, 2018). According to the ACLED database, the period from 2014 and 2018 saw 1277 conflict-related events and 2870 fatalities in Mali. Fig 3.1 highlights the distribution of conflict events per region during the same period.

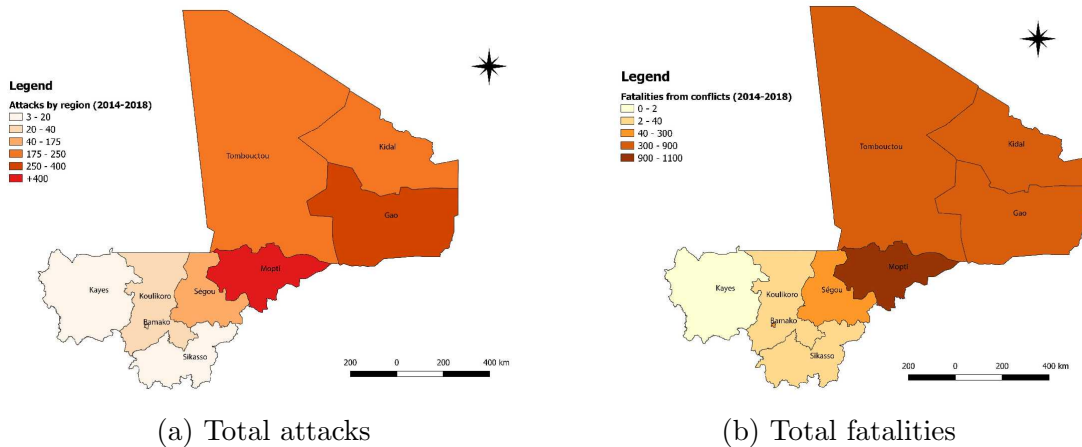


Figure 3.1: Total attacks and fatalities in Mali between 2014-2018 by region
Source: ACLED

However, the Mopti region experienced substantial conflict especially between 2014

and 2018. The region registered more than 1000 deaths, which is higher than the other regions and this shows the intensity of the conflict in this part of the country. In Mopti, 95% of conflict events and fatalities over the last 20 years took place between 2012 and 2016. Conflicts in Mopti increased by 7% and 22% respectively between 2015 and 2016.

3.3 Theoretical framework and Empirical specification

3.3.1 Theoretical framework

To illustrate the relationship between conflicts and the households' investment in productivity-enhancing inputs, we employ a simple model where we consider a household with a production function $G_i = c(L, H, V)$ where L is the labor, H land and V purchased inputs (fertilizer, pesticide and other equipments). We define the price of labor as w , rent for land as r and μ as fertilizer price. We define K_i as the probability of exposure to an attack. K_i is a function of the distance to the Mopti region $K_i = \phi(d_M)$ and $K_i \in [0, 1]$. As defined by Adelaja and George (2019), the household production function when he is exposed to conflict is $(1-K_i)c(L, H, V)$ and will support additional production cost defined as $C_i = g(G_i, K_i)$. The producer profit maximization problem in a conflict environment is:

$$\pi = Max P_G \cdot c(L, H, V) \cdot (1 - K_i) - wL - rH - \mu V - g(G_i, K_i) \quad (3.1)$$

P_G is the output good price. Applying First Order Conditions to this equation, we can derive the inputs demand functions as :

$$L^* = \frac{\partial \pi}{\partial L} = L(w, r, \mu, G, K, P_G) \quad (3.2)$$

$$H^* = \frac{\partial \pi}{\partial H} = H(w, r, \mu, G, K, P_G) \quad (3.3)$$

$$V^* = \frac{\partial \pi}{\partial V} = V(w, r, \mu, G, K, P_G) \quad (3.4)$$

We can then specify the maximum profit $\pi^* = \pi(L^*, H^*, V^*)$ and the input demand equations are a function of input and output prices, wages from labor, and probability of exposure to attack.

Following that, we assume in this study that there is an association between conflict events and the households' investments in productivity-enhancing inputs. We specified the following relationship :

$$Y = f(C, X, W) \quad (3.5)$$

where Y represents the outcome variables and depends on conflict events in the household locality, households characteristics X including environmental factors, and households fixed effect including regions and years effect W .

3.3.2 Empirical specification

We use panel data methods to investigate the effect of conflict on agricultural outcomes. We estimate the following regression model separately for each outcome variable:

$$Y_{ijt} = \alpha + \gamma \text{conflict}_{jt} + \beta X_{ijt} + \lambda CT_{ijt} + \theta_k + \mu_i + v_{it} \quad (3.6)$$

Y_{ijt} is the outcome variable of interest of household i living in locality j at time t . conflict_{jt} is the conflict exposure in locality j at time t and it is assumed to be the same for all households in the same locality. X_{ijt} is a matrix of households-level and environmental factors control variables. CT_{ijt} is a binary defined as 1 if the household receives government cash transfer and 0 otherwise. θ represents the matrix of k region dummies. The composite error terms consist of unobserved time-invariant household-specific effects μ and the time-variant idiosyncratic error term v . The estimation of equation (1) varies by outcome variable. When the outcome is continuous, we apply fixed effect (FE) estimator. For fertilizer, pesticide and machinery expenditure, the outcomes take the value zero for households who do not buy input and positive and continuous for input-buying households. There is a corner at zero for some expenditure categories with substantial shares of households not buying input. To estimate equation (1) for these variables and control for households' time-invariant unobserved heterogeneity, we combine Tobit with Correlated Random Effects model [CRE-Tobit]. This is an alternative to estimating a household fixed effect in non-linear context like Tobit models ¹ where fixed effects (FE) estimator cause well known incidental parameter problem (Mundlak (1978); Chamberlain (1982); Deininger *et al.* (2011); Wooldridge (2009)). The CRE model requires that the means of time-varying explanatory variables are included as additional regres-

¹Incorporating random effects are feasible for panel Tobit regression models

sors in the model. The principle is that these within-panel means are adequately correlated with μ_i so that their inclusion can partly control for the unobserved fixed effects that are correlated with household characteristics. The CRE model allows to include time-invariant variables as explanatory variables in the model and at the same time delivers fixed effect (FE) estimates on the time-varying covariates. Finally, the fertilizer, pesticide and machinery use outcomes are binary and we use probit with CRE approach [CRE-Probit].

Controlling for unobserved time-invariant household-specific effects μ_i helps partially to deal with endogeneity issues. However, we still need to deal with endogeneity for conflict variable. Prior studies have shown the possible endogeneity of conflicts (Ghorpade (2017), Brück *et al.* (2019)). Strict exogeneity for conflict fails if households' conflict exposure is not random. This would be the case if attacks carried out by the armed groups were targeted rather than random. The armed groups have more control in the northern part of the country. Carrying out attacks in the areas close to the northern part of the country is likely less expensive to them. One possible concern might also be that the armed groups' strategy is to target areas experiencing positive economic shocks or where many humanitarian's NGOs and United Nation organizations are established in order to maximize impact and social distress. This would introduce an upward bias in estimates of the effect of conflict on outcomes. There may be omitted factors that affect both outcomes and conflict; there may also be measurement errors in how the conflict exposure is measured. The estimation of our equation requires a method that addresses this endogeneity. We adopt an instrumental variable (IV) approach to overcome the endogeneity concerns and then estimate a combined method which is [IV-FE], [IV-CRE Probit] or [IV-CRE Tobit] depending on the nature of the outcome variable. To do this, we use a control function approach combined with a correlated random effect (CRE) approach as suggested by Lin and Wooldridge (2019) in nonlinear contexts. This approach suggests that, we get the residuals from the first regression, add it to the second stage with the endogenous variable, explanatory variables X_{ijt} and means of time-varying, observed covariates. We use the panel bootstrap to compute robust standard errors.

The IV estimation requires finding at least one exogenous instrument. The validity of an instrumental variable requires to fulfil two criteria : (i) the relevance criteria i.e the instrument should be significantly correlated with the endogenous variable, conflict² in this case and, (ii) the exclusion restriction i.e the instrument has to

²measured as the number of attacks caused by conflict events

influence the outcome variables only through the endogenous variable. We find the instrument for conflict exposure by calculating, based on the GPS data, the distance from the household’s location to the most dangerous place where attacks are concentrated (centroid of Mopti region). Our data show a significantly negative correlation between conflict (number of attacks) and distance to Mopti. The closer the household is located to Mopti, the more likely he is to experience conflict. This is supported by the graph on figure 3.2.

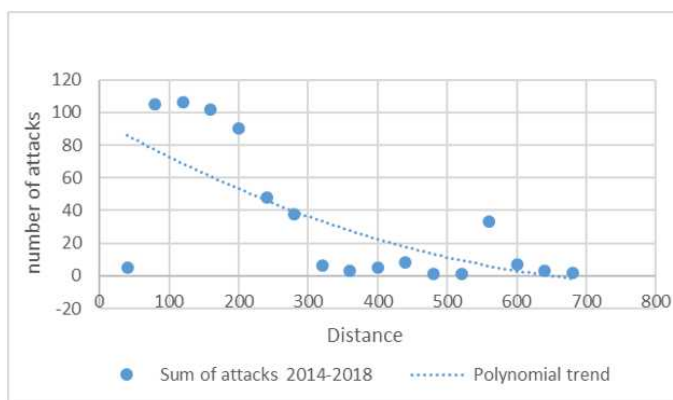


Figure 3.2: Attacks and distance to Mopti center
Source: ACLED and own calculations

The graph shows the total number of attacks occurring in the study areas between 2014 and 2016 by the distance in kilometers between the household’s location and Mopti centroid.

The strategy of instrumenting conflict exposure with the distance to geographical areas of maximum conflict intensity, which could be the border, or the capital of a country is very common in the empirical literature (Rohner *et al.* (2013);Serneels and Verpoorten (2015);Ghorpade (2017);Brück *et al.* (2019);Alfano and Görlach (2019)). In addition, we run an OLS regression of the endogenous variable (conflict) on the instrument (distance) when controlling for covariates, regions and year dummies. Results of the OLS estimations (Table 3.8 in Appendix) show that the suggested instrument is negatively and significantly correlated with distance.

As previously indicated, for the instrument to be valid, it is also required to satisfy the exclusion restriction condition. The instrumental variable used in this work assumes that the distance to the Mopti region has no fundamental effect on our outcomes in general. We assume that, the distance to Mopti is not supposed to directly affect the investment in agricultural input, but only through the conflict events. Moreover, in the model, we control for the household’s unobserved heterogeneity, region fixed effects and time effect.

To investigate if the cash program implemented in the study area has any mitigating effect on conflict, we take advantage of the random assignment of the program and, estimate equation (1) separately for cash receivers and non-receivers and compare the outcome for both subgroups. In addition, we estimate equation (1) without controlling for the cash treatment variable and check whether the effects of conflict (γ) remain the same.

3.4 Data sources and variables descriptions

This paper uses panel data of two households surveys conducted in Mali as part of the national cash transfer program impact evaluation. The Research Institute for Development (in French: Institut de Recherche pour le Développement, IRD) conducted the survey, with the support of the International Food Policy Research Institute (IFPRI). Two-stage probability proportional to size sampling was used. The communes were selected with probability proportional to size within the regions of the country and households were selected using random systematic sampling within each commune. We consider households for whose data was fully available for the previous agricultural season (one year agricultural cycle) and for the two rounds of surveys. We keep a balanced panel of 2039 households. All sampled households were visited for a personal interview using a structured questionnaire, after pretesting. The questionnaire was programmed with SurveyCTO (data entry and CAPI software package) for use with tablet computers. The interviews were conducted by local enumerators who were carefully trained and supervised by the IFPRI and IRD researchers. The household level control variables were collected during the interview with a household questionnaire containing detailed modules on demographics, assets ownership, agriculture, inputs investment, inputs use information and receipt of cash transfers from the government. The distance and environmental variables like annual rainfall were obtained using GPS-based household locations. The rainfall variable is the average 12-months total rainfall from January to December in millimeters for each circle³.

To identify the conflict data, we use the Armed Conflict Location & Event Data (ACLED) geo-coded data. ACLED collects information on armed conflicts events in Africa and some countries in Asia. The dataset covers different types of violent and non-violent conflicts such as civil wars, militia interaction, violence against

³Circle is the next administrative level after region in Mali. . .

civilians, riots, protests. . . and involved actors. From ACLED, we extract events caused by rebels' forces and militias. For the attack variable, we use the number of conflict events caused by armed groups over the 12 months before the interview and resultant fatalities at circle level.

Social protection policies like Unconditional Cash Transfers (UCTs) can help overcome many constraints and allow households to spend and invest in agriculture. Soares *et al.* (2010) found that the Paraguayan Tekopora program increases agricultural expenditures, particularly for extremely poor households while (Maluccio, 2010) finds in Nicaragua that the Red de Proteccion Social has little spending linked to agricultural and non-agricultural activities. Hidrobo *et al.* (2019) found that part of the Mali national cash transfer received by households was invested in agriculture beyond food consumption and health. The outcome variables used in this study are the use of fertilizer and pesticide, and the value of investment in productivity-enhancing inputs such as expenditures on fertilizer, pesticide and machinery during the twelve months before the survey, as reported by farmers during the interviews. It is measured in West African Francs (CFA). In addition, we use the area of cereals cultivated by the households during the previous season.

Table 3.1 presents the definition and summary statistics for the variables used in the analysis. The dependent variable fertilizer, pesticide and machinery use represent the application of the input in the household's farm. They are binary and take the value 1 if the household decides to apply them to his farm. The dependent variable fertilizer, pesticide and machinery expenditure represent the amount of money the household spent buying the inputs. Finally, area cereal measures the cereal areas cultivated by household. In our sample, households invest on average 36000 FCFA/ha in chemical fertilizers and 8000 FCFA/ha on pesticide. The average cultivated area for cereals is 4ha per household.

Many control variables are included in the models. We control for the household socio-economic characteristics, households' assets and access to market, benefit from the government cash transfer program and some environmental factors. Households in our sample are predominantly male-headed. Only 11% of households are female-headed. The age of the household head ranges from 20 to 102 years, with an average of 54 years. The average household size is 11. We also include a dummy variable for the migration status of the household head. This variable serves as a proxy for involvement in off-farming activities. Education is a binary variable coded as 1 if the household head has ever received a formal education and 0 otherwise. Most household head in the sample are not formally educated, only 7% have received a

formal education. To investigate the household's composition in our sample, we describe the number of household members per age range. The average number of household members between 15 and 64 years old is 5 while the number less than 15 years old is 6. Most of the households (96%) own their farmland and the average total land owned by the households is 6 hectares. On average, 77% of the households have received the government cash transfer which is about 120,000 FCFA per year. We measure the conflict with two variables. The first is attacks and the second fatalities. Attack measures the total number of attack events in the household locality for the last 12 months while fatalities measure the number of deaths within the same period. In our sample, households experience between 0 and 17 attacks with a maximum of 56 deaths.

Table 3.1: Descriptive Statistics

Variable	Description and measurement	Mean	Std. Dev.	Min	Max
Outcome variables					
Fertilizer use	1 if household applies fertilizer and 0 otherwise	0.421	0.48	0	1
Pesticide use	1 if household applies pesticide and 0 otherwise	0.291	0.45	0	1
Machinery use	1 if household uses machinery and 0 otherwise	0.117	0.32	0	1
Fertilizer expenditure	Total fertilizer expenditure (1000 FCFA/ha)	36.67	113.26	0	3055
Pesticide expenditure	Total pesticide expenditure (1000FCFA/ha)	8.60	30.90	0	823
Equipment expenditure	Agricultural equipment hiring expenditure per household (1000 FCFA)	4.69	19.58	0	360
Area cereals	Cultivated cereal area per household (ha)	4.27	3.72	0,1	53
Conflict measures					
Attacks	Number of attacks last 12 months	1.30	3.70	0	17
Fatalities	Number of death last 12 months	5.23	12.88	0	56
Control variables					
Land size	Total land own by the household (ha)	6.03	5.68	0	112
Education	Household head has received a formal education (1=yes, 0= no)	0.07	0.26	0	1
Migrant	Household head is a migrant (1=yes, 0= no)	0.51	0.40	0	1
Household size	Number of persons in the household	11.60	5.54	3	46
Age of household head	Age of household head in full year	54.67	14.56	20	102
Cash transfers program	Household benefit of cash transfer program (1=yes,0=no)	0.77	0.41	0	1
Time to closest market	Time to reach the closest market in minutes	50.62	89.95	1	3600
Market road accessible	Road most used to access market is non passable at least once during last month (1=yes,0=no)	0.31	0.46	0	1
Female owned households	Household head is female (1=yes,0=no)	0.11	0.31	0	1
Farmland ownership	Household own farmland (1=yes,0=no)	0.96	0.18	0	1
Cotton zone	Household lives in cotton production area (1=yes,0=no)	0.20	0.40	0	1
Dependency ratio	Household dependency ratio	1.63	0.88	0	8
Members less than 15 years	Number of household members less than 15 years old	5.88	3.22	0	24
Member between 15 and 64 years	Number of household members between 15 and 64 years old	4.57	2.53	0	21
Member more than 65 years	Number of household members more than 65 years old	0.60	0.74	0	5
Rainfall (mm)	Annual rainfall in mm	732.30	203.55	441.6	1382.4
Fertilizer price	Average commercial fertiliser price (FCFA/50kg)	15893.31	1436.03	14000	20000
Simpson Index	Simpson crop diversity index to account for crop diversification	0.501	0.21	0	0.88

As previously mentioned, households were randomly assigned to receive the government cash transfer program. To access whether the covariates we used in our analysis are balanced between cash-receivers and non-receivers groups, we generate Table 3.2 which shows a statistical test of the means difference in covariates between the two groups. As expected, we found no statistically significant difference in covariates, the groups are then balanced.

Table 3.2: Test of covariates balance for cash transfer

	Full Sample	Non-Cash	Cash	P-value
Land size	5.342	5.47	5.306	0.862
Household size	10.212	10.184	10.22	0.668
Age of household head	53.682	53.312	53.787	0.737
Time to closest market	57.862	62.024	56.677	0.468
Female owned household	0.111	0.115	0.11	0.231
Farmland ownership	0.97	0.985	0.966	0.144
Cotton Zone	0.613	0.566	0.626	0.286
Market road accessible	0.226	0.25	0.219	0.443
Fertilizer price/50 kg	16223.01	16216.81	16224.78	0.929
Simpson index	0.455	0.461	0.453	0.708
Dependency ratio	1.632	1.615	1.636	0.242
Number of members more that 65 years old	0.515	0.469	0.529	0.647
Number of members less than 15 years old	5.467	5.5	5.458	0.850
Number of members between 15-64 years old	4.229	4.215	4.233	0.411
Fertilizer Price	16223.01	16216.81	16224.78	0.929
Area cereals	4.009	4.119	3.977	0.932
Fertilizer expenditure (FCFA)	43306.849	51174.828	41065.938	0.730
Pesticide expenditure (FCFA)	8665.591	9047.677	8556.768	0.705
Machinery expenditure (FCFA)	5322.615	6515.001	4983.006	0.339
Fertilizer Use	0.377	0.374	0.378	0.872
Pesticide Use	0.259	0.248	0.263	0.518
Machinery use	0.125	0.137	0.121	0.373
Observation	2039	452	1587	

3.5 Results

3.5.1 Impact of conflict on agriculture

Our main parameter of interest is γ which shows how the conflict events (which is the number of attacks that the household is exposed to in his locality) affect the household's behavior on the utilization and investment in agricultural inputs. Table 3.3 reports the result of γ estimation based on equation (2), while controlling for

household fixed effect, region fixed effect and year effect.

Table 3.3 presents the results that are consistent in the presence of potential endogeneity of the conflict variable. For the input use outcomes, columns (1), (2) and (3) present the marginal effects. With regard to the expenditure in input, columns (4), (5) and (6) present the marginal effects of the observed values of the outcomes.

Table 3.3: Effect of conflict on agriculture

VARIABLES	IV CRE Probit			IV CRE Tobit			IV FE
	Fertilizer Use	Pesticide Use	Machinery Use	Fertilizer Expenditure	Pesticide Expenditure	Machinery Expenditure	Area Cereals
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Number of attacks	-0.010*	-0.111***	-0.022***	-0.015*	-0.233***	-0.145*	-0.051
	(0.006)	(0.007)	(0.007)	(0.039)	(0.063)	(0.079)	(0.066)
Land size	0.007***	0.002*	-0.004	0.005	0.003	0.029	0.485***
	(0.002)	(0.001)	(0.001)	(0.007)	(0.010)	(0.018)	(0.076)
Household size	0.004***	0.003**	-0.001	0.009	0.005	0.034*	-0.009
	(0.001)	(0.001)	(0.001)	(0.006)	(0.007)	(0.017)	(0.019)
Age of household head	-0.007	0.001	-0.003	0.006	0.002	0.022	0.044
	(0.005)	(0.005)	(0.005)	(0.027)	(0.033)	(0.073)	(0.081)
Education	0.065***	0.021***	0.024	-0.054	-0.062	-0.141	0.02
	(0.092)	(0.019)	(0.017)	(0.1)	(0.11)	(0.230)	(0.168)
Migrant	0.140***	0.114**	0.060*	-0.119	0.195	-0.239	0.387
	(0.047)	(0.043)	(0.034)	(0.224)	(0.279)	(0.420)	(0.260)
Time to closest market	-0.006	0.015***	0.001	0.004	0.009	0.031	0.049
	(0.005)	(0.004)	(0.004)	(0.029)	(0.033)	(0.055)	(0.041)
Market road accessible	-0.004	0.022*	-0.005	-0.029	0.054	0.265	-0.116
	(0.013)	(0.012)	(0.011)	(0.065)	(0.080)	(0.194)	(0.111)
Cash transfer program	0.040***	0.025*	-0.020	-0.001	0.059	0.173	-
	(0.015)	(0.014)	(0.013)	(0.078)	(0.109)	(0.200)	-
Female owned households	-0.013	0.001	-0.010	0.161	0.165	0.086	0.152
	(0.021)	(0.022)	(0.016)	(0.099)	(0.103)	(0.198)	(0.370)
Rainfall (mm)	0.568***	1.217***	0.239***	1.238***	2.195***	0.917	-
	(0.061)	(0.060)	(0.059)	(0.329)	(0.438)	(0.690)	-
Farmland ownership	-0.045	0.033	0.021	-0.023	-0.001	1.824**	0.266
	(0.033)	(0.031)	(0.027)	(0.158)	(0.237)	(0.884)	(0.240)
Cotton zone	0.197***	-0.220***	-0.039	1.017***	0.102	0.302	-
	(0.035)	(0.020)	(0.029)	(0.354)	(0.319)	(0.384)	-
Dependency ratio	-0.017	-0.009	0.023*	-0.104	0.043	-0.185	-0.052
	(0.015)	(0.015)	(0.013)	(0.085)	(0.086)	(0.193)	(0.077)
Member older than 65 years	0.066***	-0.010	0.043**	-0.018	0.427**	-0.557	-0.091
	(0.025)	(0.024)	(0.020)	(0.132)	(0.181)	(0.347)	(0.122)
Fertilizer price	-1.459***	-	0.074	0.599	-	0.461	-0.151
	(0.198)	-	(0.196)	(0.954)	-	(2.774)	(1.045)
Simpson index	0.223***	0.178***	0.001	1.663***	1.457***	1.212*	-0.651
	(0.045)	(0.044)	(0.038)	(0.246)	(0.395)	(0.619)	(0.436)
Region FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Observations	4,076	4,076	4,076	3,392	3,392	3,392	4,076

Asterisks denote statistical significance * p 0.1 ** p 0.05 ***p 0.01

Robust Standard error in parentheses

The estimates in Table 3.3 show that the number of attacks reduces the likelihood to use and invest in agricultural input. There is a negative association between the number of attacks and the household's capacity to use and invest in agricultural inputs. Exposure to conflict significantly decreases the use and amount invested in chemical fertilizers, pesticides and machinery by the households.

The CRE-probit model (columns (1),(2),(3)) predicts that each additional attack in the household locality decreases the probability of the use of chemical fertilizer by 0.010, 0.11 for pesticide use and 0.022 for machinery use. Land size, household size and rainfall are also significantly and positively correlated with fertilizer and pesticide use.

The CRE-Tobit model (columns (4),(5),(6)) shows the significant and negative association between the conflict event and the expenditure on fertilizer, pesticide and machinery. Each additional attack in the household locality is associated with an average decrease of 1.5% of fertilizer expenditure, 23.3% on pesticide expenditure and 14.5% of machinery expenditure. The results further reveal that the Simpson index is positively significant for the outcomes, implying a positive association between crop diversification and investment in farm inputs. Finally, we find that conflict events have a negative effect on cereal areas cultivated by the household, but this is not significant.

According to Kimenyi *et al.* (2014), one of the possible ways conflict can affect agriculture is the market disruption which can have an effect on inputs access, commodity prices and market sales. The fear of attacks and the damages to farm equipment prevent the households from using and investing in machinery. For example, Kimenyi *et al.* (2014) reported that in many conflict-affected communities in Mali farm equipment such as irrigation pumps were severely damaged. In addition, the market disruption and the lack of buyers reduced the household's income from agricultural production which may in turn affect their expenditure in hiring or buying agricultural equipment.

During the conflict, farmers reduced the application of inputs that can improve yields. Access to farm inputs is important to produce enough and to meet the demand for food. With the reduction of investment in agricultural input, households may only produce to satisfy basic consumption.

3.5.2 Mitigating effect of unconditional cash transfer program

Previous sections clearly show the negative impact of conflict on agriculture. In this section, we investigate whether the government's cash transfer program implemented as social safety net policy has any mitigating effect on the agricultural outcomes. To do this, we first examine whether the effect of conflict (γ) remains the same after removing the cash transfer (CT) variable from the model. Results displayed in Table 3.7 in the Appendix show that (γ) remains negative, significant and of the same magnitude for all outcomes.

Furthermore, we estimate equation (1) separately for cash receivers and non-cash receivers so that we can compare outcomes for both groups of households. We take advantage of the random assignment of the cash transfer program to the two groups of households to obtain non-bias analysis. For all the estimations, we control for individual and households characteristics and fixed effects.

Table 3.4: Impact of conflict on agriculture for cash receivers and non receivers

	Cash Receivers			Non Cash Receivers			Diff
	IV CRE Probit	IV CRE Tobit	IV FE	IV CRE Probit	IV CRE Tobit	IV FE	
	(1)	(2)	(3)	(4)	(5)	(6)	
Fertilizer use	-0.019* (0.009)			-0.049* (0.017)			-0.03 (0.011)
Pesticide Use	-0.124*** (0.009)			-0.032** (0.025)			0.092 (0.055)
Machinery Use	-0.019*** (0.007)			-0.021* (0.018)			-0.002 (0.016)
Fertilizer Expenditure		-0.058 (0.037)			0.224 (0.107)		0.16 (0.09)
Pesticide expenditure		-0.324 (0.085)			0.205 (0.16)		-0.119 (0.10)
Machinery expenditure		-0.124 (0.01)			-0.233 (0.328)		-0.109 (0.328)
Area cereals			-0.021 (0.114)				-0.154 (0.102) -0.133 (0.08)
Household controls included	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regions dummies included	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies included	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Asterisks denote statistical significance * p 0.1 ** p 0.05 ***p 0.01

Robust Standard error in parentheses

The estimated results in table 3.4 show that there is no significant difference in the impact of conflict on agriculture for cash receivers and non receivers. The cash transfer alone appears to not restore the productive capacity of the conflict-affected populations.

3.5.3 Robustness checks

In the previous sections, we used the attacks variable to measure conflict. To test for the robustness of our results, we use fatalities to measure conflict as previously indicated. We defined fatalities as the total number of people killed in the conflict in the household's locality 12 months before the interview. The further away the household is from Mopti, the less he is affected by the conflicts and less experienced fatalities in his locality. Table 3.5 shows the effect of fatalities as conflict measured on agricultural outcomes with the same format as in Table 3.3. The sample is the same and the results of our robustness checks are consistent with the ones we get with the number of attacks. These confirm that the distance between Mopti and the household's location is a good predictor of the conflict, even when using another measure of conflict.

Table 3.5: Effect of fatalities on agriculture

VARIABLES	IV CRE Probit			IV CRE Tobit			IV FE
	Fertilizer Use	Pesticide Use	Machinery Use	Fertilizer Expenditure	Pesticide Expenditure	Machinery Expenditure	Area Cereals
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Number of fatalities	-0.009*	-0.029***	-0.007***	-0.02*	-0.044***	-0.042*	-0.06
	(0.002)	(0.002)	(0.002)	(0.012)	(0.016)	(0.024)	(0.020)
Land size	0.007***	0.002*	-0.000	0.005	0.003	0.028	0.485***
	(0.002)	(0.001)	(0.001)	(0.007)	(0.010)	(0.018)	(0.075)
Household size	0.004***	0.003**	-0.001	0.010	0.007	0.034**	-0.008
	(0.001)	(0.001)	(0.001)	(0.006)	(0.007)	(0.017)	(0.018)
Age of household head	-0.006	0.000	-0.003	0.007	-0.003	0.019	0.048
	(0.005)	(0.005)	(0.005)	(0.027)	(0.033)	(0.074)	(0.078)
Education	0.065***	0.068***	0.023	-0.0501	-0.079	-0.142	0.002
	(0.022)	(0.018)	(0.017)	(0.101)	(0.1)	(0.26)	(0.17)
Migrant	0.147***	0.115***	0.062*	-0.032	0.149	-0.162	0.385
	(0.047)	(0.039)	(0.034)	(0.225)	(0.23)	(0.34)	(0.25)
Time to closest market	-0.005	0.013***	0.001	0.003	-0.002	0.033	0.041
	(0.005)	(0.004)	(0.004)	(0.029)	(0.034)	(0.056)	(0.041)
Market road accessible	-0.003	0.016	-0.007	-0.027	0.037	0.255	-0.118
	(0.013)	(0.012)	(0.011)	(0.065)	(0.081)	(0.198)	(0.113)
Cash transfer program	0.040***	0.023*	-0.021	0.008	0.064	0.173	-
	(0.015)	(0.014)	(0.014)	(0.078)	(0.109)	(0.201)	-
Female owned households	-0.014	-0.001	-0.009	0.156	0.166	0.094	0.208
	(0.021)	(0.022)	(0.016)	(0.099)	(0.102)	(0.199)	(2.313)
Rainfall (mm)	0.620***	1.045***	0.211***	1.221***	1.556***	0.846	-0.425
	(0.056)	(0.057)	(0.054)	(0.302)	(0.358)	(0.662)	(0.760)
Farmland ownership	-0.040	0.029	0.020	-0.006	-0.028	1.812**	0.262
	(0.033)	(0.031)	(0.027)	(0.160)	(0.238)	(0.884)	(0.238)
Cotton zone	0.131***	-0.139***	-0.010	0.751***	0.486*	0.366	-
	(0.031)	(0.024)	(0.024)	(0.291)	(0.285)	(0.355)	-
Dependency ratio	-0.017	-0.008	0.023*	-0.098	0.045	-0.186	-0.048
	(0.015)	(0.015)	(0.013)	(0.086)	(0.086)	(0.195)	(0.079)
Member older than 65 years	0.066***	-0.012	0.043**	-0.019	0.425**	-0.557	-0.097
	(0.025)	(0.024)	(0.020)	(0.133)	(0.179)	(0.355)	(0.121)
Fertilizer price	-1.488***	-	0.025	0.621	-	0.271	-
	(0.196)	-	(0.199)	(0.955)	-	(2.790)	-
Simpson index	0.224***	0.177***	0.001	1.655***	1.461***	1.202*	-0.649
	(0.045)	(0.045)	(0.037)	(0.246)	(0.393)	(0.614)	(0.429)
Region FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Observations	4,076	4,076	4,076	3,392	3,392	3,392	4,076

Asterisks denote statistical significance * p 0.1 ** p 0.05 ***p 0.01

Robust Standard error in parentheses

To further check the robustness of our analysis, we consider an alternative measure of conflict that is the total number of attacks and fatalities taken together. As expected the results are robust with the previous ones (Table 3.6 in the Appendix).

3.6 Discussion and conclusions

This study has analyzed the effects of exposure to moderate conflict, measured at the community level, on household investment in productivity-enhancing inputs in agriculture and investigated the role of a large, government-run unconditional cash transfer program to mitigate the impacts. To address the endogeneity problem of conflict exposure, we use an instrumental variable approach, and to control for time invariant unobserved heterogeneity in the non-linear model we use the Correlated Random Effects model (CRE).

We found that exposure to violence such as terrorism and armed group attacks experienced by the population in Mali have reduced the investments households made in productivity-enhancing inputs. The results show a reduction of both the probability of use and the expenditures in fertilizer, pesticide and machinery. The results also show a reduction of cereal areas cultivated by the households, however this is not statistically significant.

By looking at the effects of conflict in presence of a cash transfer program, the results show that the cash transfer program as implemented in Mali has no significant effect in mitigating the negative impacts of conflict on investments in agricultural inputs. Conflict still has negative effects on agricultural outcomes even in the presence of a cash transfer program. The negative effect of conflict on the use and investment in agricultural inputs may be explained by the market disruption. Markets can be disrupted by conflict, as travelling becomes more difficult and risky (Masset *et al.* (2021)). The majority of our sampled households obtain inputs from agro-dealers. Because of the conflict, the agro-dealers have to travel to risky destinations to purchase and transport the input, thereby increasing transaction costs and the total costs of the product at the farmers' level. Masset *et al.* (2019) by analyzing the impact of conflict on agriculture in Mali found a decline in agricultural production and profits, suggesting that farmers were facing higher production costs.

The security risk and the fear associated with the presence of conflict could be a major reason for a reduced investment in agriculture. Because of the fear of attacks, some producers may completely abandon participating in agricultural markets. The

conflict environment can also reduce the off-farm employment opportunities, because of fear and uncertainty caused by anticipated future attacks (Adelaja and George, 2019). In addition, a drop in agricultural profit may generate a reduction of household income and less investment in input and farm equipment. Column (7) of Table 3.3 shows a negative but non-significant impact of attacks on the area of cereals cultivated by households. The non-significant effect of conflict may be driven by the importance of cereals for the household's subsistence. Consumption is a primary objective for the households in conflict environment, then a large part of cereals produced are mostly consumed.

Credit access can also have an effect on investment in productivity-enhancing inputs. The literature shows that credit can improve farmers' access and use of agricultural input (Mahoukede *et al.* (2015); Appiah *et al.* (2016)). However, farmers are often constrained in accessing credit in our study areas. Less than 3% of the survey households have access to credit.

The results further show that even in the presence of a cash transfer program, we find no significant difference in investments in farm inputs. These findings are similar to that of (Masset *et al.* (2021)). The authors found that the provision of food assistance had no impact on farming in Mali. But Tranchant (2019) found that social protection policies like food assistance have a protective effect among food insecure population in conflict context in Mali. Ecker *et al.* (2019) in their analysis in Yemen found that cash transfers can mitigate the detrimental impact of lingering civil conflict on child nutritional status. The same authors stressed the regularity of the cash transfer as an important point in mitigating the effect of the conflict. The productive capacities of households in Mali have been reduced because of the conflict and the cash transfer alone is not able to restore it. A recovery of markets operations can come through the eventual re-establishment of security.

This study contributes to the literature gap on the conflict effects on agriculture at the micro-level, and calls for greater attention to evidence for conflict-affected populations in the presence of social safety nets. This research is useful for better decision-making for humanitarian and development organizations.

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Appendix

Table 3.6: Combined effect of attacks and fatalities on agriculture

VARIABLES	IV CRE Probit			IV CRE Tobit			IV FE
	Fertilizer Use	Pesticide Use	Machinery Use	Fertilizer Expenditure	Pesticide Expenditure	Machinery Expenditure	Area Cereals
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Attack + Fatalities	-0.006* (0.002)	-0.023*** (0.002)	-0.005*** (0.002)	-0.001* (0.009)	-0.038*** (0.013)	-0.033* (0.018)	-0.05 (0.017)
Land size	0.007*** (0.002)	0.002* (0.001)	-0.001 (0.001)	0.005 (0.007)	0.003 (0.010)	0.028 (0.018)	0.485*** (0.075)
Household size	0.004*** (0.001)	0.003** (0.001)	-0.001 (0.001)	0.009 (0.006)	0.006 (0.007)	0.034** (0.017)	-0.008 (0.019)
Age of household head	-0.006 (0.005)	0.001 (0.005)	-0.003 (0.005)	0.006 (0.027)	-0.002 (0.033)	0.020 (0.074)	0.048 (0.079)
Education	0.065*** (0.022)	0.07*** (0.018)	0.023 (0.017)	-0.051 (0.101)	-0.076 (0.1)	-0.141 (0.258)	0.002 (0.168)
Migrant	0.145*** (0.047)	0.115*** (0.039)	0.061* (0.034)	-0.025 (0.225)	-0.160 (0.229)	-0.167 (0.343)	0.387 (0.260)
Time to closest market	-0.005 (0.005)	0.013*** (0.004)	0.001 (0.004)	0.004 (0.029)	0.001 (0.034)	0.032 (0.055)	0.042 (0.042)
Market road accessible	-0.003 (0.013)	0.017 (0.012)	-0.007 (0.011)	-0.027 (0.065)	0.040 (0.081)	0.257 (0.197)	-0.118 (0.113)
Cash transfer program	0.040*** (0.015)	0.023* (0.014)	-0.020 (0.014)	0.006 (0.078)	0.063 (0.109)	0.173 (0.200)	- -
Female owned households	-0.013 (0.021)	-0.000 (0.022)	-0.009 (0.016)	0.157 (0.099)	0.165 (0.102)	0.092 (0.199)	0.205 (2.312)
Rainfall (mm)	0.611*** (0.057)	1.082*** (0.057)	0.217*** (0.055)	1.230*** (0.308)	1.674*** (0.374)	0.863 (0.667)	-0.391 (0.813)
Farmland ownership	-0.041 (0.033)	0.030 (0.031)	0.020 (0.027)	-0.009 (0.160)	-0.022 (0.238)	1.815** (0.884)	0.262 (0.238)
Cotton zone	0.144*** (0.032)	-0.158*** (0.023)	-0.016 (0.025)	0.807*** (0.304)	0.411 (0.291)	0.350 (0.360)	- -
Dependency ratio	-0.017 (0.015)	-0.009 (0.015)	0.023* (0.013)	-0.099 (0.085)	0.044 (0.086)	-0.186 (0.194)	-0.048 (0.080)
Member older than 65 years	0.066*** (0.025)	-0.011 (0.024)	0.043** (0.020)	-0.018 (0.132)	0.425** (0.180)	-0.558 (0.353)	-0.097 (0.122)
Fertilizer price	-1.478*** (0.196)	- -	0.038 (0.198)	0.609 (0.954)	- -	0.316 (2.787)	- -
Simpson index	0.224*** (0.045)	0.177*** (0.045)	0.001 (0.037)	1.658*** (0.246)	1.460*** (0.394)	1.205* (0.615)	-0.650 (0.430)
Region FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Observations	4,076	4,076	4,076	3,392	3,392	3,392	4,076

Table 3.7: Impact of conflict on agricultural outcomes while controlling or not for cash transfer

	Not Controlling for Cash			Controlling for Cash		
	IV CRE Probit (1)	IV CRE Tobit (2)	IV FE (3)	IV CRE Probit (4)	IV CRE Tobit (5)	IV FE (6)
Fertilizer use	-0.011* (0.006)			-0.010* (0.006)		
Pesticide Use	-0.112*** (0.007)			-0.111*** (0.007)		
Machinery Use	-0.021*** (0.007)			-0.022*** (0.007)		
Fertilizer Expenditure		-0.014 (0.038)			-0.015 (0.039)	
Pesticide expenditure		-0.238*** (0.061)			-0.233*** (0.063)	
Machinery expenditure		-0.149* (0.079)			-0.145* (0.079)	
Area cereals			-0.05 (0.065)			-0.051 (0.066)
Household controls included	Yes	Yes	Yes	Yes	Yes	Yes
Regions dummies included	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies included	Yes	Yes	Yes	Yes	Yes	Yes

Asterisks denote statistical significance * p 0.1 ** p 0.05 ***p 0.01

Robust Standard error in parentheses

Table 3.8: First stage regression

VARIABLES	First stage regression
Distance to mopti	-0.0112*** (0.00235)
Land size	-0.0169 (0.0106)
Household size	-0.0205** (0.00930)
Age of household head	0.0177 (0.0151)
Age of household head squared	-7.84e-05 (0.000135)
Time to closest market	0.0682 (0.0510)
Market road accessible	-0.0662 (0.141)
Female owned households	0.0113 (0.120)
Rainfall (mm)	-0.181 (1.255)
Farmland ownership	0.0386 (0.232)
Regions effect	Yes
Year effect	Yes
Observations	4,078
R-squared	0.442

Asterisks denote statistical significance * p 0.1 ** p 0.05 ***p 0.01

Robust Standard error in parentheses

Chapter 4

Cash Transfer programs and exit strategies adoption: Evidence from Mali

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Abstract

Cash transfer programs are becoming a key component of social safety nets policies in developing countries. Many pieces of evidence exist on the impact of the programs. However, policymakers still miss information on the different exit strategies that can prevent extremely poor households from falling back into the poverty trap after leaving the program. To address this challenge, this article uses a multinomial endogenous treatment effects model in combination with propensity score matching techniques to evaluate the impact of income generating activities as cash transfer program exit strategy on the household welfare in Mali. We rely on a unique and detailed cross-sectional dataset that covers a random sample of 1275 cash beneficiaries' households. The results indicate that income generating activities significantly influence the cash beneficiaries' household welfare. We found strong evidence that the hypothesis of selectivity bias cannot be rejected. The estimates of the impact on welfare are consistent across specifications for matched and unmatched samples. This study will help to promote evidence-based policies and inform decision-makers on which are the best exit strategies for cash transfer programs.

Keywords: Cash transfer, exit strategies, adoption, impact evaluation, Mali.

4.1 Introduction

Safety nets and social assistance policies have taken the form of cash or in-kind transfers aiming at tackling poverty and vulnerability. A review of the impact of cash transfer programs based on 165 studies in low and middle-income countries over the period from 2000 to 2015 shows that the cash transfer programs have a positive impact on monetary poverty, education, health and nutrition, savings, investment, production, work, and women empowerment (Bastagli *et al.* (2019)). Eligible households start their participation in cash transfer programs once they are classified in the extreme poverty group by the targeting methods. The participation to the program helps these households to build up precautionary assets and savings that could be used to maintain a minimum living standard (Bastagli *et al.* (2016)).

Evidences from the literature (Haushofer and Shapiro (2016);Asfaw *et al.* (2017); Brugh *et al.* (2018);Hidrobo *et al.* (2018);Iqbal *et al.* (2020)) demonstrate the effectiveness of transfer programs in short-run. However, very little is known as to whether short-term impacts translate into longer-term gains (Millán *et al.* (2019)). Even if they are no longer extremely poor, households exiting the cash transfer program remain largely impoverished. It is therefore important to find a system that guarantees a minimum income to those households. Exit strategies are the cash program intervention that aims to promote the sustainable independence of beneficiaries that are close to exiting from the cash transfer program, by increasing their autonomous income generation capacity (Paes-Sousa *et al.*, 2013). Establishing a good exit strategy for cash transfer programs will prevent the poor households leaving the program from falling back into extreme poverty.

Few studies investigated the trajectory of households benefiting from cash once they leave the program. For instance, Mexico’s national cash transfer program “PROGRESA”, (Parker and Vogl (2018)) found improvements in household-level asset indices after 13 years. To the best of our knowledge, no research has been made in sub-Saharan Africa (SSA) on whether the different cash transfer exit strategies can enable sustainable changes in the beneficiaries’ welfare.

This paper attempts to fill this knowledge gap in SSA by investigating whether the choice of an income generating activity (IGA) as an exit strategy enhances the welfare of the cash beneficiaries.

Empirically, this paper used the endline data from the national cash transfer programme evaluation in Mali. The program provided beneficiary households with unconditional cash transfers and accompanying measures during a period of 36 months.

Income Generating Activities (IGAs) are alternative income sources for households. They refer to activities aiming at encouraging participants to obtain additional income to supplement what they earn from their main occupations. IGAs generally include among others products processing, edible oil extraction, animal husbandry and especially poultry farming, fisheries, mushrooms farming, and so on.. The incomes generated from these activities may seem small, but they play significant roles in household livelihoods (IFAD (2007)). Many people in developing countries are engaged in income generating activities to reduce poverty. Most of them are living in extreme poverty. For example, rural women in Bangladesh engaged themselves in different IGAs for earning money through small loans in the form of microcredits from different loan providers. This enables them to improve their economic condition (Sultana and Hasan (2010)).

The Malian government through its national cash transfer program introduced IGAs as an exit strategy to consolidate the impact of the cash transfer program on the beneficiaries, and permanently remove them from extreme poverty. That way, the government would guarantee a minimum income to these beneficiaries, which can help them to meet their basic needs even after exiting the program. The exit strategy is implemented through the Behaviors Change Communication (BCC) in the Accompanying Measures (AM) component of the program for households approaching the end of their participation in the cash transfer program. This is a support measure put in place by the government to empower the benefiting households exiting the program. They will therefore be equipped to continue their path out of poverty.

This paper contributes to the limited literature on the impact of IGAs as cash transfer exit strategy on the household welfare in SSA. It aims at identifying the determinants and impacts of IGAs on rural households' welfare measured in consumption expenditure per capita. Two specific questions are of interest: What are the determinants of the choice of the IGAs and what is the choice's impact on consumption expenditure per capita. We used consumption expenditure per capita as a proxy for the cash beneficiary household's welfare.

We relied on detailed household data which enables us to control for endogeneity and selection bias which might arise due to the correlation of unobservable heterogeneities and observed explanatory variables. We applied a maximum simulated likelihood estimation of a multinomial endogenous treatment effect model (METE) that we combined with the propensity score matching to account for observable and unobservable heterogeneity. We find that generally, IGAs increase cash beneficiary

households' welfare.

The rest of the paper is organized as follows: section 2 presents the econometrics framework, the model specification and the estimation strategy applied in the study. Section 3 presents the variables, data and descriptive statistics. Results and the discussion are presented in section 4. The last section concludes.

4.2 Econometric framework

The choice of an IGA by households depends on their specific observed and unobserved characteristics. We use the multinomial endogenous treatment effect model proposed by (Deb and Trivedi (2006)) to account for unobserved variables. This model is a two-stage model. In the first stage, decision process to choose an IGA is modeled by a mixed multinomial logit model and in the second stage, the impact of each IGA on the outcome variable. The model is estimated using the maximum simulated likelihood approach. To control for selection bias on observed variables, we use the propensity score matching (PSM) method.

4.2.1 The multinomial endogenous treatment effects model

To model the exit strategy choices and their impact on household's welfare, we used the multinomial endogenous treatment effect model developed by Deb and Trivedi (2006). The model has two components: treatment equation and outcome equation. In the first step of the model, the cash beneficiary choose one exit strategy from four options (1) vegetable production (2) animal fattening (3) poultry rearing and (4) no IGA. We formulate the hypothesis that the cash transfer beneficiary maximizes its utility V_{ij} by comparing the utility provided by alternative choices. A given cash beneficiary i will choose an IGA j against any other alternative k if and only if $V_{ij} > V_{ik}$, $j \neq k$. Following Deb and Trivedi (2006), let's EV^* represents the indirect utility associated with the j^{th} choice of IGA, $j=0,1,2...j$. Then the model describing the utility is written :

$$EV_{ij}^* = Z_i' \alpha_j + \gamma_j \lambda_{ij} + \eta_{ij} \quad (4.1)$$

Z_i is exogenous variables and α_j is its associated parameter to be estimated. λ_{ij} is the latent factor that includes the unobservable characteristics common to the choice of IGA and welfare for cash beneficiaries. η_{ij} is the error term. Latent factors λ_{ij} is suppose to be independent of the error term η_{ij} . Following Deb and Trivedi

(2006), let $j=0$ represents the cash beneficiaries who choose no IGA options and $EV_{i0}^* = 0$. EV_{ij}^* cannot be observed, but the choice of IGAs can be measured by a set of binary variables and are stored for each beneficiary in a vector denoted, $d_i = (d_{i1}, d_{i2}, \dots, d_{ij})$. Similarly, we assume $\lambda_i = (\lambda_{i1}, \lambda_{i2}, \dots, \lambda_{ij})$. Based on these assumptions, the probability of choosing an IGA, conditional on the latent variables is written as:

$$Pr(d_i|Z_i, \lambda_i) = f(Z_i'\alpha_1 + \gamma_1\lambda_{i1}, Z_i'\alpha_2 + \gamma_2\lambda_{i2}, \dots, Z_i'\alpha_j + \gamma_j\lambda_{ij}) \quad (4.2)$$

Where f is a multinomial probability distribution function. As shown in the model of Deb and Trivedi (2006), we assume that f has a Mixed Multinomial Logit structure (MMNL) defined as:

$$Pr(d_i|Z_i, \lambda_i) = \frac{\exp(Z_i'\alpha_j + \gamma_j\lambda_{ij})}{1 + \sum_{k=1}^J \exp(Z_i'\alpha_k + \gamma_k\lambda_{ik})} \quad (4.3)$$

In the second step, we investigate the impact of choosing an IGA on the welfare which is measured by the total household consumption expenditure per capita. The expected outcome equation is formulated as:

$$E(y_i|d_i, x_i, \lambda_i) = x_i'\beta + \sum_{j=1}^J \gamma_j d_{ij} + \sum_{j=1}^J \theta_j \lambda_{ij} \quad (4.4)$$

x_i represents exogenous covariates with parameter vectors β , parameter γ_j represents the treatment effect (e.g. vegetables cultivation, animal fattening, rearing) relative to control choice (no income generating activity). Specifically, coefficients γ_j measures the impacts of the choice of the IGA on the household welfare. Since $E(y_i|d_i, x_i, \lambda_i)$ is a function of the latent factors λ_{ij} , the outcome variable is affected by unobserved characteristics which affect the selection into treatments.

It is important to note that when the coefficient of the latent factor θ_j , is positive (negative), the treatment and the outcome are positively (negatively) correlated through unobservable characteristics, i.e there is positive (negative) selection, with γ and θ the associated parameter vectors. Because our outcome variable is continuous, we assume a normal distribution function. The model was estimated using the stata command *mtreatreg*. This command fits models with multinomial treatments and continuous, count and binary outcomes using maximum simulated likelihood Deb (2009). For all estimations, 500 simulations draws were used, based on Halton

sequences. Standard errors were adjusted at the household level to account for potential heteroskedasticity.

Parameters of the fitted model can be identified even if an exclusion restriction variable is not included in the treatment equation (Deb and Trivedi (2006)). However, it is recommended the use of at least one exclusion restriction or instrumental variable for a more robust identification. We used distance to the main road as exclusion restriction variable. Our instrumental variable, is only included in the treatment equation and excluded from the outcome equation. The distance from the cash beneficiary households' location to the main road is a measure of remoteness and can influence the choice of the IGA but cannot have a direct effect on the household consumption expenditure per capita. To test this, we perform the falsification test proposed by (Di Falco *et al.* (2011)). In this test, a variable is a valid instrument if it affects the decision to choose IGA but does not affect the outcome variable among the sub-sample of no-IGA choosing. We show that our instrument does not influence the household consumption expenditure per capita through mechanisms other than the distance to the main road (Table 4.5 in the Appendix). In addition, the instrument we use is statistically significant in the equations of the multinomial regression (first stage).

4.2.2 Propensity score matching method for multiple treatment

This study aims at evaluating the impact of multiple treatments (4 treatments) on the household's welfare. The objective is to isolate the initial differences of the cash recipients' characteristics from the real effect of each treatment on welfare. The economic literature has proven the effectiveness of the propensity score matching method to control for selection bias on observable characteristics. The method is generally used in the case of binary treatments where individuals in the treatment group are compared to those in the control group who have on average the same propensity scores. In the case of binary treatment, the average treatment effect on treated is :

$$\theta(x) = E(Y^T - Y^C | D = 1, X = x) = E(Y^T | D = 1, X = x) - E(Y^C | D = 1, X = x) \quad (4.5)$$

In this equation, Y^T and Y^C represent the potential outcome of the individuals in the treatment group ($D=1$) and the control group ($D=0$) and X the set of observ-

ables covariates. Since the average result of the counterfactual $E(Y^C|D = 1, X = x)$ is unobservable, $\theta(x)$ can only be estimated by the matching method if conditional on observable characteristics, the potential results of untreated individuals are independent of the treatment (assumption of conditional independence). This assumption can be written as follow:

$$Y^C \perp\!\!\!\perp D|X = x \quad \forall x \in X \quad (4.6)$$

$\perp\!\!\!\perp$ represent the independence. Rubin (1977) and Rosenbaum and Rubin (1984) show that under the conditional independence hypothesis, it is not necessary to match on the observable characteristics, but only on the probability of being treated conditional on the observable characteristics (the propensity score). This allows the dimension of the estimate to be reduced to one. In the case of multiple treatment of $(M+1)$ treatment mutually exclusive, the potential outcome are represented as Y^0, Y^1, \dots, Y^M . For each individual, we can observe only one outcome of Y^0, Y^1, \dots, Y^M . Which means that for $M=0$, we observe Y^0 and the other M outcomes are counterfactuals. The average treatment effect m relative to treatment l for participants in treatment m is written as follows:

$$\theta^{m,l}(x) = E(Y^m - Y^l | D = m, X = x) = E(Y^m | D = m, X = x) - E(Y^l | D = m, X = x) \quad (4.7)$$

$D \in \{0, 1, \dots, M\}$ represent the type of treatment. The equation (4.7) represents the expected effect for a random individual drawn from the population of participants in the treatment m . The equation also shows that the problem of evaluation is also a missing data problem in the case of multiple treatment since the potential result $E(Y^l | D = m, X = x)$ is not observable for the same individual.

According to Imbens (2000) and Lechner (2001), Lechner (2002) the conditional independence hypothesis implies that all potentials results are independent of treatment given the observable characteristics.

$$Y^0, Y^1, \dots, Y^M \perp\!\!\!\perp D|X = x \quad \forall x \in X \quad (4.8)$$

Imbens (2000) and Lechner (2001) show that the properties of the propensity score of binary treatment are also valid for multiple treatments. The conditional independence hypothesis to estimate $\theta^{m,l}(x)$ is:

$$Y^l \perp\!\!\!\perp D | p^{l/ml}(x), D \in \{m, l\} \quad \forall x \in X \quad (4.9)$$

Lechner (2001) shows that the average treatment effect of m relative to treatment l for participants in treatment m defined in equation (4.7), can be estimated as follow:

$$\theta^{m,l} = E(Y^m | D = m) - E_{p^{l/ml}(x)} [E \{Y^l | p^{l/ml}(x), D = l\} | D = m] \quad (4.10)$$

$$p^{l/ml}(x) = p^{l/ml}(D = l | D \in \{m, l\}, X = x) = p^l(x) / [p^l(x) + p^m(x)] \quad (4.11)$$

As in the case of binary treatments, equation 4.10 can be estimated by matching on the balanced propensity scores $p^{l/ml}(x)$.

In terms of the empirical application of this theory on the multiple treatment effects, two approaches emerge from the literature. A first approach is that of Imbens (2000) and Lechner (2001) where the propensity score is estimated by a logit or multinomial probit model. A second approach is to use a series of binomial models to estimate the propensity scores. This approach requires estimation of $M(M-1)/2$ propensity score models Lechner (2002) which is 6 in our case. The advantage of binomial models is that their assumptions are less restrictive than the multinomial logit. Moreover, according to Lechner (2002), binomial models are less sensitive to specifications than the multinomial model. The author has also shown empirically that binomial models produce similar results to the multinomial model. However, this empirical study alone is not sufficient to generalize the result. For more flexibility, we adopted the binomial models.

Following Lawin and Tamini (2019), our PSM approach is implemented in three main steps. First, we estimated the propensity scores with a binomial logit model for each pair of IGA choices. To ensure that the conditional independence hypothesis holds, we have included in the propensity score estimation equations the variables that are likely to influence both the household consumption expenditure per capita and the choice of income generating activities. These variables were identified from the literature. For each model, to ensure that the treatment and control group are comparable on the basis of the covariates, we performed some balancing tests before and after pairing. The estimated propensity scores are used to perform the match. But before pairing, we need to make sure that the common support hypothesis is

verified. So in a second step, we deleted the observations whose propensity score is outside the common support. This implies that observations that are outside the common support in at least one of the income generating activities choices pairs have been deleted. The third step is pairing for each pair of income generating activities choices. We used the PSMATCH2 command in stata to do pairing. We used the options "nonreplacement", so that control group observation can be used only once for the pairing, the "common" option which means that before the matching, we delete all observations from the treatment group whose propensity scores are outside the range of propensity scores of the control group and finally "caliper (0.01). To test the quality of our pairing, following Leuven and Sianesi (2003) and Bravo-Ureta *et al.* (2012), we performed mean t-tests between the treated group and the control group in each pair of income generating activities choices to test the null hypothesis of equality of means.

4.3 Data, variables and descriptive statistics

The cross-sectional data used for this analysis come from a survey conducted in Mali, which covers a random sample of 1,599 households that mainly benefited from a national cash transfer program over 3 years (2014 - 2017). The survey was done under the endline impact evaluation of Mali's national cash transfer program performed by the International Food Policy Research Institute (IFPRI) in collaboration with the French National Research Institute for Sustainable Development (IRD) between August-November 2018. A multistage sampling procedure was applied for the selection of households. The households in this study received information on income generating activities (IGAs) as cash transfer program exit strategy through the behaviour change communication message (BCC) during the program accompanying measure section. A structured household questionnaire was used to collect information. The questionnaire covers many modules like socio-demographic information, households assets, agriculture, household expenditures, access to infrastructure, shocks, and investment. This sample included farmers located in 3 regions of southern Mali (Kayes, Segou, Koulikoro).

According to Becerril and Abdulai (2010), the per capita expenditure reflects the effective consumption of households and therefore provides more information on the welfare and poverty status while the household income indicates the ability of the household to satisfy its basic needs. Our outcome variable is the total household's consumption expenditure per capita. To construct the outcome variable, we

used 7-day recalls to capture household food expenditure, and 30-day recall for frequently purchased items and non-durable goods. 12 months recall period was used for durable items and transfer payments spent by the household. All consumption categories have been converted to their respective total annual consumption levels. The total annual household consumption expenditure was standardized by the adult equivalent of the household to obtain the consumption expenditure per capita.

Table 4.1 presents the definition and descriptive statistics of the variables used in the analysis. The average age of the household head is 55 years old. About 40% of the households are polygamous. The average household size is 13 members. The average farm size of the respondents is about 5.62 hectares. To explore the household member distribution by working age, we estimated the number of household members less than 15 years old, the number within 15 and 60 years old and the number older than 60 years. An average of 6 members have less than 15 years old, while 5 members have between 15 and 64 years old. Few members have more than 65 years old. Active members are aged between 15 and 64 years old and dependents group members are aged below 15 years and more than 65 years. Education is captured by using the household head's literacy by asking if the household head can read and write. Statistics in table 4.1 showed that only 12% of household head can read and write. Distance to the nearest main road and distance to the nearest city was used to show the household's village accessibility. Walking distance in minutes to the food market and market road accessibility in the last 30 days provides information about transaction costs involved in market access. The variable fertilizer captures the value in FCFA of total fertilizer used for the production. The variable representing shocks is used to control for unexpected events influencing selection into income generating activities, as well as the impact from participating in IGA. About the land tenure, the majority of the households own their land.

Table 4.1: Descriptive statistics of variables used in the analysis

Variables	Description	Mean	SD
Age of household head	Age of household head in full year	55.863	14.157
Female-headed household	Household head is female (1 = yes; 0 = Otherwise)	0.115	0.319
Household head is polygamous	Household head is polygamous (1 = yes; 0 = Otherwise)	0.407	0.491
Household size	Number of persons in the household	13.580	6.665
Literacy	Household head can read and write (1 = yes, 0 = Otherwise)	0.125	0.331
Members less than 15 years	Number of household members less than 15 years old	6.421	3.487
Members between 15 and 64 years	Number of household members between 15 and 64 years old	5.130	2.991
Members more than 65 years	Number of household members more than 65 years old	0.728	0.819
Market distance	Walking distance in minutes	42.728	56.605
Household owns saving	Binary, 1 = yes, 0 = Otherwise	0.49	0.5
Farm size	Total size in hectare of all parcels of the household	5.620	4.720
Region: Kayes	Locality binary, 1 = yes, 0 = Otherwise	0.523	0.5
Region: Koulikoro	Locality binary, 1 = yes, 0 = Otherwise	0.136	0.342
Region: Segou	Locality binary, 1 = yes, 0 = Otherwise	0.341	0.474
Road accessible last 30 days	Market road accessible in the last 30 days (1 = yes, 0 = Otherwise)	0.362	0.481
Consumption expenditure per capita	Household's Consumption expenditure per capita (FCFA)	74600.649	133142.129
Shock	Household receive any shock in the past 12 months (1 = yes, 0 = Otherwise)	0.248	0.432
Fertilizers	Value of fertilizer use for production in FCFA	46672.322	99846.803
Tenure	Land ownership (1=own land, 0=otherwise)	0.961	0.193
Rainfall	Annual rainfall in mm	63.040	12.846
Distance road	Distance to the nearest main road (km)	2.527	2.650
Distance city	Distance to the nearest city (km)	8.458	6.376

Our main independent variable (treatment variable) is the choice of income generating activities (IGAs) by cash beneficiaries households. The households have the possibility to choose between vegetable production, animal fattening, poultry rearing or no IGA. In the regressions, no IGA choice was chosen as the reference category. The potential IGAs are activities where cash beneficiaries households can use skills they already possess like small-scale trading and agricultural production, animal production, processing.. Vegetable production is an activity undertaken in or near the home where households produce fresh vegetables, aromatic and medicinal plants. It is an interesting source of income for villages located close to towns where there is a market for this kind of production. Rearing concerns poultry raising and mostly village chicken under traditional practices. In this study, animal fattening concerns sheep and cattle. It is an activity where the households intensify feeding of animals to obtain the greatest quantity of high-quality meat. Fattening is a livestock production practice that reduces animal movements thereby fattening them more quickly. Larger animals can be sold for more money on the market as they yield more meat.

4.4 Results and discussion

This section first reports the factors that drive the choice of IGAs as exit strategy using the mixed multinomial logit regression model (MMNL). It is followed by the result of the impact of IGAs on household welfare using the multinomial endogenous treatment effects model. To further correct for bias on observable variables, we implement the propensity score matching. On the matched subsample, we re-estimated the impact of IGAs on household welfare using the multinomial endogenous treatment effects model. Finally, the treatment effects are discussed.

4.4.1 Determinants of the choice of Income Generating Activities

Table 4.2 shows the results of the first stage of the multinomial endogenous treatment effects model where a mixed multinomial logit regression (MMNL) is used to predict the IGA choice, and where the baseline category of the dependent variable is no IGA. The Wald test indicates $\chi^2 = 478,03$ and $p > \chi^2 = 0.000$. This shows that the null hypothesis that all the regression coefficients are jointly equal

to zero is rejected. Results of estimations of the MMNL indicate that IGAs choice is significantly influenced by the household size, education of the household head, the number of active members in the household, the gender of the household head, the market road accessibility, the distance to the nearest main road and city, the environmental factors, and the shock received by the households.

The estimates illustrate that households with larger sizes have a higher probability of choosing vegetable production as income generating activities compare to households with smaller sizes. This is probably because family labor is primarily used for farm production. With more active members, households have a higher probability to choose vegetable production as an exit strategy. This is confirmed in our results by the fact that households with more members aged than 60 years, have less probability to choose vegetable production.

In the model specifications using animal fattening as the dependent variable, the more the head of household is educated, the more he prefers animal fattening as IGA. In addition, the more the household has member older than 60 years, the less he prefers animal fattening. The results also show that households that spend a lot on the fertilizer prefer animal fattening as IGA. This can be explained by the positive relationship between the amount spent in the fertilizer and the quantity of production. A large production can mean a lot of crop debris available to feed animals. The results also reveal that households who are far from the nearest main road prefer animal fattening as IGA.

By using poultry rearing as the dependent variable in the model specification, the estimates illustrate that women-headed households have a higher probability of choosing rearing as IGA than men-headed households. This illustrates that rearing is a suitable activity for women. Another reason may also be that women farmers have less control over productive resources, so they prefer rearing as IGA. The variables saving, distance to city and road accessibility are also positively associated with choosing rearing as IGA. In the model, when we consider Animal fattening and rearing as the dependent variable (model 2 and 3 in table 4.2), household size has no effect on the IGAs choice. Similarly, farm size and household head age have no effect on IGA choice.

Table 4.2: Mixed Multinomial Logit model of the determinants of IGA choices

	Vegetables production (1)	Animal fattening (2)	Poultry rearing (3)
Household size	0.195(0.060)***	0.039 (0.057)	-0.003 (0.048)
Household head is polygamous	0.183 (0.436)	-0.326 (0.320)	-0.179 (0.235)
Farm size	-0.004 (0.051)	0.033 (0.031)	0.024 (0.022)
Literacy	-0.333 (0.654)	0.746 (0.402)*	0.590(0.311)*
Age of household head/10	0.181 (0.168)	0.158 (0.138)	0.083 (0.095)
Household owns saving	-0.440 (0.397)	-0.351 (0.297)	0.462(0.219)**
Members less than 15 years	-0.146 (0.095)	-0.027 (0.081)	-0.031 (0.063)
Members between 15 and 60 years	0.318(0.129)**	-0.102 (0.095)	-0.007 (0.071)
Members more than 60 years	-0.783(0.347)**	-0.875(0.313)***	-0.167 (0.155)
Female-headed household	0.039 (0.673)	0.305 (0.496)	0.899(0.319)***
Road accessible last 30 days	0.164 (0.453)	-0.296 (0.327)	0.525(0.228)**
Value of fertilizer used for production	-0.008 (0.043)	0.085(0.032)***	0.057(0.032)*
Market distance	0.078 (0.139)	-0.081 (0.118)	0.009 (0.081)
Log rainfall	1.3 (3.11)	-6.75(2.19)***	-11.82(1.89)***
Temperature	1.23 (2.127)	-1.767 (1.385)	-7.251(1.171)***
Shock	-0.938 (0.605)	-0.088 (0.349)	0.436 (0.261)*
Distance city	-0.014 (0.094)	-0.040 (0.051)	-0.106(0.041)**
Distance road	-0.061 (0.048)	0.076(0.023)***	0.030(0.017)**
Tenure	0.156 (1.06)	-0.362 (0.595)	0.802 (0.663)
Constant	-46.03 (74.25)	74.59 (48.82)	256.7(41.23)***
Region dummies	Yes	Yes	Yes
Observations	1275	1275	1275

Regions fixed effects are included. Robust standard errors in parentheses. Asterisks denote statistical significance * p 0.1 ** p 0.05 ***p 0.01

4.4.2 Average treatment effect of income generating activities: unmatched sample

Table 4.3 presents the results of the second stage of our multinomial endogenous treatment effects model. It compares the results of the treatment effects under exogeneity and endogeneity assumption of IGA choice. The first model considers the choice of IGA as exogenous variables, while the second model treats the choice of IGA as endogenous variables and therefore controls for bias from unobservable variables. By comparing the two models, we will show the effects of the endogenous bias on the estimates. The model (1) in table 4.3, with the exogeneity assumption of the IGA choice, shows that on average, the choice of vegetable production, animal fattening and rearing as IGA, has no impact on the cash beneficiaries' welfare compare to no IGA choice. Because initial unobserved differences between farmers characteristics can effect the different IGA choice made by the cash beneficiaries, the exogeneity assumption of IGA choice can lead to bias. The difference in the IGA

choice can be explained by unobservable characteristics such as cash beneficiaries motivation or managerial ability. To control for the selection biases from the unobservable characteristics, we estimated a multinomial endogenous treatment effect model (model 2 in table 4.3).

The λ coefficient of animal fattening and rearing in model (2) in table 4.3 is negative and significant at the 1 percent level. This shows the existence of negative selection bias. The coefficient λ indicates that the unobservable characteristics that increase the likelihood of the cash beneficiaries' choosing animal fattening and rearing are associated with lower consumption per capita (lower welfare) than what could be expected when the IGA was randomly assigned to the cash beneficiaries.

Table 4.3: Multinomial endogenous treatment effects model of income generating activities impact on cash beneficiaries' welfare: unmatched sample

	(1)	(2)
	Exogenous	Endogenous
Vegetables production	0.13(0.268)	0.122(0.3)
Animal fattening	-0.064(0.106)	0.575(0.194)***
Poultry rearing	-0.085(0.104)	0.394(0.192)**
Household size	-0.043(0.015)***	-0.043(0.015)***
Household head is polygamous	0.084(0.065)	0.097(0.067)
Farm size	0.025(0.007)***	0.022(0.007)***
Literacy	0.156(0.089)*	0.175(0.087)**
Age of household head/10	-0.006(0.024)	-0.011(0.025)
Household owns saving	-0.17(0.058)***	-0.186(0.061)***
Members less than 15 years	0.0111(0.018)	0.011(0.019)
Members between 15 and 60 years	0.033(0.02)	0.032(0.021)
Members more than 60 years	0.057(0.046)	0.084(0.048)*
Female-headed household	-0.054(0.108)	-0.099(0.112)
Road accessible last 30 days	0.174(0.063)***	0.162(0.065)**
Value of fertilizer used for production	0.016(0.006)**	0.013(0.006)*
Market distance	0.017(0.021)	0.018(0.022)
Log rainfall	-0.614(0.448)	-0.20(0.45)
Temperature	0.298(0.285)	0.55(0.297)*
Shock	-0.049(0.07)	-0.072(0.071)
Tenure	0.273(0.153)*	0.263(0.159)*
Distance city	-0.010(0.004)**	-0.012(0.004)***
Constant	4.213(9.942)	-4.756(10.328)
Insigma		-0.581(0.238)**
λ_1 [Vegetables production]		-0.021(0.188)
λ_2 [Animal fattening]		-0.695(0.177)***
λ_3 [Rearing]		-0.534(0.196)***
Region dummies	Yes	Yes
Observations	1275	1275

Asterisks denote statistical significance * p 0.1 ** p 0.05 ***p 0.01

After controlling for the selection bias from unobserved characteristics, the model (2) in table 4.3 results show that the choice of animal fattening and rearing has a positive and significant effect on the cash beneficiaries' welfare. However, choosing vegetable

production has no impact on the consumption expenditure per capita. Cash beneficiaries' households that choose animal fattening and rearing are respectively 57 and 39 per cent more likely to increase their consumption per capita than households that choose no IGA. The magnitude, sign and significance of animal fattening and rearing have changed after controlling for unobserved characteristics. These estimates show that we could not be able to have the real effect of the IGA choices on per capita consumption for cash beneficiary households without controlling for the selection bias from unobserved variables.

4.4.3 Average treatment effect of income generating activities: matched sample

To check the consistency of our result, we combine the Propensity Score Matching (PSM) method with the multinomial endogenous treatment effects model. With the matched subsamples, we estimated two additional models, reported in table 4.4. Model (3) considers IGA choice as exogenous variable, so controlling only for observable characteristics and model (4) considers IGA choices as endogenous variables and then correction for observable and unobservable characteristics.

Table 4.4: Multinomial endogenous treatment effects model of income generating activities impact on cash beneficiaries' welfare: matched sample

	(3)	(4)
	Exogenous	Endogenous
Vegetables production	0.196(0.232)	-0.009(0.002)
Animal fattening	-0.071(0.117)	0.663(0.035)***
Poultry rearing	-0.13(0.122)	0.181(0.018)***
Household size	-0.063(0.033)*	-0.066(0.001)***
Household head is polygamous	0.085(0.111)	0.186(0.012)***
Farm size	0.026(0.011)**	0.021(0.002)***
Literacy	0.209(0.148)	0.597(0.027)***
Age of household head/10	-0.066(0.049)	-0.017(0.009)*
Household owns saving	-0.171(0.105)	-0.165(0.029)***
Members less than 15 years	0.035(0.035)	0.008(0.002)***
Members between 15 and 60 years	0.078(0.055)	0.121(0.003)***
Members more than 60 years	0.157(0.08)**	0.097(0.008)***
Female-headed household	-0.111(0.167)	-0.295(0.012)***
Road accessible last 30 days	0.039(0.099)	0.154(0.011)***
Value of fertilizer used for production	0.005(0.016)	-0.012(0.001)***
Log rainfall	-1.187(0.87)	0.427(0.159)**
Temperature	-0.138(0.504)	0.253(0.099)**
Shock	-0.147(0.132)	-0.025(0.026)
Tenure	0.478(0.244)*	0.259 (0.020)**
Market distance	0.005(0.04)	-0.006(0.001)
Distance city	-0.009(0.007)	-0.019(0.001)***
Constant	19.889(17.669)	1.514(3.567)
lnsigma		-3.317(0.281)***
λ_1 [Vegetables production]		0.058(0.012)***
λ_2 [Animal fattening]		-0.956(0.004)***
λ_3 [Rearing]		-0.410(0.011)***
Region dummies	Yes	Yes
Observations	536	536

Asterisks denote statistical significance * p 0.1 ** p 0.05 ***p 0.01

Results from the model (4) where we control for both initial differences in observable and unobservable characteristics, show that animal fattening and rearing have a positive and significant effect on the cash beneficiaries' welfare. The choice of animal fattening and rearing are 66 and 18 percent more likely to increase the household consumption per capita than those who choose no IGA. As in the unmatched sample, vegetable production has no impact on the household's welfare. The parameter (λ) is statistically significant in all models using the unmatched and matched sample. We cannot therefore reject the self-selection hypothesis. The multinomial endogenous treatment effects model we use for the analysis is then justified. The positive and significant relationship between animal fattening, rearing and consumption expenditure per capita, implies that IGAs improve cash beneficiaries' welfare and can be considered as a good exit strategy for cash transfer programs. In the models, the negative coefficient of the variable "distance to the nearest city" shows that the

further the household is from the nearest city, the lower is the consumption per capita and therefore his welfare. This situation can be explained by the transaction cost which is higher for remote villages in Mali where roads infrastructures are poor. There is also a positive association between the household farm size and the consumption per capita. This may be explained by the fact that the households have more production output if they cultivate larger areas.

4.5 Conclusion

Several studies have shown that cash transfer programs are a potential response to poverty alleviation. However, in the empirical literature, very little attention has been paid to understand the determinants of the program exit strategies choice and their impact on the cash beneficiaries' welfare. This study contributes to the empirical literature by examining the impact of different cash transfer exit strategies on the households' welfare in rural Mali by using a multinomial endogenous treatment effects model combined with a propensity score matching technique. We relied on a cross-sectional and detailed household survey data collected from a sample of 1275 cash beneficiaries' households and control for the selectivity biases and the endogeneity of the exit strategy choices.

The results indicate that the socio-economic characteristics that influence the exit strategies choices are household size, the households' members composition, household head education, the road accessibility, crop production, the distance to the main road and the distance to the nearest city. Women-headed households have more probability to choose rearing as IGA. This result is similar to (FAO, 2004) where they conclude that women are more involved in raising poultry than other types of livestock and this represents an opportunity to increase women's assets and economic empowerment. The household head age does not affect the IGAs choice.

Our estimates show that IGAs significantly influence the cash beneficiaries households' welfare. The choice of animal fattening or poultry rearing is more likely to increase the household consumption per capita than households that don't choose any IGAs. Poultry rearing is a common activity in rural areas in Mali and contributes to both the food security and cash income of smallholder farmers. Hoffmann *et al.* (2020) found that 88% of households in their study areas in Burkina-Faso raised poultry. People in rural areas generally consume poultry they have raised themselves and this provides an important source of food and protein. In addition, commercially

raised poultry can be sold in urban restaurants. Households sell their poultry to collectors who use bicycles to attend markets in the cities. For example, demand for chicken is highest in urban areas and the mining areas, such as the Kayes region in Mali.

Animal fattening which consists of feeding the animal for an average period of 3 months to add weight before they can be sold has a positive and significant effect on cash beneficiaries' household welfare. When households engaged in adding value through fattening, they earned more benefit per head of animal than they did without fattening. Fattened animals are sold at a good price at times of the year when demand is very high, such as during religious celebrations.

Our results also indicate that choosing vegetable production has no significant impact on household welfare. Difficulties vegetable producers face in Mali include among others the lack of marketing opportunities in rural areas, lack of transport, volatile markets, and pests and diseases. Pesticides are the principal method of pest control. The markets where pesticides are purchased are often several kilometers from the village which mean high transaction cost to carry the input from the market to home. In addition, cities provide the main market for vegetable products. Communities that are located close to the cities market have an advantage.

IGAs are positively correlated with the welfare of households exiting the cash program. IGAs as exit strategies can maintain a minimum income for the cash beneficiaries and would be a good exit strategy to be promoted in other sub-Saharan african countries benefiting from cash transfer programs. This can give insurance that the household who left the cash program will not return to the extreme poverty level.

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Appendix

Table 4.5: Test on the validity of instrument

VARIABLES	Consumption expenditure per capita
Household size	-0.039 (0.017)**
Household head is polygamous	0.055(0.069)
Farm size	0.024(0.008)***
Literacy	-0.195(0.102)*
Age of household head	0.001(0.027)
Household owns saving	-0.141(0.064)**
Members less than 15 years	0.012(0.021)
Members more than 60 years	0.045(0.049)
Female-headed household	-0.045(0.108)
Road accessible last 30 days	0.222(0.069)***
Value of fertilizer used for production	0.020(0.007)***
Members between 15 and 60 years	0.020(0.023)
Market distance	0.014(0.025)
Log rainfall	-0.502(0.482)
Temperature	0.446(0.334)
Shock	-0.047(0.077)
Distance road	-0.006(0.012)
Distance city	-0.008(0.005)
Regions dummies	Yes
Observations	1,054
R-squared	0.151

Table 4.6: Vegetable production versus Agriculture

Variable	Unmatched Matched	Mean		%reduct		t-test	
		Treated	Control	% bias	bias	t	p>t
Household size	U	14.357	13.397	13.4		0.77	0.443
	M	13.32	14.44	-15.7	-16.6	-0.60	0.555
Household head is polygamous	U	0.42857	0.41357	3.0		0.16	0.874
	M	0.44	0.32	24.1	-700.1	0.86	0.392
Farm size	U	4.9839	5.3015	-7.3		-0.38	0.702
	M	5.242	5.55	-7.1	3.0	-0.29	0.770
Literacy	U	0.10714	0.10604	0.4		0.02	0.985
	M	0.04	0.08	-12.8	-3541.9	-0.59	0.561
Age of household head	U	5.5857	5.5494	2.8		0.14	0.892
	M	5.632	5.704	-5.6	-98.4	-0.21	0.833
Members less than 15 years	U	6.3929	6.4698	-2.5		-0.12	0.908
	M	6.56	7.16	-19.4	-680.0	-0.69	0.492
Members between 15 and 60 years	U	4.75	4.9597	-7.4		-0.40	0.693
	M	4.68	4.88	-7.1	4.6	-0.25	0.801
Members more than 60 years	U	0.53571	0.66172	-18.5		-0.91	0.362
	M	0.56	0.52	5.9	68.3	0.23	0.820
Female-headed household	U	0.10714	0.11241	-1.7		-0.09	0.931
	M	0.12	0.16	-12.7	-659.8	-0.40	0.691
Road accessible last 30 days	U	0.42857	0.4825	-10.7		-0.56	0.574
	M	0.36	0.4	-8.0	25.8	-0.29	0.776
Household owns saving	U	0.35714	0.36691	-2.0		-0.11	0.916
	M	0.36	0.28	16.5	-718.7	0.60	0.554
Value of fertilizer used for production	U	5.5629	5.6707	-1.8		-0.10	0.924
	M	5.255	5.9333	-11.3	-529.1	-0.40	0.690
Rainfall	U	4.1509	4.1436	3.5		0.18	0.855
	M	4.1565	4.1225	16.5	-367.6	0.61	0.545
Shock	U	0.14286	0.20785	-17.0		-0.84	0.403
	M	0.12	0.12	0.0	100.0	0.00	1.000
Market distance	U	3.0427	3.0169	2.0		0.10	0.919
	M	3.1242	2.8654	20.1	-902.4	0.73	0.469
Kayes	U	0.42857	0.51432	-17.1		-0.89	0.372
	M	0.44	0.44	0.0	100.0	0.00	1.000
segou	U	0.42857	0.36585	12.7		0.68	0.498
	M	0.48	0.44	8.1	36.2	0.28	0.782
koulikoro	U	0.14286	0.11983	6.8		0.37	0.713
	M	0.08	0.12	-11.7	-73.7	-0.46	0.646

*If variance ratio outside [0.46 ; 2.16] for U and [0.44 ; 2.27] for M

Table 4.7: Animal fattening versus Agriculture

Variable	Unmatched Matched	Mean		%reduct		t-test	
		Treated	Control	% bias	bias	t	p>t
Household size	U	13.172	13.622	-6.7		-0.52	0.600
	M	13.033	13.367	-5.0	25.9	-0.29	0.773
Household head is polygamous	U	0.34375	0.4193	-14.4		-1.11	0.269
	M	0.35	0.4	-10.3	28.8	-0.56	0.575
Farm size	U	6.1803	5.4744	15.2		1.21	0.225
	M	6.2423	6.8925	-14.0	7.9	-0.65	0.518
Literacy	U	0.17188	0.11578	16.0		1.34	0.180
	M	0.16667	0.18333	-4.7	70.3	-0.24	0.812
Age of household head	U	5.4422	5.5609	-8.7		-0.65	0.517
	M	5.3667	5.55	-13.5	-54.5	-0.83	0.409
Members less than 15 years	U	6.3594	6.5594	-5.4		-0.44	0.663
	M	6.4	6.45	-1.3	75.0	-0.08	0.938
Members between 15 and 60 years	U	4.9688	5.1189	-5.2		-0.40	0.692
	M	4.95	5.0167	-2.3	55.6	-0.13	0.899
Members more than 60 years	U	0.46875	0.68033	-28.2		-2.19	0.029
	M	0.45	0.55	-13.3	52.7	-0.84	0.400
Female-headed household	U	0.10938	0.10656	0.9		0.07	0.944
	M	0.11667	0.8333	10.7	-1083.0	0.60	0.547
Road accessible last 30 days	U	0.4375	0.48463	-9.4		-0.73	0.465
	M	0.43333	0.4	6.7	29.3	0.37	0.714
Household owns saving	U	0.29688	0.34939	-11.2		-0.85	0.393
	M	0.31667	0.33333	-3.6	68.3	-0.19	0.847
Value of fertilizer used for production	U	6.7575	5.4038	23.1		1.79	0.073
	M	6.8235	7.0649	-4.1	82.2	-0.23	0.822
Rainfall	U	4.105	4.1154	-5.2		-0.39	0.694
	M	4.111	4.1237	-6.4	-23.2	-0.37	0.712
Shock	U	0.23438	0.25717	-5.3		-0.40	0.686
	M	0.23333	0.26667	-7.7	-46.2	-0.42	0.676
Market distance	U	2.8914	2.9907	-7.1		-0.57	0.572
	M	2.9575	2.9622	-0.3	95.2	-0.02	0.985
Kayes	U	0.375	0.51332	-28.0		-2.15	0.032
	M	0.35	0.35	0.0	100.0	-0.00	1.000
segou	U	0.4375	0.3668	14.4		1.13	0.257
	M	0.46667	0.46667	0.0	100.0	0.00	1.000
koulikoro	U	0.1875	0.11988	18.7		1.59	0.112
	M	0.18333	0.18333	0.0	100.0	0.00	1.000

*If variance ratio outside [0.61 ; 1.65] for U and [0.60 ; 1.67] for M

Table 4.8: Poultry rearing versus Agriculture

Variable	Unmatched Matched	Mean		%reduct		t-test	
		Treated	Control	% bias	bias	t	p>t
Household size	U	13.581	13.701	-1.9		-0.19	0.847
	M	13.597	13.355	3.8	-102.3	0.31	0.758
Household head is polygamous	U	0.41085	0.4198	-1.8		-0.19	0.846
	M	0.41935	0.37903	8.2	-350.6	0.65	0.519
Farm size	U	6.2421	5.5035	14.9		1.67	0.095
	M	6.2236	6.3008	-1.6	89.5	-0.12	0.906
Literacy	U	0.16279	0.11881	12.6		1.43	0.154
	M	0.15323	0.16129	-2.3	81.7	-0.17	0.862
Age of household head	U	5.7039	5.6132	6.4		0.68	0.498
	M	5.6742	5.7677	-6.5	-3.1	-0.53	0.595
Members less than 15 years	U	6.4031	6.5089	-3.1		-0.32	0.745
	M	6.4274	6.4677	-1.2	61.9	-0.09	0.924
Members between 15 and 60 years	U	5.1473	5.1762	-1.0		-0.11	0.916
	M	5.1532	5.0242	4.4	-345.7	0.36	0.720
Members more than 60 years	U	0.72093	0.75248	-4.0		-0.41	0.683
	M	0.70161	0.79032	-11.2	-181.2	-0.81	0.418
Female-headed household	U	0.17829	0.11089	19.2		2.23	0.026
	M	0.18548	0.19355	-2.3	88.0	-0.16	0.872
Road accessible last 30 days	U	0.5969	0.50891	17.7		1.88	0.060
	M	0.58871	0.6129	-4.9	72.5	-0.39	0.699
Household owns saving	U	0.48062	0.37426	21.6		2.34	0.019
	M	0.46774	0.5	-6.5	69.7	-0.51	0.613
Value of fertilizer used for production	U	6.256	5.5712	11.7		1.25	0.211
	M	6.2395	6.2795	-0.7	94.2	-0.05	0.958
Rainfall	U	4.1108	4.1267	-7.8		-0.81	0.419
	M	4.1109	4.1054	2.7	65.2	0.22	0.827
Shock	U	0.29457	0.26238	7.2		0.78	0.436
	M	0.26613	0.25806	1.8	75.0	0.14	0.886
Market distance	U	3.0776	2.996	6.1		0.64	0.520
	M	3.0321	3.1216	-6.7	-9.8	-0.54	0.589
Kayes	U	0.49612	.055446	-11.7		-1.25	0.210
	M	0.5	0.51613	-3.2	72.3	-0.25	0.800
segou	U	0.30233	0.32673	-5.2		-0.56	0.577
	M	0.29032	0.28226	1.7	67.0	0.14	0.889
koulikoro	U	0.20155	0.11881	22.6		2.65	0.008
	M	0.20968	0.20161	2.2	90.3	0.16	0.876

*If variance ratio outside [0.71 ; 1.42] for U and [0.70 ; 1.43] for M

Table 4.9: Animal fattening versus vegetable production

Variable	Unmatched Matched	Mean		%reduct		t-test	
		Treated	Control	% bias	bias	t	p>t
Household size	U	13.172	12.4	13.2		0.48	0.635
	M	14.111	11.556	43.7	-231.1	1.08	0.295
Household head is polygamous	U	0.34375	0.45	-21.5		-0.85	0.396
	M	0.66667	0.22222	89.8	-318.3	2.00	0.063
Farm size	U	6.1803	5.5775	12.6		0.49	0.623
	M	6.5556	6.2222	7.0	44.7	0.13	0.901
Literacy	U	0.17188	0.1	20.8		0.77	0.444
	M	0	0.11111	-32.1	-54.6	-1.00	0.332
Age of household head	U	5.4422	5.5	-4.7		-0.18	0.859
	M	5.6	5.4667	10.8	-130.6	0.17	0.864
Members less than 15 years	U	6.3594	6.4	-1.2		-0.04	0.966
	M	7.3333	6.2222	31.8	-2635.0	0.67	0.510
Members between 15 and 60 years	U	4.9688	4.45	19.5		0.73	0.465
	M	4.3333	4	12.5	35.7	0.43	0.675
Members more than 60 years	U	0.46875	0.6	-18.3		-0.69	0.490
	M	0.88889	0.55556	46.4	-154.0	0.78	0.446
Female-headed household	U	0.10938	0.1	3.0		0.12	0.907
	M	0	0.11111	-35.7	-1085.2	-1.00	0.332
Road accessible last 30 days	U	0.4375	0.4	7.5		0.29	0.771
	M	0.66667	0.33333	66.5	-788.9	1.41	0.176
Household owns saving	U	0.29688	0.4	-21.4		-0.86	0.395
	M	0.44444	0.55556	-23.1	-7.7	-0.45	0.661
Value of fertilizer used for production	U	6.7575	6.5687	3.1		0.12	0.901
	M	6.5567	5.3969	19.3	-514.3	0.39	0.702
Rainfall	U	4.105	4.1296	-12.3		-0.49	0.627
	M	4.0833	4.0904	-3.6	71.0	-0.09	0.932
Shock	U	0.23438	0.2	8.2		0.32	0.752
	M	0.33333	0.44444	-26.5	-223.2	-0.46	0.653
Market distance	U	2.8914	3.2429	-26.6		-0.99	0.326
	M	2.9084	3.4651	-42.2	-58.4	-1.00	0.331
Kayes	U	0.375	0.45	-15.0		-0.59	0.554
	M	0.33333	0.33333	0.0	100.0	0.00	1.000
segou	U	0.4375	0.5	-12.3		-0.49	0.629
	M	0.55556	0.55556	0.0	100.0	0.00	1.000
koulikoro	U	0.1875	0.05	43.0		1.49	0.141
	M	0.11111	0.11111	0.0	100.0	0.00	1.000

*If variance ratio outside [0.61 ; 1.65] for U and [0.23 ; 4.43] for M

Table 4.10: Poultry rearing versus vegetable production

Variable	Unmatched Matched	Mean		%reduct		t-test	
		Treated	Control	% bias	bias	t	p>t
Household size	U	13.581	14.389	-11.6		-0.50	0.617
	M	14	12.333	23.9	-106.4	0.87	0.392
Household head is polygamous	U	0.41085	0.33333	15.8		0.63	0.533
	M	0.5	0.33333	34.0	-115.0	0.80	0.430
Farm size	U	6.2421	5.3639	18.2		0.68	0.497
	M	5.5208	5.4625	1.2	93.4	0.03	0.975
Literacy	U	0.16279	0.11111	14.9		0.56	0.575
	M	0.08333	0.16667	-24.0	-61.2	-0.60	0.557
Age of household head	U	5.7039	5.5889	8.6		0.33	0.745
	M	5.73333	5.5417	14.3	-66.7	0.30	0.763
Members less than 15 years	U	6.4031	6.5	-3.1		-0.12	0.906
	M	6.25	5.9167	10.7	-244.0	0.30	0.764
Members between 15 and 60 years	U	5.1473	5	5.2		0.20	0.843
	M	5.1667	4.6667	17.6	-239.5	0.49	0.628
Members more than 60 years	U	0.72093	0.61111	15.2		0.59	0.558
	M	0.83333	0.66667	23.0	-51.8	0.60	0.557
Female-headed household	U	0.17829	0.16667	3.0		0.12	0.904
	M	0	0.25	-65.1	-2050.0	-1.91	0.069
Road accessible last 30 days	U	0.5969	0.55556	8.2		0.33	0.740
	M	0.66667	0.5	33.2	-303.1	0.80	0.430
Household owns saving	U	0.48062	0.5	-3.8		-0.15	0.879
	M	0.5	0.5	0.0	100.0	0.00	1.000
Value of fertilizer used for production	U	6.256	5.9419	5.2		0.21	0.833
	M	7.9246	5.9005	33.7	-544.5	0.82	0.421
Rainfall	U	4.1108	4.1364	-12.8		-0.52	0.603
	M	4.0789	4.1301	-25.6	-100.3	-0.55	0.589
Shock	U	0.29457	0.22222	16.3		0.63	0.528
	M	0.25	0.25	0.0	100.0	0.00	1.000
Market distance	U	3.0776	3.3473	-21.1		-0.81	0.419
	M	3.2083	2.9738	18.4	13.1	0.46	0.653
Kayes	U	0.49612	0.44444	10.2		0.41	0.684
	M	0.66667	0.5	32.9	-222.5	0.80	0.430
segou	U	0.30233	0.38889	-18.0		-0.74	0.462
	M	0.33333	0.41667	-17.3	3.7	-0.41	0.689
koulikoro	U	0.20155	0.16667	8.9		0.35	0.730
	M	0	0.08333	-21.2	-138.9	-1.00	0.328

*If variance ratio outside [0.71 ; 1.42] for U and [0.29 ; 3.47] for M

Table 4.11: Poultry rearing versus animal fattening

Variable	Unmatched Matched	Mean		%reduct		t-test	
		Treated	Control	% bias	bias	t	p>t
Household size	U	13.581	12.915	10.5		0.67	0.503
	M	11.474	12.632	-18.2	-73.8	-1.04	0.302
Household head is polygamous	U	0.41085	0.33898	14.8		0.94	0.351
	M	0.28947	0.34211	-10.8	26.8	-0.49	0.627
Farm size	U	6.2421	5.7422	10.6		0.65	0.517
	M	5.5605	6.3434	-16.6	-56.6	-0.80	0.428
Literacy	U	0.16279	0.16949	-1.8		-0.11	0.909
	M	0.21053	0.18421	7.0	-292.7	0.28	0.777
Age of household head	U	5.7039	5.4254	20.6		1.28	0.201
	M	5.2632	5.5868	-23.9	-16.2	-0.99	0.323
Members less than 15 years	U	6.4031	6.2203	5.2		0.34	0.735
	M	5.7368	5.9474	-6.0	-15.2	-0.35	0.727
Members between 15 and 60 years	U	5.1473	4.8814	9.2		0.58	0.564
	M	4.2895	4.7105	-14.5	-58.3	-0.81	0.420
Members more than 60 years	U	0.72093	0.42373	41.0		2.57	0.011
	M	0.39474	0.57895	-25.4	38.0	-1.21	0.228
Female-headed household	U	0.17829	0.11864	16.7		1.03	0.303
	M	0.18421	0.15789	7.4	55.9	0.30	0.764
Road accessible last 30 days	U	0.5969	0.47458	24.6		1.57	0.118
	M	0.52632	0.55263	-5.3	78.5	-0.23	0.821
Household owns saving	U	0.48062	0.32203	32.6		2.05	0.042
	M	0.36842	0.34211	5.4	83.4	0.24	0.814
Value of fertilizer used for production	U	6.256	6.5129	-4.4		-0.28	0.781
	M	6.7502	7.7168	-16.4	-276.3	-0.73	0.469
Rainfall	U	4.1108	4.1052	2.9		0.18	0.855
	M	4.1423	4.1553	-6.7	-133.2	-0.32	0.751
Shock	U	0.29457	0.25424	9.0		0.57	0.571
	M	0.18421	0.26316	-17.6	-95.7	-0.82	0.416
Market distance	U	3.0776	2.9958	5.9		0.38	0.705
	M	2.9359	3.143	-14.9	-153.3	-0.75	0.458
Kayes	U	0.49612	0.38983	21.4		1.36	0.177
	M	0.34211	0.28947	10.6	50.5	0.49	0.627
segou	U	0.30233	0.40678	-21.8		-1.41	0.161
	M	0.36842	0.47368	-22.0	-0.8	-0.92	0.359
koulikoro	U	0.20155	0.20339	-0.5		-0.03	0.977
	M	0.28947	0.23684	13.0	-2761.3	0.52	0.608

*If variance ratio outside [0.71 ; 1.42] for U and [0.52 ; 1.92] for M

Chapter 5

Assessing the cash transfer program spillover effects: A Village-SAM multiplier analysis

M.F. Eric Sessou, Christian H.C.A. Henning

Abstract

Village Social Accounting Matrices (SAMs) are designed to capture the complex interlinkages among village production activities, village institutions, and the outside world. The strengths of the SAM are its comprehensiveness and its flexibility in adapting to diverse institutional settings and economic structures and in providing an accounting framework to address diverse policy and planning issues. This paper describes the structure and estimation of a Social Accounting Matrix (SAM) of a Malian village for the year 2016. Among its specifications, this SAM uses household survey data collected for both beneficiaries and non-beneficiaries of a national cash transfer program. We build a SAM for the program beneficiaries and non-beneficiaries groups and nested the two SAM in a village SAM. Agricultural activity was disaggregated into seven accounts to help provide a strong analysis of the socio-economic activities of households. An application of the multiplier model shows the capacity of an exogenous transfer to generate a multiplier effect in the local economy.

Keywords: Social Accounting Matrix, Household survey, Cash transfers, Multiplier effects

5.1 Introduction

A Social Accounting Matrix (SAM) represents a database where information about all economic transactions that take place in a country or a region at a given time. It refers to a single year providing a static picture of the economy in a country, region or village. The SAM explicitly shows the interconnection between the structure of production in the economy and the distribution of factor income to households as well as the relationships between all institutions (households, enterprises, government, and trade partners) in the economy Akkemik (2012). The accounting principle requires that for each SAM account income equates expenditure Croes and Rivera (2017). The SAM is a conceptual framework for thinking about the structure of an economy. It is an accounting framework based on principles like Leontief's input-output matrices (Leontief, 1986). While input-output matrices only represent inter-industrial flows of value, a SAM feature accounts for all agents in the economy, including factors (labor, capital, land), Institutions (households, governments), and exogenous rest-of-the-world accounts. The SAM provides a more complete picture of the value flows in an economy during a given time period which is usually a year. Traditionally, the SAMs have been used as data inputs for general-equilibrium modeling. Many national SAMs have been constructed and used extensively for policy analysis in developing countries Round (2003). However, we have fewer SAM applications at the regional or village level (Rickman, 2010).

Social Accounting Matrix framework has been used to study the economies of villages in diverse social, cultural and market settings. The village SAM framework was used to analyze the village economy and tenure security in Senegal (Golan *et al.*, 1990), to perform an empirical study of the economic linkages that exist in a small region in Kenya (Lewis and Thorbecke, 1992) and to analyze a household nutrition and economic linkages for West Java in Indonesia (Ralston, 1994). The village SAM presents here is developed as part of a project focusing on assessing the impact of a Social Cash Transfer (SCT) program on beneficiaries and non-beneficiaries. The cash transfer program "*Programme de Filets Sociaux (Jigisémejiri)*" is a Malian government national cash transfer program with poverty reduction, food security and human capital development as main objective. The program transfers 10,000 FCFA (equivalent to U.S 20\$) to beneficiaries' households and there are no conditions to receive the money. Beneficiaries' households are the poorest in the project area and they are selected based on some specific criteria. The cash is given to the household head.

To study the spillover effects of the cash transfer program on non-beneficiaries, we develop in this paper a village-SAM. The household data for the year 2016 is used, so 2016 is the based year because of the data availability. We construct elemental household SAM for cash and non-cash beneficiaries' group and then nested the two SAMs in a meta-SAM for the village. A bottom-up approach as suggested by (Taylor *et al.*, 1996) is followed in the construction of the village SAM.

The Village SAM depicted in this chapter shows that households largely rely on agriculture for their livelihoods. We have seven production activities that produce seven commodities. We have three factors of production, labor, capital and land. The households trade in local markets for locally produced goods, services and factors. The village is connected to the outside through trade. The remaining part of this chapter presents the structure and the selection of the accounts used in the household SAM, the construction of the household SAM, the estimation and overview of the village-nested SAM, the multiplier analysis and finally the conclusions.

5.2 Construction of the SAM

5.3 Structure and accounts in the household SAM

Figure 5.1 displays the household SAM framework used in this study. The SAM framework presents the information in a matrix form, where economic sectors and institutions are represented each by one account. In this framework, expenditures made by one account are incomes for another account. Incomes to each account appear along the account's row, while expenditures appear along its column. Hence, a cell entry in the matrix represents a particular transaction within the economy flowing from the column account to the row account.

Figure 5.1: Household SAM framework

		ACTIVITIES							COMMODITIES							FACTORS			HH	VILLAGE MARKET							Row	TOT					
		Millet	Sorghum	Maize	Groundnut	Cotton	Animal	Service	Millet	Sorghum	Maize	Groundnut	Cotton	Animal	Service	FL	Land	Cap	Consumption	Millet	Sorghum	Maize	Groundnut	Cotton	Animal	Service	HL	Row	TOT				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28				
ACTIVITY	A	Millet																															
	B	Sorghum																															
	C	Maize																															
	D	Groundnut										G																	T				
	E	Cotton																															
	F	Animal																															
	G	Service																															
COMMO	H	Millet																															
	I	Sorghum																															
	J	Maize																															
	K	Groundnut				A																											
	L	Cotton																															
	M	Animal																															
FACTORS	N	Service																															
	O	FL																															
	P	Land				B																				P			R	V			
HH	Q	Cap																															
	R	Income																I										S	W				
VILLAGE MARKET	S	Millet																															
	T	Sorghum																															
	U	Maize																															
	V	Groundnut																															
	W	Cotton																															
	X	Animal																															
	Y	Service																															
Z	HL				D																												
AA	Row				E																												
AB	TOT				F																												

Source: Own elaboration from Taylor and Filipski (2014)

We have six accounts in our household SAM: activities, commodities, factors, institutions, village market and the rest of world.

5.3.1 Activities

Activities are the processes undertaken to produce commodities within the village economy. In our household SAM, agricultural activities are disaggregated into millet, sorghum, maize, groundnut and cotton production. Livestock (also called animals) and the service sector are also included in the SAM because of their importance in the production process. We end up with seven activities account, of which five are agricultural activities, one is livestock production and one is service sector.

5.3.2 Commodities

An activity can produce multiple commodities and a commodity can be produced by more than one kind of activity (Lofgren *et al.*, 2002). In our household SAM, similarly to the activities account, we have seven commodity accounts. Each commodity is produced by one activity.

5.3.3 Factors

Production factors are labor, capital and land. Labor is disaggregated between family and hired labor. The capital account represents any capital (plow, tractor. . .) that was used in the production process. This account recorded the contribution of the capital to value added. The land account recorded information about the quantity of land used for the production (own land or other people's land).

5.3.4 Institutions

Institution account contains information about economic agents which is in this SAM the two groups of households¹: the cash beneficiaries and the non-cash beneficiaries. This account recorded information about the household's group income, saving, consumption and expenditures. In the nested village-SAM, the two groups will represent the institution account.

¹HH in the SAM framework refers to Households

5.3.5 Village market and the rest of the world (row)

In our SAM, activities, commodities, factors and households are endogenous accounts and the village market and the rest of the world are exogenous accounts. The exogenous accounts record all the interactions with the outside economy. The row describes all transactions that go beyond the border of the village economy. It stands for everything else that is exogenous to the household group and not already in the SAM. This can be any local or national government or any village or commune which is beyond the village.

5.4 Construction of the household SAM

We will present here how each value of the household SAM has been obtained. Each cell in the SAM carries the payment from column to the row (from one account to another). Account refers to activities, commodities, factors, institutions and the rest of the world. This subsection presents the procedures used to derive the values for each entry in the household SAM. The SAM cells are identified as shown in figure 5.1 by their row letter (from A to AB) and their column number (from 1 to 28). Each cell in a household SAM is the sum of values across all households in the group the SAM represents. Our village-SAM combines two groups of households: the households who receive the cash transfer and households who do not receive the cash transfer. The two groups of households produce the same crops and use the same production factors. We build the SAM for each household group and integrated them into a village-SAM. In the village SAM, each of the household-group SAM account is household-specific.

Cells A [(H-N) & (1-7)] *Intermediate inputs*: This entry shows the demand for intermediate inputs by the productive activities. This includes self-provided intermediate inputs valued at the village market price.

Cells B [(O-Q) & (1-7)] *Factor inputs*: This is the part of value-added accruing to production factors owned by the households which are in this case: family labor, capital and land. It is computed by calculating the value of each factor used for each production activity. For cereal production for example, it is the value of family labor used in cereal production.

Cells C [(S-Y) & (1-7)] *Purchased Inputs in the village market*: This shows intermediate inputs purchased on the village market. The cell D ((1-7) & Z) is the labor

hired in the village market for the household's activities.

Cells E [(AA) & (1-7)] *Inputs and factors purchased elsewhere*: This shows inputs and factors purchased outside the village (row). For maize production for example, the cell will show the value of part of maize bought from outside the village as input for production (seeds).

Cells F [(AB) & (1-7)] *Total inputs value*: This records all expenditures involved in the production activities. This gives the value of the total amount to buy inputs used in the production process. The expenditures can be explicit or implicit because the household doesn't pay for family labor for example. We used opportunity cost instead.

Cells G [(A-G) & (8-14)] *Activity outputs*: This is the value of each activity output computed by summing up the output of individual households in each group. There are implicit payments from the commodity accounts to the activity accounts.

Cells H [(AB) & (8-14)] *Total output value*: The total value of production activities is computed by taking the total output for each activity.

Cells I [(R) & (15-17)] *Household Income*: Household income from factors endowment. This income from factors is paid to the household for the production factors. In addition to that, cell S records any additional income the household may receive from outside the village like remittances or government transfers.

Cells J [AB & (15-17)] *Total factor income*: This is the total household income coming from the factor endowment.

Cells K [(H-N) & (18)] *Subsistence consumption*: Household consumption demand coming from his production. This is calculated for each group of households by summing up the value of part of the activity output consumed by each household from its production.

Cell L [(S-Y) & 18] *Goods purchased in the village*: The cell computes the values spent on various goods and services the household consumed and that are purchased in the village.

Cell M [AA & 18] *Goods purchased elsewhere*: This computes the values spent on various goods and services the household consumed and that are purchased elsewhere, outside the village.

Cells N [(AB) & 18] *Total household expenditures*: This column records payment to

subsistence consumption for goods and services consumed by the households on the village markets as well as from elsewhere (row).

Cell O [(H-N) & (19-26)] *Marketed surplus sold in the village*: Part of the production which is sold out in the village.

Cell P [(O-Q) & (19-26)] *Factors hired out in the village*: This calculates the value of the household production factors (labor, land, capital) that is hired out in the village. For family labor for example, it is the value of family labor hired out in the village. This is the same thing for capital rented out inside the village.

Cell Q [(H-N) & 27] *Marketed surplus sold elsewhere*: This calculates the part of the agricultural commodity that is not consumed by the household and is sold on the market outside the village (row).

Cell R [(O-Q) & 27] *Factors hired out elsewhere*: This calculates the value of the production factors that are hired out from the village and are not used in home production or hired in the village. For family labor for example, it is the value of family labor hired out elsewhere (row). This is the same thing for capital rented out outside the village.

Cell T [(A-G) & 28] *Total output value* : This calculates the total output value.

Cell U [(H-N) & 28] *Total output used*: This calculates the total value of output used as intermediate inputs, subsistence consumption, seed stock investment and marketed surplus sold in the village and elsewhere.

Cell V [(O-Q) & 28] *Total payments to factors*: Total payments to factors include factors inputs, factors hired out in the village and outside the village.

Cell W [R& 28] *Total household income*: The total household income is the income the households got from factor endowment, transfers from the government and remittances from the rest of the world (row).

5.5 The village Social Accounting Matrice (village-SAM)

5.5.1 Data sources

Primary and secondary data have been merged for the construction of the SAM. Primary data come from the household survey. The survey includes data on the household economic activities, the activities output, the production inputs and factors as well as household's income, consumption and investment. A total of 200 households with 100 non-cash beneficiaries and 100 cash beneficiaries were considered. The household's selection captures all agents and economic activities. Secondary data like regional statistics from the National Institute of Statistics (INSTAT) are also used to fill gaps observed in the primary data. A strength of the SAM is that it can be constructed by using different data sources (Round, 2003). A market survey was conducted at the same time as the household survey was occurring and market prices data were collected in the village.

5.5.2 Estimation of the village-SAM

We first estimate a household SAM for each group of households: the cash beneficiaries and non cash-beneficiaries. We use the balanced SAM for each household group and integrated them to obtain a nested household group SAM which is the village-SAM.

A cross entropy program is used to estimate a balanced household SAM for each group of households. The cross-entropy program is a technique to estimate the cells of a consistent SAM assuming that the initial data are inconsistent and measured with error (McDonald *et al.*, 2006). The estimation philosophy is Bayesian and interactive. The entropy approach used in this paper treats every cell in the SAM as being specified with an error support set whose weights are estimated. There is a prior, which is specified for each error distribution. For the estimation process, constraints are imposed on the prior SAM such that row sums and corresponding column sums must be equal. The village-nested balanced SAM is presented in the Appendix.

5.5.3 Overview of the village SAM

The accounts within the village-SAM are identical to those presented in figure 5.1. We have five accounts which are activities, commodities, factors, institutions (household accounts) and the village market account. Agricultural activities are further disaggregated in different crop production (millet, sorghum, maize, groundnut, cotton, animal, service) and labor account in hired and family labor. All entries in the SAM are in West Africa CFA values. The village has two (02) cash-crop (cotton & groundnut) and three (03) staple-crop (millet, sorghum & maize) in its economy. The income and expenditure patterns are not complicated. The majority of purchased inputs are imported into the village and cash crops are exported from the village. Seeds are almost selected from the previous harvest.

Production and factors demand

Table 5.1 is obtained from the commodity columns of the village-SAM and reports the shares of commodity supplies from the two groups of the household. Cereals are the dominant product for the two groups of households. Cotton is also an important cash crop produced by the two groups of households. Table 5.1 shows that beneficiaries' households produce a small share of goods in the village. For example, they produce only 8% of millet, 3.4% of sorghum and 4.3% of maize. The non-beneficiaries' group in contrast produces 16% of millet, 8% of sorghum and 12% of maize in the village. This makes sense because the cash beneficiaries' households are the poorest in the village. They face more constraints in accessing the production factors.

Table 5.1: Shares of the production of Goods and Services by Household Group

	Household Group	
	Beneficiaries	Non-beneficiaries
Millet	0.081	0.16
Sorghum	0.034	0.084
Maize	0.043	0.12
Groundnut	0.026	0.082
Cotton	0.099	0.203
Animals	0.02	0.039
Services	0.008	0.003

From the activities column in the village-SAM, we calculate the share of factor de-

mand. The production factors demand in Table 5.2 globally show that the factors demand is higher for non-cash beneficiary households than cash beneficiary households. The table confirms that the poorest households were selected for the cash program in the village. The land is an important production factors for agricultural activities. Family labor and hired labor are used in the same proportion for commodities productions. However, family labor is used in a higher proportion for services in poor households' groups. Capital demand is important for services compared to agricultural activities.

Table 5.2: Shares of factors demand by activities

Commodity	Factor	Households	
		Beneficiaries	Non-Beneficiaries
Millet	HL	0.01	0.0115
	FL	0.006	0.0098
	Land	0.111	0.1924
	Cap	0.022	0.0259
Sorghum	HL	0.005	0.0172
	FL	0.003	0.0147
	Land	0.051	0.1847
	Cap	0.024	0.0338
Maize	HL	0.006	0.0288
	FL	0.004	0.0246
	Land	0.048	0.097
	Cap	0.023	0.0265
Groundnut	HL	0.01	0.0064
	FL	0.006	0.0055
	Land	0.114	0.4775
	Cap	0.024	0.0355
Cotton	HL	0.01	0.0309
	FL	0.006	0.0265
	Land	0.095	0.172
	Cap	0.021	0.0162
Animal	HL	0.084	0.0487
	FL	0.021	0.0416
	Cap	0.016	0.024
Service	HL	0.02	0.0423
	FL	0.071	0.0362
	Cap	0.65	0.1798

We can see that the village economy is dominated by agricultural activities. The farm production is almost rain-fed and the agriculture output is correlated with the amount of rainfall. Cereals and cotton are important crops produced in the village. Cotton is a cash crop as well as groundnut and all households in the village produce at least one cereal (millet, sorghum or maize. . .). Cereal is an important food crop and the basic food staple of the households in the village. Animals (livestock) and services are also other economic activities in the village. Services activity is small

compare to the agriculture sector. They provide less than 2% of the total output of economic activities.

Household's subsistence consumption analysis

Subsistence production is an important part of the village economy. In a typical country SAM, economic activities produce only market-oriented commodities and use only inputs acquired in the market. But the village-SAM includes products that can be own-consumed or sold in the market. The household's production in the village is own-consumed and sold in the market. The consumption share in the village-SAM is valued at the village market price. Table 5.3 shows the subsistence consumption share of output retained by each household group.

Table 5.3: Share of output retained by each household group for consumption

	Household Group	
	Beneficiaries	Non-beneficiaries
Millet	0.247	0.438
Sorghum	0.298	0.399
Maize	0.51	0.415
Groundnut	0.232	0.385
Animals	0.264	0.184

Table 5.3 clearly shows that cotton is a cash crop for the two household groups. All the cotton production is sold out to the government. The groundnut is consumed but a large part is sold to the market. We can draw from the table that household consumption is dominated by cereals. Cereals crops (millet, sorghum, maize) are a staple food for households. Non-beneficiaries' households (non-poor) consume more from their food crops production than beneficiaries' households. We can also see in the table that beneficiaries' households consume more of the livestock they produce compare to the non-beneficiary households.

Village market

The village market provides information on how the households interact with relevant markets and with the rest of the world (row). The households engage with markets in different ways. The poor households supply more of cereals and labor in

local market than non-poor households and non-poor households supply more cereals outside the local economy. Table 5.4 shows the share of output sold out by each household group in the village market and to the rest of the world (row). Cotton and groundnut are market-oriented commodities and mostly sold out to the rest of world market. Beyond the share that are consumed, a large share of the marketed cereals is sold outside the village by the two groups of households. However, non-poor households sold a small share of their cereals to the village market compared to poor households (33.06% vs 11.52% for millet, 20.56% vs 9.05% for sorghum, 20.73% vs 9.33% for maize). So, we can say that poor households prefer to sell their products in the village. This can also be explained by the transaction cost which may be higher for poor households.

Table 5.4: Share of market supply in the village and rest of the world

	Beneficiaries households (%)		Non beneficiaries households (%)	
	village	row	village	row
Millet	33.06	38.58	11.52	43.62
Sorghum	20.56	42.85	9.05	47.8
Maize	20.73	20.07	9.33	47.43
Groundnut	6.23	63.55	3.42	52.83
Cotton	0	100	0	100
Animal	35.63	37.96	37.95	43.64
Service	0.05	99.95	0.05	99.95

The households depicted here (poor and non-poor) are fully integrated with the village market and the rest of the world. Their income is used to consume agricultural products and services by the local market, as well as a few others types of goods obtained from the rest-of-world markets. The household supplies some of its consumption from home production and purchased some of these goods from other poor households in the group represented in this village-SAM. According to Singh *et al.* (1986), if households are fully integrated with markets, as in a conventional agricultural household model, they will be indifferent between consuming their product or selling their output and subsequently buying from the market.

5.6 Multiplier analysis

The village-SAM provides information on the economic transactions that happened in a village for one year. It is also a database for numerous scientific works like

multiplier analysis and Computable General Equilibrium model. The multiplier analysis can help to evaluate the direct and indirect effect of an exogenous shock to economy. The multiplier effect analyses how much the direct effects are multiplied by indirect linkages. Multipliers effectively show the distributional effects of exogenous shocks or changes in the economy (Round, 2003). They stand out for their simplicity to interpret and their capacity to explain clearly the effects produced by economic policies.

The SAM multiplier models have been used for a wide range of issues such as trade policies, agricultural growth (Morton *et al.*, 2016). For impact evaluation, the simplest simulation model is an unconstrained SAM accounting multiplier model. In our study, the multiplier analysis helps to show how 1 FCFA transfer to a beneficiary household that spends a share of it locally and outside the local economy can affect poor and non-poor households' incomes. It shows how the transfer affects the income of the different household groups.

The household that receives the cash will use it either in the local market or outside the local economy buying items in the village. The farmer that sold it in the village has an income gain. As the process continues, we get a multiplier effect of the exogenous transfer in the local economy. To estimate an unconstrained SAM accounting multiplier for the village, let's consider y as a vector of total incomes and x a vector of final demands for the endogenous accounts in our SAM. A SAM coefficients matrix is derived for these endogenous accounts by dividing each internal element by its corresponding column total. If A refers to this shares matrix, the relationship between y and x is:

$$y = Ay + x \tag{5.1}$$

$$y = (I - A)^{-1}x = M_a x \tag{5.2}$$

The change in income (d_y) resulting from a change in final demand (d_x) is given by :

$$d_y = (I - A)^{-1}d_x = M_a d_x \tag{5.3}$$

Table 5.5 shows the multiplier of 1 FCFA cash transfer to a poor household. The effect represents the total effects of the exogenous transfer. Under the SAM linear multiplier analysis assumption, a 1 FCFA transfer has a multiplier effect of 1.28 on poor-household (cash beneficiaries) incomes and 0.16 on the incomes of non-poor households (non-cash beneficiaries). These income multipliers result from an

increase in poor-household expenditures on goods supplied from markets within the village, which in turn stimulate production in both poor and non-poor households. Millet production increases by 0.36 for beneficiaries' households and by 0.15 for non-beneficiary households and the combined income increase by 1.44 for the two groups of households.

Multipliers give a sense of how large linkages might be in an economy that satisfies the basic assumptions underlying the model. So, SAM multiplier analysis can be a useful preliminary step in conducting impact analysis using simulation methods (Taylor and Filipski, 2014). According to the same authors, impact evaluation using SAM accounting multiplier models is more reasonable in economies with high unemployment and without severe capital constraints than in economies at full employment or where technological limitations on production are more severe.

The SAM multiplier model represents an extreme case in which production is linear and local supply responses are so elastic that increases in demand do not affect market price. It assumes that the behaviour of all actors is linear. The model is simple but intuitive and provides results that are valid, comparable, and suitable for multisectoral qualitative analysis, although they need to be taken with caution due to the restrictive hypothesis associated with the model. The policy recommendations provided should be taken lightly due to these restrictions, but they are still useful for initial impact analysis.

Table 5.5: SAM multiplier effects

Output multipliers	Multiplier effect of a 1 FCFA transfer to a poor household
<i>BENEFICIARIES HOUSEHOLDS</i>	
Activities	
Millet	0.367
Sorghum	0.141
Maize	0.265
Groundnut	0.070
Cotton	0.005
Animal	0.077
Service	0.017
Factors	
FL	0.040
Land	0.138
Cap	0.102
Income	1.281
<i>NON BENEFICIARIES HOUSEHOLDS</i>	
Activities	
Millet	0.154
Sorghum	0.06
Maize	0.083
Groundnut	0.031
Cotton	0
Animal	0.057
Service	0.007
Factors	
FL	0.048
Land	0.09
Cap	0.020
Income	0.159
<i>COMBINED INCOME</i>	1.44
Market	
Millet	0.274
Sorghum	0.073
Maize	0.093
Groundnut	0.017
Animal	0.078
Service	0.059

5.7 Conclusion

The village-SAM has been developed from household data as well as from different sources. We used the cross-entropy method to balance SAM accounts or reconcile incomes and expenditures. However, automated procedures to balance out the data set can modify structures without considering economic behaviour (Savard, 2003). We used information about the village to make decisions when constructing the

SAM. The village-SAM plays an important role in policy planning and monitoring. It represents the total economic transactions within an economy for a single year and displays the linkages between economic activities. Because of the objective of our work, we build a separate SAM for cash beneficiaries and non-cash beneficiary households and nested them in a village-SAM. This SAM provides a basic data structure for the design of advanced computer-based mathematical programming models in the following chapter.

A linear multiplier model has been applied to this village-SAM. The analysis shows that exogenous cash transfer to poor households has a multiplier effect on the local economy. These income multipliers result from an increase in cash beneficiaries' expenditures on goods supplied from markets in the village, which in turn stimulate production in both poor and non-poor households. The multiplier effect is small for cash crops which are mostly sold outside the village. The transfer has no multiplier effect on cotton production activity. The restrictive hypotheses imply that the findings should be used as reference in the analysis of economic policies and always with caution. The limitations of SAM multiplier analysis justify the use of more complex SAM-based methods such as CGE models, which drop the assumption of linearity, fixed price and unlimited resources.

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Appendix

Figure 5.2: Balanced SAM HH Beneficiaries

		ACTIVITIES							COMMODITIES							FACTORS			H	VILLAGE MARKET						ROW	TOTAL		
		Millet	Sorghum	Maize	Groundnut	Cotton	Animal	Service	Millet	Sorghum	Maize	Groundnut	Cotton	Animal	Service	FL	Land	Cap	Cons/Exp	Millet	Sorghum	Maize	Groundnut	Animal	Service	HL		Row	
		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25	A26		
ACTIVITIES	Millet	A1							15473193																			15473193,1	
	Sorghum	A2								6475229																		6475228,512	
	Maize	A3									8062423																	8062423,389	
	Groundnut	A4										4905835																4905835,211	
	Cotton	A5											18575406															18575406,41	
	Animal	A6													3837890													3837889,629	
	Service	A7														1426795												1426794,514	
COMMO	Millet	A8	24198,61					250302											3965197	5223262							6010233	15473193,1	
	Sorghum	A9		35759,6				291121											1998788		1358031						2791530	6475228,512	
	Maize	A10			20078,1			345797											4326362			1720675				1649511	8062423,389		
	Groundnut	A11				2652,23		218047											1196428				314520,9				3174188	4905835,211	
	Cotton	A12					108814,2	324019																			18142573	18575406,41	
	Animal	A13																							1374167		1434296	3837889,629	
	Service	A14																							473454	953340,4	1426794,514		
FACTORS	FL	A15	282548,2	70949,5	111033	125108	343570,4	234407	137145																	2448480	11591	3764833,892	
	Land	A16	5024434	1124793	1455454	2299314	5313954																					15217948,36	
	Cap	A17	994146,5	528649	692248	487045	1166371	177275	1250238																			5295971,934	
H	Inc	A18														3764834	15217948	5295972									1168278	25447032,63	
VILLAGE MARKET	Millet	A19																	5223262								5223262,429		
	Sorghum	A20																	1358031								1358030,794		
	Maize	A21																	1720675								1720675,356		
	Groundnut	A22																	314520,9								314520,8626		
	Animal	A23																	1374167								1374167,374		
	Service	A24																	473454,2								473454,155		
HL	A25	442061,9	111004	173718	195739	537534,3	949012	39411,1																			2448480,332		
ROW	Row	A26	8705804	4604073	5609893	1795977	11105163	1047909											2466721								35335540,41		
TOTAL			15473193	6475229	8062423	4905835	18575406	3837890	1426795	15473193	6475229	8062423	4905835	18575406	3837890	1426795	3764834	15217948	5295972	25447033	5223262	1358031	1720675	314520,9	1374167	473454	2448480	35335540	215487460,1

Figure 5.3: Balanced SAM HH Non-Beneficiaries

		ACTIVITIES								COMMODITIES								FACTORS			H		VILLAGE MARKET								Row	Total
		Millet	Sorghum	Maize	Groundnut	Cotton	Animal	Service	Millet	Sorghum	Maize	Groundnut	Cotton	Animal	Service	FL	Land	Cap	Cons/Exp	Millet	Sorghum	Maize	Groundnut	Animal	Service	HL						
		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25	A26					
ACTIVITIES	Millet	A1							30607696																				30607696,43			
	Sorghum	A2								16013590																			16013589,83			
	Maize	A3									22936711																		22936711,18			
	Groundnut	A4										15400799																	15400799,34			
	Cotton	A5											38638193																38638193,36			
	Animal	A6													7581392														7581391,905			
	Service	A7														493457													493457,4878			
COMMO	Millet	A8	160946																	13629414	3553376							13263961	30607696,43			
	Sorghum	A9		142612,6																6630947	1480018							7760012	16013589,83			
	Maize	A10			89855,85			33847,9												9749263		2168276						10895469	22936711,18			
	Groundnut	A11				102080,571														6300082			547210,66					8451426	15400799,34			
	Cotton	A12					663628,2																					37974565	38638193,36			
	Animal	A13																							2892004			3275342	7581391,905			
	Service	A14																							187604			305853,3	493457,4878			
FACTORS	FL	A15	449475,4	327219,6	756068,9	110830,822	1505494	469945	68896,9																			4341094	116319,7	8145344,628		
	Land	A16	8831774	4125142	2990165	9656712,6	9816736																							35420529,77		
	Cap	A17	1186966	754028	817598	718379,619	921749,2	271380	343462																					5013561,956		
H	Inc	A18														8145345	35420530	5013562										1854999	50434435,68			
VILLAGE MARKET	Millet	A19																		3553376									3553375,543			
	Sorghum	A20																		1480018									1480017,6			
	Maize	A21																		2168276									2168276,047			
	Groundnut	A22																		547210,7									547210,659			
	Animal	A23																		2892004									2892003,822			
	Service	A24																		187604,2									187604,1514			
	HL	A25	529081,3	385173	889975,1	130459,895	1772130	553176	81099,1																				4341094,278			
Row	A26	19449454	10279415	17393048	4682335,83	23958457	6253043												1882196										83897947,3			
Total		30607696	16013590	22936711	15400799,3	38638193	7581392	493457	30607696	16013590	22936711	15400799	38638193	7581392	493457	8145345	35420530	5013562	50434436	3553376	1480018	2168276	547210,66	2892004	187604	4341094	83897947	461425080,8				

Figure 5.4: Balanced nested SAM

		NON BENEFICIARIES																			
		ACTIVITIES							COMMODITIES							FACTORS			HH		
		Millet	Sorghum	Maize	Groundnut	Cotton	Animal	Service	Millet	Sorghum	Maize	Groundnut	Cotton	Animal	Service	FL	Land	Cap	Cons/Exp		
NON BENEFICIARIES	ACTIVITIES	Millet							30607696,4												
		Sorghum								16013589,8											
		Maize									22936711,2										
		Groundnut										15400799,3									
		Cotton											38638193,4								
		Animal													7581392						
	COMMO	Service													493457,5						
		Millet	160946,03																		13629413,95
		Sorghum		142612,599																	6630947,36
		Maize			89855,85				33847,91												9749262,571
		Groundnut				102080,571															6300082,247
		Cotton					663628,164														1414046,196
	FACTORS	Animal																			
		Service																			
FL		449475,394	327219,634	756068,9	110830,822	1505493,87	469945,2	68896,86													
HH	Land	8831774,11	4125141,79	2990165	9656712,6	9816736															
	Cap	1186965,69	754028,049	817598	718379,619	921749,209	271379,9	343461,6													
	Inc														8145345	35420529,8	5013562				
BENEFICIARIES	ACTIVITIES	Millet																			
		Sorghum																			
		Maize																			
		Groundnut																			
		Cotton																			
		Animal																			
	COMMO	Service																			
		Millet																			
		Sorghum																			
		Maize																			
		Groundnut																			
		Cotton																			
	FACTORS	Animal																			
		Service																			
FL																					
HH	Land																				
	Cap																				
	Inc																				
VILLAGE MARKETS	Millet																			3553375,543	
	Sorghum																			1480017,6	
	Maize																			2168276,047	
	Groundnut																			547210,659	
	Animal																			2892003,822	
	Service																			187604,1514	
HH	529081,278	385172,993	889975,1	130459,895	1772129,54	553176,4	81099,07														
ROW	19449453,9	10279414,8	17393048	4682335,83	23958456,6	6253043														1882195,528	
TOTAL	30607696,4	16013589,8	22936711	15400799,3	38638193,4	7581392	493457,5	30607696,4	16013589,8	22936711,2	15400799,3	38638193,4	7581392	493457,5	8145345	35420529,8	5013562		50434435,68		

Figure 5.5: Balanced nested SAM

			BENEFICIARIES																		
			ACTIVITIES							COMMODITIES							FACTORS			HH	
			Millet	Sorghum	Maize	Groundnut	Cotton	Animal	Service	Millet	Sorghum	Maize	Groundnut	Cotton	Animal	Service	FL	Land	Cap	Cons/Exp	
NON BENEFICIARIES	ACTIVITIES	Millet																			
		Sorghum																			
		Maize																			
		Groundnut																			
		Cotton																			
		Animal																			
	COMMO	Service																			
		Millet																			
		Sorghum																			
		Maize																			
		Groundnut																			
		Cotton																			
FACTORS	Animal																				
	Service																				
	FL																				
HH	Land																				
	Cap																				
BENEFICIARIES	ACTIVITIES	Inc																			
		Millet								15473193,1											
		Sorghum									6475229										
		Maize										8062423									
		Groundnut											4905835								
		Cotton												18575406,4							
	COMMO	Animal													3837890						
		Service														1426795					
		Millet	24198,6051																		3965196,7
		Sorghum		35759,57																	1998787,6
		Maize			20078,05																4326361,73
		Groundnut				2652,232															1196427,55
FACTORS	Cotton					108814,19															
	Animal						324019,2													1029426,71	
	Service																				
HH	FL	282548,235	70949,54	111033,4	125108,5	343570,374	234407,1	137145,5													
	Land	5024434,11	1124793	1455454	2299314	5313953,59															
	Cap	994146,482	528649	692247,6	487044,8	1166370,76	177275,4	1250238													
VILLAGE MARKETS	HL	Inc															3764834	15217948,4	5295972		
		Millet																			5223262,43
		Sorghum																			1358030,79
		Maize																			1720675,36
		Groundnut																			314520,863
		Animal																			1374167,37
ROW		8705803,79	4604073	5609893	1795977	11105163,2	1047909													473454,155	
TOTAL		15473193,1	6475229	8062423	4905835	18575406,4	3837890	1426795	15473193,1	6475229	8062423	4905835	18575406,4	3837890	1426795	3764834	15217948,4	5295972	25447032,6		

Figure 5.6: Balanced nested SAM

		VILLAGE MARKETS							ROW	TOTAL	
		Millet	Sorghum	Maize	Groundnut	Animal	Service	HL			
NON-BENEFICIARIES	ACTIVITIES	Millet								30607696,4	
		Sorghum								16013589,8	
		Maize								22936711,2	
		Groundnut								15400799,3	
		Cotton								38638193,4	
		Animal								7581391,91	
		Service								493457,488	
	COMMO	Millet	3553376							13263960,9	30607696,4
		Sorghum		1480018						7760012,272	16013589,8
		Maize			2168276					10895468,81	22936711,2
		Groundnut				547211				8451425,858	15400799,3
		Cotton								37974565,2	38638193,4
		Animal					2892004			3275341,887	7581391,91
		Service						187604,2		305853,3364	493457,488
	FACTORS	FL							4341094	116319,7097	8145344,63
		Land									35420529,8
		Cap									5013561,96
HH	Inc								1854999,324	50434435,7	
ACTIVITIES	Millet									15473193,1	
	Sorghum									6475228,51	
	Maize									8062423,39	
	Groundnut									4905835,21	
	Cotton									18575406,4	
	Animal									3837889,63	
	Service									1426794,51	
COMMO	Millet	5223262							6010233,391	15473193,1	
	Sorghum		1358031						2791529,704	6475228,51	
	Maize			1720675					1649510,983	8062423,39	
	Groundnut				314521				3174187,926	4905835,21	
	Cotton								18142573,05	18575406,4	
	Animal					1374167			1434295,544	3837889,63	
	Service						473454,2		953340,3591	1426794,51	
FACTORS	FL							2448480	11591,00385	3764833,89	
	Land									15217948,4	
	Cap									5295971,93	
HH	Inc								1168278,445	25447032,6	
VILLAGE MARKETS	Millet									8776637,97	
	Sorghum									2838048,39	
	Maize									3888951,4	
	Groundnut									861731,522	
	Animal									4266171,2	
	Service									661058,306	
	HL									6789574,61	
ROW										119233488	
TOTAL		8776638	2838048	3888951	861732	4266171	661058,3	6789575	119233487,7	676912541	

Chapter 6

Modeling the impacts of social cash transfer programs in the local economy

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Abstract

Governments and policymakers are interested in documenting impacts beyond those directly affected by the interventions. Programs and projects can have local general-equilibrium effects that are shaped by the economic behavior of both the interventions beneficiaries and non-beneficiaries. This paper uses a local economy-wide impact evaluation model to evaluate spillovers from a cash transfer program in Mali. The model was calibrated using a village Social Accounting Matrix (village-SAM) constructed by households survey data. We simulate real income multipliers for non-beneficiary households according to different factor supply elasticity. We consider real income as a proxy for welfare. We found that the project generates a positive income multipliers for non-beneficiary households in the village.

Keywords: Local-economywide effects, Cash Transfer, CGE, Mali.

6.1 Introduction

Cash transfer programs implemented as a social safety net are becoming very popular in sub-Saharan African countries. An extensive economic literature has evaluated the impacts of the treatment on the treated of these programs. Handa *et al.* (2018) summarize impacts of eight cash transfers programs in sub-Saharan Africa and Hidrobo *et al.* (2018) published a broader review of the literature on social protection and asset formation. Most of these published evidences don't take into account the general equilibrium effects of the program. Projects and policies often create spillovers within the project areas. Cash transfer beneficiaries' households are part of a local community in which they interact with other households. As soon as a beneficiary household receives the transfer, his spending increases. The transfer impacts can then spread into the local economy through cash beneficiaries' purchase of goods and services. For example, purchase in the village markets, doorstep trade or trade with outside the village. The transfer's impact is then transmitted from the beneficiary to others inside and outside the local economy, including households ineligible for the cash. If households interact in the local markets and these markets are not well integrated, local general equilibrium effects can occur.

The cash spending in the economy creates local general-equilibrium effects in addition to direct impacts on the treated. Therefore, primary cash beneficiaries may not be the only ones who benefit from the cash transfer. The effects of the interventions may affect households other than the intended recipients and without accounting for this, the thorough impact of the program in the local economies may be understated.

The Government of Mali began in 2014 the implementation of the "*Programme de Filets Sociaux*" with the aimed to reduce poverty and improve human capital accumulation. To investigate the spillover effects of the program in Mali, we previously show in chapter 5 that the cash transfer creates income multipliers that benefit non-beneficiary households as well as beneficiary households. To do this, we used a villa-SAM multiplier model to perform the simulations. Even if the village-SAM model is a useful step in conducting impact analysis using simulation methods, it assumes that the behavior of all actors is linear, the supplies of all goods, services, and factors are perfectly elastic, and linear response in production activities and in household consumption. Because of these constraints, the SAM multiplier model may overstate the impacts of cash transfers on the local economy.

To document the local economy-wide impacts while taking into account these constraints, we use the local economy-wide impact evaluation method (Taylor *et al.*

(2014)) to quantify how treatment impacts spill over into the non-treated population. The model integrates a micromodel of agricultural households with general-equilibrium methods. The entire model is calibrated from the village Social Accounting Matrix (village-SAM). We simulate the spillover effects on households' welfare. We consider real income, which deflates nominal income, as a proxy for welfare. Simulations results show how the transfer to most indigent segments of a population generates a multiplier in the village economy while taking into account the limits of the SAM multiplier model.

6.2 Cash transfers and the local economy

Cash transfer programs are among the most efficient development interventions (Adato and Hoddinott, 2007) and are implemented in many sub-Saharan African countries. Randomized Control Trials (RCT) design are used to inform on the impact of the programs. For example, Natali *et al.* (2018) use a randomized controlled trial in rural Zambia to investigate whether a government-run unconditional cash transfer paid directly to women in poor households had an impact on self-reported happiness; de Hoop *et al.* (2020) used cluster-randomized trials carried out during the rollout of large-scale programs in Malawi and Zambia to analyze the impact of the program on micro-entrepreneurial activity and child work. RCTs evaluate the impacts of the treatment on the treated while the impact of the program can also be found in the local economy.

Spillovers are important to get a full impact of any program intervention. For example, Taylor *et al.* (2005) explore how agricultural and trade policy reforms play out within rural economies of less developed countries and Miguel and Kremer (2004) show that children in the control schools appeared to benefit from the program through reduced disease transmission in the Kenyan deworming program. Filip-ski *et al.* (2015) find that Lesotho's cash grants program has spillover effects and Angelucci and De Giorgi (2009) show that a cash transfer can also benefit some ineligible households by affecting inter-household gifts and loans or saving and investment behavior.

To analyze the local economy-wide effect, Thome *et al.* (2013) use a local economy-wide impact evaluation (LEWIE) model to simulate the effects of cash transfers on production in Kenya, Filip-ski and Belton (2018) use the same model to analyze whether and how aquaculture impacts local incomes and employment in Myanmar's

main aquaculture zone. The LEWIE model is widely used to simulate projects and policies spillovers within project areas. This approach is used in this study to capture the spillover effects of the cash transfer program on the non-beneficiary households living in the same commune as the beneficiary households in Mali.

6.3 Modeling the village-level general equilibrium

At the village level, the prices of some goods, services and factors can be influenced by the local supply and demand conditions. The prices of items that are not easily traded outside of the local economy will be more responsive to local market conditions than items for which markets are seamlessly integrated at the national or international level (Abdulai *et al.* (2006), Fackler and Goodwin (2001)). When an item is not traded outside the village market, its price is endogenous, and it will respond more to local market conditions. The structure of the LEWIE model captures the dual nature of farm households as producers and consumers of goods and services. The spillovers come from a linkage from one household to the other. In the integrated markets, the income of beneficiaries increases but their spending does not affect the other households in the village, so there is no spillover.

To model the local economy-wide impacts of the cash transfers programs, we follow Filipinski and Belton (2018) who integrate into a general equilibrium framework a micromodel of agricultural household to describe the household's behavior. Let's consider that households preferences are represented by a Stone-Geary utility function given in (6.1).

$$U(X_i) = \prod_i (X_i - cm_i)^{\alpha_i} \quad (6.1)$$

X_i is the demand for goods and services consumed by the households h. Goods are produced at home or purchased in the market. cm_i is the subsistence minimum of good i as perceived by the household. α_i is the output elasticity associated with good i. The household will maximize its utility function :

$$U(X_i) = \sum_i \alpha_i \ln(X_i - cm_i) \quad (6.2)$$

Subject to the following constraints

$$Y_h = P_i C_i \quad (6.3)$$

$$\bar{T} = L_h + X_l \quad (6.4)$$

X_l is the leisure and L_h is the labor.

$$Y_h = \sum_i (P_i Q_i - w L_i) + w L_h + E \quad (6.5)$$

Y_h is the household potential or full income in which the value of time is explicitly incorporated (Becker (1965)). Q_i is the quantity of goods produced by the households; T is the household time endowment and w is the household labor wage. In absence of labor market, the household time is valued at a household "shadow price". E is any exogenous income for the household. For example, the cash transfer or remittances from abroad.

Assuming well functioning market for output and services, and constant returns to scale, we can rewrite Y_h as:

$$Y_h = \sum_i (R_{(h,i)} \bar{K}_{(i)} + w L_h + E) \quad (6.6)$$

K is the capital and it is fixed and R is the capital rent. By doing Income = Expenses (constraint in the farm household model),

$$Y_h = P_i C_i = \sum_i (P_i Q_i - w L_i) + w L_h + E \quad (6.7)$$

$$P_i(Q_i) - w L_i + w(\bar{T} - X_l) + E = P_i C_i \quad (6.8)$$

The production technology of the household is represented by a Cobb-Douglas, defined as :

$$Q_h = g_i(FD_i) \quad (6.9)$$

FD is the factor demand which is in our case, the household labor, the land and the capital. We assume land and capital are fixed. The Lagrange multiplier is :

$$L = U(X_i) - \lambda [P(g_i(FD_i)) - w L_i + w(\bar{T}) - w_l X_l + E - P_i C_i] \quad (6.10)$$

We derive the consumption demands by maximizing utility subject to full income and obtain a linear expenditure system (LES):

$$X_i = c m_i + \frac{\alpha_i}{P_i} (Y_h - \sum_i c m_i P_i) \quad (6.11)$$

If we consider the minimum consumption equal to 0, the equation (6.11) can be rewritten as:

$$X_i = \alpha_i \frac{Y_h}{P_i} \quad (6.12)$$

Households interact through the market and the price transmits impacts in the economy. Market closures are then important in the model. We have market-clearing constraints that sum up supplies and demands across households to obtain marketed surplus (MS) for goods and factors at the village level.

$$HMS_{i,h} = QP_{i,h} - X_{i,h} - \sum id_h \quad (6.13)$$

In (6.13), h stands for household, $HMS_{i,h}$ is the household market surplus which is the total quantity of output for good i produced by the household without the quantity consumed $X_{i,h}$ and intermediary demand id_h . At the village level, we obtain the village market surplus by summing the household market surplus.

$$VMS_i = \sum HMS_{i,h} \quad (6.14)$$

For goods that are tradable in the village but non-tradable between the village and the rest of the world, $VMS_{(i)}$ and the price are endogenous. But for goods that are tradable with the outside of the village (row), the price is fixed \bar{P} and determined by the net trade between the village and the rest of the economy (row). For rural factors, at the household level, household factor marketed surplus is the difference between factor supply from the household and the factor demand. Activity level factors are labor and capital which are assumed to be fixed for each household.

$$HFMS_{f,h} = HFSup_{f,h} - \sum_i FD_{i,f} \quad (6.15)$$

In the equation (6.15), $HFMS_{f,h}$ denotes household factor marketed surplus, $HFSup_{f,h}$ is the household factor supply and $FD_{i,f}$ is the factor demand at the household level. At the village level, the village factor marketed surplus is the sum of the household factor marketed surplus. It is given by the following equation:

$$VFMS_f = \sum_h HFMS_{f,h} \quad (6.16)$$

6.4 Data and model estimation

We use the village-SAM estimated in chapter 5 as data input for the model. The accounts in the village-SAM are generated for each household group (cash beneficiaries and non-beneficiaries) therefore each of the two households group participates in the production activities. The village market account in the village-SAM records interactions between different groups of households. Production activities combine two factors of production: labor and capital.

The equations used in the model (see equations in the Appendix) describe the household production, the way they trade with each other and with the rest of the world (row), how they earn money and how they spend their incomes. The village-SAM is used to provide initial values for all variables in the model, and to parameterize the model. The entire model is calibrated from the village-SAM.

6.5 Simulation Results

We simulate the household welfare using the local economy-wide impact evaluation. We consider an exogenous shock of 12 million FCFA (equivalent of USD 24000) payments to the cash receivers group in the village. Three (03) scenarios are simulated. In the base simulation, we use assumptions that most likely represent the village economy. We assume a nearly perfectly elastic labor supply (elasticity=100), since we do not know what the elasticity of labor supply is. This reflects excess labor supply in the rural economy. We assume capital supply is fixed. We assume that goods are tradable within the village. Given the high transaction costs in rural Mali, we assume that the prices of goods are determined in the village market.

For the second scenario, we assume that the supply of both hired and family labor in the village is inelastic (elasticity=1.0). The first two scenarios are supposed to show how the labor supply shape project impacts. Our third scenario simulates a 10 percent increase in the cash given to the households. The simulation results show how the village economy adjusts to the liquidity influx.

Table 6.1 shows the nominal and real income multiplier for cash receivers and non-cash receivers. We can see how the magnitude of welfare varies under different scenarios. The welfare measure considered here is the real income multiplier. Changes in the production, prices, wages generate a shift in income for cash beneficiaries and

non-beneficiaries. Households respond to price incentives. Prices are the mechanism by which impacts on the treated are transmitted to others within the local economy Taylor *et al.* (2014). Because of the prices change, real income reveals more household welfare than nominal income. In this study, we deflate the nominal income by the consumer price index to get the real income (Filipski *et al.* (2015)).

The table shows the income multiplier for cash receivers (beneficiaries) and non-cash receivers (non-beneficiaries). Beneficiaries' households receive the direct transfer, plus a small spillover while non-beneficiary households don't receive the transfer but because they live in the treated village, they benefit from the transfer which is a pure spillover. Under the base simulation where we assume fixed capital and land but elastic labor supply, for non-cash beneficiaries, the nominal income multiplier is 1.50 and 0.16 for real income multiplier. Simulation 2 differs from the base simulation in that it assumes the labor supply is inelastic. In that case, the nominal income multiplier of the non-cash beneficiaries is 1.57 while the real income is 0.15. The nominal income is higher for factor constrained simulation that is for inelastic factor supply.

Table 6.1: Spillover effect of cash transfer on welfare under scenarios

	scenario 1		scenario 2		scenario 3	
	N-Cash	Cash	N-Cash	Cash	N-Cash	Cash
Nominal Income	1.5	1.58	1.57	1.69	1.74	1.36
Real Income	0.16	0.65	0.14	0.64	0.17	0.71

Unlike that, the real income multiplier is higher for elastic factor supply. So, in real term, the program's multiplier effect increases as the labor supply become more elastic. Factor supply elasticity influences the income effect of the program. As concluded by Taylor *et al.* (2014) in their study on the general equilibrium impact of a transfer program in Lesotho, factor supply elasticity determine whether the income benefits from the program are real or inflationary.

In simulation 3, we increase the transfer given to households by 10% while keeping the labor supply very elastic, and we analyze the effect on the household's welfare. The spillover for non-beneficiaries is 1.74 for nominal income and 0.17 for real income. The change in welfare compared to the base scenario is 1% and compare to the simulation 2 is 3%.

Simulation results show that factor supply elasticity affects the spillovers. In rural Mali where the data was collected, we think that there is high unemployment and land supply is very elastic. The most plausible assumption is to consider elastic

factor supply. We then think that the cash transfer project generates income multipliers in the village and spillover for ineligible households. Considering the elastic labor supply in rural Mali, increasing the transfer by 10% does not have a huge effect spillover effect compared to the normal transfer.

6.6 Conclusion

Cash transfer programs are important strategies to tackle extreme poverty in developing countries. The program injects an important quantity of money into the local economy through the program beneficiaries. By spending the money in the local economy, the program impact can be transmitted from beneficiary to non-beneficiary households and therefore general equilibrium effect can occur.

In this paper, we use the local economy-wide impact evaluation model that was calibrated with a village-SAM developed in chapter 5. We consider two groups of households: cash receivers and non-receivers. We have simulated three scenarios: elastic labor supply, inelastic labor supply and an increase of 10 percent of the transfer. We analyze the spillover effect on non-cash beneficiaries.

Simulations results show that the spillover effect on real income that we consider as the welfare effect varies according to the labor supply elasticity. The effect of the money injection in the local economy will depend on the local factor supply elasticity. Overall, results suggest that the money transfer in the village economy has an impact not only on the cash beneficiaries but also on non-cash beneficiaries. It is then important to include the spillover effect in the global impact evaluation. In terms of policy perspective, cash transfer programs have an important benefit for non-cash receivers that live in the same area as the cash beneficiaries. Because of the spillover they generate on the non-cash beneficiaries' welfare, similar interventions should be encouraged where production factors supply are elastic.

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Appendix

Model Equations

- Household level
- Prices in the economy

$$EQ_PVA_{(g,h)} = PH_{(g,h)} - \sum_{gg} idsh_{(gg,g,h)} \times PH_{(gg,h)} \quad (6.17)$$

- Production block

$$EQ_QP_{(g,h)} = \frac{1}{vash_{g,h}} \times a_{(g,h)} \times \prod_f (FD_{g,f,h})^{\beta_{g,f,h}} \quad (6.18)$$

$$EQ_FD_{(g,f,h)} = FD_{(g,f,h)} \times [R_{(g,f,h)} + W_f] \quad (6.19)$$

$$EQ_ID_{(g,f,h)} = QP_{(g,h)} \times idsh_{(gg,g,h)} \quad (6.20)$$

- Income and consumption

$$EQ_Y_{(h)} = \sum_{g,fk} (R_{(g,fk,h)} \times FD_{(g,fk,h)}) + \sum (HFSUP \times W) + Yexog_h \quad (6.21)$$

$$EQ_QC_{(g,h)} = \frac{\alpha_{g,h}}{PH_{g,h}} \times Y_h \quad (6.22)$$

- Village level
- Market clearing

$$EQ_HMS_{(g,h)} = QP_{g,h} - QC_{g,h} - \sum_{gg} ID_{g,gg,h} \quad (6.23)$$

$$EQ_VMS_{(g)} = \sum_h HMS_{g,h} \quad (6.24)$$

$$EQ_FIXMS_{(gnt)} = VMS_{(gnt)} \quad (6.25)$$

$$EQ_HFMS_{(ft,h)} = HFSUP_{f,h} - \sum_{gp} FD_{gp,f,h} \quad (6.26)$$

$$EQ_VFMS_{(ft)} = \sum_h HFMS_{ft,h} \quad (6.27)$$

- Village level
- Clearing rents and wages

$$EQ_FIXF_{g,fx,h} = FD_{g,fx,h} = fixfac_{g,fx,h} \quad (6.28)$$

$$EQ_FIXVF_{ftv} = VFMS_{ftv} \quad (6.29)$$

$$EQ_HFSUP_{ftv,h} = W_{ftv} \times hfSupel_{ftv,h} \quad (6.30)$$

- Useful output

$$EQ_CPI_h = \sum_g PH_{g,h} \times \alpha_{g,h} \quad (6.31)$$

$$EQ_RY_h = \frac{Y_h}{CPI_h} \quad (6.32)$$

Chapter 7

General conclusion

This dissertation attempts to analyze the impacts of the cash program on beneficiary households and its spillovers effects on the local economy. Various empirical strategies were used in this study including the Randomized Control Trial (RCT) design, the Multinomial Endogenous Treatment Effect (METE) model, the Propensity Score Matching (PSM), Social Accounting Matrix (SAM), and the Local Economy-Wide Impact Evaluation Method (LEWIE). This section summarizes the main findings from the different chapters and makes some recommendations to improve the cash programs and sustained their effects on the beneficiary households.

7.1 Main findings

We investigate the causal relationship between the cash transfer program and children's time allocation in the second chapter of the dissertation. We take advantage of the random assignment of the cash transfer and conduct an intent-to-treat (ITT) analysis. Results revealed that the program has no impact on school enrolment for children aged 7-16 but increases child participation in domestic work by 3.1 percentage points. Disaggregating by gender and age, the program increases girls school enrolment by 4.3 percentage points at the primary school. Potential mechanisms through which the program has implications for children could be the "soft condition" role played by the Accompanying Measures sessions.

The third chapter of the thesis analyses the relationship between armed conflict and the household's investment in productivity-enhancing inputs. It also investigates if the cash transfer program has any mitigating effect on the conflict impact. We combine household-level panel data with conflict data and apply the instrumental variable approach to address the conflict variable endogeneity and Correlated Random Effect (CRE) model to control for household time-invariant unobserved heterogeneity. Results show that armed conflict significantly reduces the probability

of use and expenditure on productivity-enhancing inputs. The cash transfer program as implemented in Mali does not create any mitigating effect on the agriculture expenditure. Future research may be useful to investigate what feature of the program should be modified to generate a mitigation effect on the agriculture investment in a conflict context.

The fourth chapter assesses the impact of the cash program exit strategies on the beneficiaries' welfare. We combine the multinomial endogenous treatment effects model with the propensity score matching technique to control for the selectivity biases and the endogeneity of the exit strategy choices. Findings show that animal fattening and poultry rearing as the program exit strategy have a positive and significant effect on the cash beneficiaries' welfare. The parameter (λ) shows that the hypothesis of selectivity bias cannot be rejected in the model. This chapter will help to promote evidence-based policies and inform decision-makers on which is the best exit strategy for cash transfer programs.

In this dissertation, we also analyze the general equilibrium effects or "spillover" effects of the cash transfer programs. We use household survey data to build a household Social Accounting Matrix (SAM) for cash receivers and non-receivers and nested the two SAMs in a village-SAM. This village-SAM is used to calculate the multiplier effect of 1 FCFA transfer in the village economy. Results presented in chapter 5 mainly proved the capacity of the exogenous transfer to generate a multiplier effect in the local economy. The simulations show that 1 FCFA transfer to the program beneficiary household has a multiplier effect of 1.28 for the beneficiary income and 0.16 on the non-beneficiary income. Results also show that the transfer has a multiplier effect on the production activities and the production factors.

Chapter six analyzes the general equilibrium effects of the cash program by dropping the assumption of linearity, fixed price, and unlimited resources that were considered in the village-SAM multiplier model. A Local Economy-Wide Impact Evaluation (LEWIE) model was used. The model was calibrated using a village Social Accounting Matrix (SAM) constructed in chapter 5. Simulations results have confirmed that the cash transfer project generates income multipliers in the village and spillover for ineligible households. Simulations results also show that the program's multiplier effect depends on the labor supply elasticity.

7.2 Policy implications

The findings from this study indicated that the UCT program implemented in Mali increases school enrolment for girls at primary school. Besides this direct effect, the program has spillover effects on non-beneficiary households. In addition, we have demonstrated that the UCT program in Mali benefits not only the cash receivers but also the non-cash receivers living in the same community. Based on this study's evidence, social safety nets in general and cash programs, in particular, should become a core part of development strategies. Even the number of social safety net programs has risen in these recent years, coverage remains limited in sub-Saharan Africa, with many of the destitute households not covered. Thus, the governments of developing countries in collaboration with development partners in their efforts to reduce household vulnerability in rural areas should bring social safety nets and cash programs to scale, and ensure their sustainability.

To consolidate the cash programs' achievements and prevent extremely poor households from falling back into poverty, the findings revealed that adoption of Income Generating Activities (IGAs) such as animal fattening and poultry rearing have a positive and significant impact on the household's welfare. The implication is that the adoption of animal fattening and poultry rearing as IGA tend to ensure a minimum income to households who leave Mali's cash transfer program. Thus, facilitating the adoption of such IGA can be an effective measure to keep households out of extreme poverty after they have left the UCT program.

Social safety nets can help build household resilience to shocks. We found in this study that armed conflict has a negative and statistically significant impact on agricultural investment and the effect is not different whether the households benefit or not from the cash program. The conflict has created market disruption and it is difficult to have agricultural recovery without re-establishment of security. Cash transfer alone is not enough to restore the productive capacity of conflict-affected populations in Mali.

Appendix A

Complement to methodology

A.1 Complement to chapter 2

A.1.1 Program components

The Filets Sociaux (Jigisémèjiri) program consists of cash transfers (CT), accompanying measures (AM), and preventive nutrition packages (PNP). As of the midline survey in August-November 2016, the preventive nutrition packages (PNP) had not been implemented and were scheduled to be rolled out in the third quarter of 2017. The CT are unconditional transfers of 30,000 FCFA paid every quarter over a 3-year period (10,000 FCFA/month, or USD 18.02/month, which is about 9 percent of beneficiary households' midline consumption for the control group). Heads of household are the main beneficiaries of the cash transfers and are given a beneficiary identity card; a substitute is also identified in case the head of household is not available to receive the money. The CT are paid either via mobile money or banks, depending on the region. For example, in most of Sikasso (excluding Kibila and Boura), Koulikoro, and Bamako, Orange Money delivers the CT. In Segou and in the remainder of Sikasso (Kibila and Boura only), the CT is delivered by Banque Nationale de Développement Agricole (BNDA). In Kayes and Mopti, Banque Malienne de Solidarité (BMS) delivers the CT. In order to receive payments via banks, the beneficiaries or their substitute must present their beneficiary card and identification card to bank agents. For mobile money, an Orange money account is opened for beneficiaries, and beneficiaries receive a free SIM card. Payments are made electronically to mobile accounts, and beneficiaries or their substitutes can withdraw their money at distribution sites upon presentation of their beneficiary card and identification card. In cases where a payment is missed in one quarter, a double payment is made in the following quarter. For the AM, nongovernmental organizations (NGOs) conduct two training sessions per month in each interven-

tion village. The AM sessions are organized into groups of themes. Each group of themes is covered for a period of 6 months, or 2 quarters. To develop the material for these sessions, the government first designs a curriculum and uses a flip chart to conduct a regional training for the NGO on each group of themes just before the start of the 6-month term for that group. Health center doctors attend the regional training to provide information specific to the region. The NGO then adapts the messages to what will be understood by beneficiaries in the local context, translates the material to the local language with the assistance of village-level and circle-level health staff, develops a dissemination strategy (which can include images or radio) that is validated by the government office at the circle level, and trains fieldworkers. Fieldworkers have access to the flip charts developed by the government. The cash transfer distribution is also used as an opportunity to present information, as some beneficiaries who do not attend the sessions are present. In total, four groups of themes had been developed for the first three years of the program, with different regions receiving different numbers of sessions, depending on when the AM was rolled out.

Table A.1: Accompanying measures topics

Groups of themes	Themes
1	Use of Cash Transfer for essential needs Exclusive Breastfeeding Prevention of Ebola Virus Disease
2	Complementary feeding (including PNP cooking demonstration sessions) Beneficiaries participation in organizations of the social and solidarity economy (mutual health,, associations and cooperatives) Prenatal and postnatal consultations
3	Nutrition practices of women, in particular pregnant women Children’s rights—Feeding, sick and malnourished children. Children’s rights - Vaccination calendar for children and mothers Children’s rights – Birth registration Children’s rights – Importance of children and teenagers’ education, in particular young girls’ education
4	Family Economy and stock management Water –Hygiene and Wash Respiratory Infections of Children – IRA Promotion of the free health care services in the health insurance scheme – RAMED for CT beneficiaries

Once commenced, PNP will also be distributed at roughly the same time as the CT payments, once per quarter over at least a 1-year period. PNP will be composed of fortified food sourced from World Food Programme (WFP) and distributed by local NGOs. For pregnant or lactating mothers, CSB+ (250g per woman per day) and oil (25g per woman per day) will be distributed. For children 6-59 months, CSB++ (200g per child per day) will be distributed.

A.1.2 Details on Randomization

The first-stage randomization of communes to Treatment vs. Control occurred in a July 2014 meeting between government officials and the evaluation team, using colored beads drawn from a bag. For each region, a number of green beads corresponding to the number of intended Treatment communes and a number of red beads corresponding to the number of Control communes were put inside a closed bag. As the name of each study commune in the region was read aloud, officials took turns drawing a bead from the bag without being able to see inside; the commune was assigned to Treatment if green was drawn, and it was assigned to Control if red was drawn. The second-stage randomization of villages to PNP or Non-PNP occurred in the following months, in public meetings within each PNP-Eligible Treatment commune. To maximize transparency and public acceptance, community leaders, including village chiefs, were in attendance. Government officials supervised these meetings and explained the rationale to all present, with a member of the evaluation team also present in many cases. In each meeting, a number of paper slips corresponding to half the number of total villages in the commune indicated receipt of PNP in the first year, and a number of paper slips corresponding to the remaining half indicated receipt of PNP the following year. These were placed face down on a table visible to everyone present. As each village name was read aloud, a village leader would come forward and draw a face-down slip of paper which assigned the village to either “PNP” in the first year or to PNP the following year (“Non PNP”), depending on which paper was drawn. Within each region, the breakdown on the number of Treatment and Control communes was chosen to be roughly proportional, so that about 20 percent of each region’s communes would be Control.

A.1.3 Details on sample design

The sampling procedure for the baseline survey used a two-stage probability proportional to size sampling (PPS) method. In the first stage, villages were sampled based on their “population” size (where population refers to total number of CT beneficiary households), and in the second stage, the same number of households within each selected village were randomly sampled. With this process, larger villages in terms of total number of beneficiaries had a higher probability of being sampled in the first stage; and in the second stage, beneficiary households in larger villages had a smaller probability of being sampled. The second stage compensated for the first stage, so that each beneficiary household in the commune had the same probability of being sampled. Given that the Second level randomization of PNP was at the village level, sample size calculations for the comparison of child outcomes in PNP villages to Non-PNP villages showed more villages required in PNP-Eligible communes. Thus, the number of villages selected per commune depended on the treatment status of the commune. The final number of villages targeted to be sampled in each commune was 8 in Control communes, 5 in PNP-Ineligible Treatment communes, and 10 in PNP-Eligible Treatment communes. Within each of the selected villages, 5 beneficiary households with children age 6–23 months were sampled to meet the baseline sample size requirements (see baseline report for more details). In total, 3175 households across 96 communes were planned to be sampled at baseline. Due to security issues, only 3080 households across 90 communes were actually sampled and form part of the baseline data.

A.1.4 Power calculations

The sample design for the midline survey is based on “power calculations” that help ensure the ability to statistically detect the program impacts on key outcomes. Conducting power calculations for a given outcome requires specifying several parameters: the mean of the outcome, the variability of the outcome (as measured by its standard deviation), the size of the “design effect” or intra-cluster correlation, the number of “clusters” included in each intervention arm, and the number of observations included in each cluster. The calculation returns the magnitude of the maximum detectable impact for each key outcome. All else equal, the larger the sample, the smaller an impact the evaluation is able to successfully detect (meaning that it is more likely to detect an impact of the program). Moreover, outcomes with high variability relative to expected impacts require larger sample sizes for a

given detectable impact, since the more random variation there is in an indicator, the larger the required sample to discern impact from this “noise.” The intra-cluster correlation is relevant because of the cluster-based randomization at the commune or village levels. Accounting for the intra-cluster correlation adjusts for the fact that two households sampled within the same commune or village are likely to be more similar than two households sampled across different communes or villages. Power calculations were conducted for the comparison of outcomes across Treatment and Control communes (First stage randomization), using the baseline data from the program evaluation. We assumed that the 90 communes surveyed at baseline would be included in both midline and endline samples. We specified desired statistical power as 80 percent and desired significance level as 0.05, following convention. We specified a sample that would allow detecting a minimum impact of a 30-percent increase in the value of the outcome using an ANCOVA model.

A.2 Complement to chapter 4

A.2.1 Stata codes for the estimation works

```

set more off
clear all
set matsize 10000
insheet using "C:\Users\Eric Sessou\Documents\Article 5\DAT_F6.csv"

*** ssc install mtreatreg

*** Run Analysis*****

xi: mtreatreg lcons_exp_cap hsize poly farmsize r_w age_10 m01
moindel5ans entre1564ans plusde65 female l11 ihs_fertilizer lpluvio temp
k01_old l106_2 kayes segou koulikoro citykm, ///
mtreatment(q14=hsize poly farmsize r_w age_10 m01 moindel5ans
entre1564ans plusde65 female l11 ihs_fertilizer l106_2 lpluvio temp
k01_old kayes segou koulikoro roadkm citykm) ///
sim(500) basecat(0) density(normal) vce(cluster hhid) difficult verbose
eststo equil
esttab equil using "C:\Users\Eric Sessou\Documents\Article
5\mixlogit.csv", se star(* 0.10 ** 0.05 *** 0.01) label append ///
title("Table 1: Mixed Multinomial Logit model (first
equation) of the Determinants of the choice of Income Generating
Activities")

* likelihood-ratio test of exogeneity

scalar LR=2*(e(l1)-e(l1_exog))
scalar p=1-chi2(2,LR)
display LR
display p

*If the lrtest is significant, that means that the control of the
endogeneity increase the fitness of the model

*****
*****;
* REMINDER!!!
*STEPS FOR DOING PSM:

*1. Develop a model of program participation (dummy var)
* as a function of variables correlated with the
* probability of participating AND with the outcome of
* interest. These vars should be unaffected by
* participation, so should be pre-program or plausibly
* exog to the participation decision.

*2. Run -pscore- or -pstest- on the participation model
* to test the "balancing properties" of the data.
* -pscore- tests that treatment and comparison obs
* have identical mean propensity scores (pps) within
* groups (roughly, quantiles) of the propensity score.
* Once it has identified groups for which this holds,
* -pscore- tests that equality of the means of each
* RHS var within these groups of the pps. If it rejects
* equality of means for any X var, it reports that
* balancing property is not satisfied. Then, need to
* change specification until it is satisfied. Note,

```

```

*   you may want to test the balancing property again
*   on the matched sample after doing the matching.  This
*   can be done using -pstest-.

*3. Run -psmatch2- to estimate impact through matching
*   followed by bootstrapping to estimate the standard
*   error on the impact estimate.  These two steps can
*   be done using one of the procedures below.  Run
*   these procedures in Stata and then call the procedure
*   for the outcome of interest.  These procedures estimate
*   average impact of the treatment on the treated (ATT)
*   rather than average treatment effect for a population.;
*****
*****;

** Estimer les scores de propension avec un model logit binomial pour
chaque paire de choix d'AGR

* Generate pairwise comparison treatment variables;

gen  maraichage_Pagr=1      if q14==1
replace maraichage_Pagr=0  if q14==0

gen  embourche_Pagr= 1     if q14==2
replace  embourche_Pagr= 0     if q14==0

gen  elevage_Pagr=1       if q14==3
replace elevage_Pagr=0     if q14==0

gen      embourche_marai=1      if q14==2
replace embourche_marai=0      if q14==1

gen  elevage_marai=1  if q14==3
replace elevage_marai=0      if q14==1

gen      elevage_embou=1  if q14==3
replace elevage_embou=0    if q14==2

// PSM maraichage versus Pagr

preserve
drop if missing(maraichage_Pagr)
set seed 1230779
gen random1=runiform()
sort random1, stable

pscore maraichage_Pagr hsize poly farmsize r_w age_10 m01 moinde15ans
entre1564ans plusde65 female l11 ihs_fertilizer l106_2 lpluvio temp
k01_old kayes segou koulikoro roadkm citykm, ///
pscore(Pscore_maraichage_Pagr) blockid(Block_maraichage_Pagr) logit
comsup level(0.001)

tab comsup

drop if comsup==0

```

```

psmatch2 maraichage_Pagr, pscore(Pscore_maraichage_Pagr) caliper(0.01)
common neighbor(1) noreplacement

pstest hsize poly farmsize r_w age_10 moinde15ans entre1564ans plusde65
female m01 l11 ihs_fertilizer lpluvio k01_old ll06_2 kayes segou
koulikoro, treated(maraichage_Pagr) both

psgraph, treated(maraichage_Pagr) pscore(Pscore_maraichage_Pagr) bin(50)
sup(comsup) saving(psm_maraichage_Pagr, replace)

* Extract matched observations

gen pair= _id if _treated==0
replace pair=_n1 if _treated==1
bysort pair: egen paircount=count(pair)
tab paircount
drop if paircount!=2
save "C:\Users\Eric Sessou\Documents\Article 5\temp1", replace
restore

// PSM embourche versus Pagr

preserve
drop if missing(embourche_Pagr)
set seed 1230779
gen random1=runiform()
sort random1, stable

pscore embourche_Pagr hsize poly farmsize r_w age_10 m01 moinde15ans
entre1564ans plusde65 female l11 ihs_fertilizer ll06_2 lpluvio temp
k01_old kayes segou koulikoro roadkm citykm, ///
pscore(Pscore_embourche_Pagr) blockid(Block_embourche_Pagr) logit comsup
level(0.001)

tab comsup

drop if comsup==0

psmatch2 embourche_Pagr, pscore(Pscore_embourche_Pagr) caliper(0.01)
common neighbor(1) noreplacement
pstest hsize poly farmsize r_w age_10 moinde15ans entre1564ans plusde65
female m01 l11 ihs_fertilizer lpluvio k01_old ll06_2 kayes segou
koulikoro, treated(embourche_Pagr) both
psgraph, treated(embourche_Pagr) pscore(Pscore_embourche_Pagr) bin(50)
sup(comsup) saving(psm_embourche_Pagr, replace)

* Extract matched observations

gen pair= _id if _treated==0
replace pair=_n1 if _treated==1
bysort pair: egen paircount=count(pair)
tab paircount
drop if paircount!=2

```

```

save "C:\Users\Eric Sessou\Documents\Article 5\temp2", replace
restore

// PSM elevage versus Pagr

preserve
drop if missing(elevage_Pagr)
set seed 1230779
gen random1=runiform()
sort random1, stable

pscore elevage_Pagr hsize poly farmsize r_w age_10 m01 moinde15ans
entre1564ans plusde65 female l11 ihs_fertilizer l106_2 lpluvio temp
k01_old kayes segou koulikoro roadkm citykm, ///
pscore(Pscore_elevage_Pagr) blockid(Block_elevage_Pagr) logit comsup
level(0.001)

tab comsup

drop if comsup==0

psmatch2 elevage_Pagr,pscore(Pscore_elevage_Pagr) caliper(0.01) common
neighbor(1) noreplacement
pstest hsize poly farmsize r_w age_10 moinde15ans entre1564ans plusde65
female m01 l11 ihs_fertilizer lpluvio k01_old l106_2 kayes segou
koulikoro, treated(elevage_Pagr) both

psgraph, treated(elevage_Pagr) pscore(Pscore_elevage_Pagr) bin(50)
sup(comsup)saving(psm_elevage_Pagr, replace)
* Extract matched observations

gen pair= _id if _treated==0
replace pair=_n1 if _treated==1
bysort pair: egen paircount=count(pair)
tab paircount
drop if paircount!=2
save "C:\Users\Eric Sessou\Documents\Article 5\temp3", replace
restore

// PSM embourche versus maraichage

preserve
drop if missing(embourche_marai)
set seed 1230779
gen random1=runiform()
sort random1, stable

pscore embourche_marai hsize poly farmsize r_w age_10 m01 moinde15ans
entre1564ans plusde65 female l11 ihs_fertilizer l106_2 lpluvio temp
k01_old kayes segou koulikoro roadkm citykm, ///
pscore(Pscore_embourche_marai) blockid(Block_embourche_marai) logit
comsup level(0.001)

tab comsup

```

```

drop if comsup==0

psmatch2 embourche_marai, pscore(Pscore_embourche_marai) caliper(0.01)
common neighbor(1) noreplacement
pstest hsize poly farmsize r_w age_10 moinde15ans entre1564ans plusde65
female m01 l11 ihs_fertilizer lpluvio k01_old l106_2 kayes segou
koulikoro, treated(embourche_marai) both

psgraph, treated(embourche_marai) pscore(Pscore_embourche_marai) bin(50)
sup(comsup) saving(psm_embourche_marai, replace)

* Extract matched observations

gen pair= _id if _treated==0
replace pair=_n1 if _treated==1
bysort pair: egen paircount=count(pair)
tab paircount
drop if paircount!=2
save "C:\Users\Eric Sessou\Documents\Article 5\temp4", replace
restore

// PSM elevage versus maraichage

preserve
drop if missing(elevage_marai)
set seed 1230779
gen random1=runiform()
sort random1, stable

pscore elevage_marai hsize poly farmsize r_w age_10 m01 moinde15ans
entre1564ans plusde65 female l11 ihs_fertilizer l106_2 lpluvio temp
k01_old kayes segou koulikoro roadkm citykm, ///
pscore(Pscore_elevage_marai) blockid(Block_elevage_marai) logit comsup
level(0.001)

tab comsup

drop if comsup==0

psmatch2 elevage_marai, pscore(Pscore_elevage_marai) caliper(0.01) common
neighbor(1) noreplacement
pstest hsize poly farmsize r_w age_10 moinde15ans entre1564ans plusde65
female m01 l11 ihs_fertilizer lpluvio k01_old l106_2 kayes segou
koulikoro, treated(elevage_marai) both

psgraph, treated(elevage_marai) pscore(Pscore_elevage_marai) bin(50)
sup(comsup) saving(psm_elevage_marai, replace)

* Extract matched observations

gen pair= _id if _treated==0
replace pair=_n1 if _treated==1
bysort pair: egen paircount=count(pair)
tab paircount

```

```

drop if paircount!=2
save "C:\Users\Eric Sessou\Documents\Article 5\temp5", replace
restore

// PSM elevage versus embourche

preserve
drop if missing(elevage_embou)
set seed 1230779
gen random1=runiform()
sort random1, stable

pscore elevage_embou hsize poly farmsize r_w age_10 m01 moinde15ans
entre1564ans plusde65 female l11 ihs_fertilizer l106_2 lpluvio temp
k01_old kayes segou koulikoro roadkm citykm, ///
pscore(Pscore_elevage_embou) blockid(Block_elevage_embou) logit comsup
level(0.001)

tab comsup

drop if comsup==0

psmatch2 elevage_embou,pscore(Pscore_elevage_embou) caliper(0.01) common
neighbor(1) noreplacement
pstest hsize poly farmsize r_w age_10 moinde15ans entre1564ans plusde65
female m01 l11 ihs_fertilizer lpluvio k01_old l106_2 kayes segou
koulikoro, treated(elevage_embou) both

psgraph, treated(elevage_embou) pscore(Pscore_elevage_embou) bin(50)
sup(comsup)saving(psm_elevage_embou, replace)

* Extract matched observations

gen pair= _id if _treated==0
replace pair=_n1 if _treated==1
bysort pair: egen paircount=count(pair)
tab paircount
drop if paircount!=2
save "C:\Users\Eric Sessou\Documents\Article 5\temp6", replace
restore

// Appending matched data from the 6 pairwise comparison

use "C:\Users\Eric Sessou\Documents\Article 5\temp1", clear
append using "C:\Users\Eric Sessou\Documents\Article 5\temp2"
append using "C:\Users\Eric Sessou\Documents\Article 5\temp3"
append using "C:\Users\Eric Sessou\Documents\Article 5\temp4"
append using "C:\Users\Eric Sessou\Documents\Article 5\temp5"
append using "C:\Users\Eric Sessou\Documents\Article 5\temp6"

// Endogenous multinomial treatment effect model with matched data: this
model correct for bias from observed and unobserved variables

```



```

xi: mtreatreg lcons_exp_cap hsize poly farmsize r_w age_10 m01
moinde15ans entre1564ans plusde65 female l11 ihs_fertilizer lpluvio temp
k01_old l106_2 kayes segou koulikoro citykm, ///
mtreatment(q14=hsize poly farmsize r_w age_10 m01 moinde15ans
entre1564ans plusde65 female l11 ihs_fertilizer l106_2 lpluvio temp
k01_old kayes segou koulikoro citykm roadkm) ///
sim(500) basecat(0) density(normal) vce(cluster hhid) difficult verbose
eststo equ2

esttab equ2 using "C:\Users\Eric Sessou\Documents\Article
5\logit_matched.csv", se star(* 0.10 ** 0.05 *** 0.01) label append ///
        title("Table 1: Mixed Multinomial Logit model (first
equation) of the Determinants of the choice of Income Generating
Activities")

* likelihood-ratio test of exogeneity
scalar LR=2*(e(ll)-e(ll_exog))
scalar proba=1-chi2(2,LR)
display LR
display proba

```

A.3 Complement to chapter 6

A.3.1 GAMS codes for the simulation works

```

* $ title MiniGE-LEWIEmodel

*Option limrow=10, limcol=50;
*OPTION DECIMALS=2 ;

* name all the set elements that will be used (all those in the SAM, and
a few more)
set i all accounts in the economy
/A_AG1      Agriculture
  A_NAG1    Non-Agricultural Activities
  C_AG1     Agriculture
  C_NAG1    Non-Agricultural Activities
  LABO1     Labor
  CAPI1     Capital
  INC1      Income
  A_AG2     Agriculture
  A_NAG2    Non-Agricultural Activities
  C_AG2     Agriculture
  C_NAG2    Non-Agricultural Activities
  LABO2     Labor
  CAPI2     Capital
  INC2      Income
  AGC       ag commodity market
  NONAGC    non-ag commodity market
  LABOM     labor factor market
  ROW       Rest of the World
  TOT       Column total

* And the accounts not in the sam:
ag, nonag, poor, nonpoor, labo, capi , exog, purch

/

* Define your elasticity
* (100 for all columns of Table 3.6, can be changed to produce
alternative scenarios)
$setlocal supel 100

* Read the SAM:
alias (i,j);
parameter sam(i,j) the sam read from excel
* The "call.gdxrw" command reads the excel sheet in the range
"LEWIE_FromSAM!A1:S19"
* and makes a.gdx file out of it
$call "gdxrw input=MLILEWIE2.xlsx output=MLILEWIE2.gdx par=sam
rng=B4:T22"
* We then load the.gdx file and read the "sam" parameter
$gdxin MLILEWIE2.gdx
$load sam
$gdxin
display sam ;
* We compute the row and column totals, which come in handy in
calculations
sam("TOT",i) = sum(j,sam(j,i));
sam(i, "TOT") = sum(j,sam(i,j));

```

```

display sam ;
*$exit

* We define subsets of the generic "i" (all accounts), to define some as
goods, some as factors, etc.
* And we make subsets of those subsets, to define some as tradable, some
as non-tradable, etc.
* "null" is a name we give to the "phantom" element = to put in empty
sets (which GAMS does not like)
* The "null" element does nothing in terms of the model

$phantom null
* calibrating off of the SAM:
sets g(i)      goods /ag, nonag, exog /
    f(i)      factors /labo, capi, purch/
    h(i)      households /poor, nonpoor/

* subsets
    gp(g)     produced goods /ag, nonag/
    gnt(g)    non-tradable goods /null, ag /
*    gnt(g)    non-tradable goods /null/
    gt(g)     tradable goods / exog, nonag/
    fx(f)     fixed factors /capi/
    ft(f)     tradable factors /labo, purch/
    ftv(ft)   factors tradable in the village /null, labo/
    ftw(ft)   factors with the world /purch/
;
alias (g,gg);
alias (f,ff) ;

PARAMETERS
* Production
    pbeta(g,f,h)  Factor share of f in production of g by h
    pshift(g,h)   Shift parameter in production of g by h
    idsh(g,gg,h)  share of intermediate demand for gg to produce g
    vash(g,h)     share of value added
* Consumption
    calpha(g,h)   Expenditure share consumption of g by h

* Market assumptions
    se(f)         Supply elasticity of factor f in the economy
* endowments
    yexog(h)      exogenous income
    hfsupel(f,h)  factor supply elasticity for each household
    fixfac(g,f,h) fixed factor demand
;

* Parameters with a "0" suffix indicate base values, before running the
model
* Those values should be reproduced by the model without any shock
* (if not, then we have an unbalanced calibration)
parameters
    p0(g)        Price of g on the village markets
    pva0(g,h)    Price value added for each household
    r0(g,f,h)    Rent for inputs fixed in production of g by h
    w0(f)        Wage for tradable inputs (common for the village)
* Production

```

```

qp0(g,h)    Quantity of g produced by h
qva0(g,h)   Quantity of value added produced by h
id0(g,gg,h) Intermediate demand for g in production of gg by h
fd0(g,f,h)  Factor demand for f in production of g by h
hfd0(f,h)   Household total use of factors
hfsup0(f,h) Elastic Factor supply from the household

* Income and consumption
y0(h)       Nominal Income of household h
cpi0(h)     Consumer price index for household h
ry0(h)      Real income of household h
qc0(g,h)    Quantity of g consumed by h

* Market clearing
hms0(g,h)   Marketed surplus of g in the household-economy
vms0(g)     Marketed surplus of g in the village economy
hfms0(f,h)  Marketed surplus of f in the household-economy
vfms0(f)    Marketed surplus of f in the village economy
;

* We use the SAM to calibrate all the variables:
*-----

* First we map the names of sam accounts to names of model accounts
* (for example "a_ag1" is the ag activity of household 1 in the matrix,
*   so we map it to the "ag" commodity account and the "poor"
household account)
set
mapgg(i,g) maps SAM activities to the goods they produce in the model/
(a_ag1,a_ag2).ag
(a_nag1,a_nag2).nonag/
mapcg(i,g) maps hh-specific commodity accounts to model goods /
(c_ag1,c_ag2).ag
(c_nag1,c_nag2).nonag/
mapmg(i,g) maps SAM market account to model goods /agc.ag, nonagc.nonag/
mapff(i,f) maps SAM factor names to model factor name/
(labo1,labo2,labom).labo
(capi1,capi2).capi/
mapgh(i,h) maps activities to the household that performs them/
(A_AG1,A_NAG1).poor
(A_AG2,A_NAG2).nonpoor/
mapfh(i,h) maps factors to the household that owns them/
(LABO1,CAP11).poor
(LABO2,CAP12).nonpoor/
maphh(i,h) maps SAM household names to model household names /incl.poor,
inc2.nonpoor/
;

* Read total production from the SAM:
* (this line says: "the quantity of g produced by h is the amount in the
"TOT" row
*   of the SAM and column "i" such that "i" is mapped to good g and
household h)
qp0(g,h) = sum(i$(mapgg(i,g)*mapgh(i,h)),sam("TOT",i)) ;
* The following lines have a similar interpretation,
* they rely on name mappings to point to specific cells of the SAM.

```

```

* Read the factors off the act rows and the market rows:
fd0(g,f,h) = sum((i,j)$ (mapff(i,f)*mapgg(j,g)*mapgh(j,h)), sam(i,j));
* Purchased inputs are read off the ROW row:
fd0(g,"purch",h) = sum(i$ (mapgg(i,g)*mapgh(i,h)), sam("ROW",i));
* Intermediate inputs off the activity rows:
id0(gg,g,h) = sum((i,j)$ (mapcg(i,g)*mapgg(j,gg)*mapgh(j,h)), sam(i,j)) ;
* Household income is read in the Totals row
y0(h) = sum(i$maphh(i,h), sam("TOT",i)) ;
* Factor supply of tradable factors:
hfsup0(ft,h) = sum((i,j)$ (mapff(i,ft)*maphh(j,h)), sam(j,i)) ;
* Consumption
qc0(g,h) = sum((i,j)$ (mapmg(i,g)*maphh(j,h)), sam(i,j)) ;
qc0("exog",h) = sum(j$maphh(j,h), sam("ROW",j)) ;
display qp0, fd0, id0, y0, hfsup0, qc0 ;

* Then we compute market surpluses at all market levels:
* Goods markets (commodity accounts need to be integrated with market
accounts):
hms0(g,h) = qp0(g,h) - qc0(g,h) - sum(gg,id0(gg,g,h)) ;
vms0(g) = sum(h,hms0(g,h)) ;
qva0(g,h) = sum(f,fd0(g,f,h));
* Factor markets:
hfd0(f,h) = sum(g,fd0(g,f,h));
hfms0(ft,h) = hfsup0(ft,h) - hfd0(ft,h) ;
vfms0(f) = sum(h,hfms0(f,h));

* Prices, wages, and rents all initialized to 1
p0(g)=1;
w0(ft)=1 ;
r0(g,fx,h)$fd0(g,fx,h) = 1;

* We initialise model parameters:
* Intermediate input shares (idsh), value added shares (vash), factor
shares in production (pbeta)
* production shift parameter (pshift), consumption expenditure shares
(alpha), fixed factor supplies (fixfac)
idsh(g,gg,h)$id0(g,gg,h) = id0(g,gg,h) / qp0(g,h) ;
vash(g,h) = 1 - sum(gg,idsh(g,gg,h)) ;
pbeta(g,f,h)$fd0(g,f,h) = fd0(g,f,h) / sum(ff,fd0(g,ff,h)) ;
pshift(g,h)$qp0(g,h) = qva0(g,h) / (prod(ff,fd0(g,ff,h)**pbeta(g,ff,h))) ;
calpha(g,h) = qc0(g,h)*p0(g) / y0(h) ;
fixfac(g,fx,h) = fd0(g,fx,h) ;
* exogenous incomes are zero in the base, we will use this parameter to
simulate transfers later
yexog(h)=0;
* supply elasticity is set by the local supel (see line 37 of the code)
hfsupel(ft,h) = %supel% ;

* A few additional initial values (computed from model parameters)
* CPI, real income, and price value added (unit price net of the value of
intermediate inputs)
cpi0(h) = sum(g,p0(g)*calpha(g,h));
ry0(h) = y0(h) / cpi0(h);
pva0(g,h) = 1 - sum(gg,idsh(g,gg,h)) ;

```

```
display qp0, qva0, id0, p0, pva0, r0, w0, fd0,
        hfd0, y0, cpi0, ry0, qc0, hms0, hfms0, vms0, vfms0;
display pbeta, pshift, idsh, vash, calpha, yexog ;
```

* We define four sets of parameters, recognizable by their suffixes:
 * before simulation (1), after simulation (2), difference ("D"), and
 percent difference ("PC")

parameters

* Base model solution (without shock) suffixed with "1"

```
p1(g)          Price of g on the village markets
pval(g,h)      Price value added for each household
r1(g,f,h)     Rent for inputs fixed in production of g by h
w1(f)         Wage for tradable inputs (common for the village)
qp1(g,h)      Quantity of g produced by h
idl(g,gg,h)   Intermediate demand for g in production of gg by h
fd1(g,f,h)    Factor demand for f in production of g by h
hfd1(f,h)     Household total use of factors
y1(h)         Nominal Income of household h
cpi1(h)       Consumer price index for household h
ry1(h)        Real income of household h
qc1(g,h)      Quantity of g consumed by h
hms1(g,h)     Marketed surplus of g in the household-economy
vms1(g)       Marketed surplus of g in the village economy
hfms1(f,h)   Marketed surplus of f in the household-economy
vfms1(f)     Marketed surplus of f in the village economy
hfsup1(f,h)  Tradable factor supply
ly1(f,h)     Labor income
fxy1(f,h)    capital income
fixfac1(g,f,h) fixed factor
yexog1(h)    exogenous income
```

* Simulation model solution (after shock) suffixed with "2"

```
p2(g)          Price of g on the village markets
pva2(g,h)      Price value added for each household
r2(g,f,h)     Rent for inputs fixed in production of g by h
w2(f)         Wage for tradable inputs (common for the village)
qp2(g,h)      Quantity of g produced by h
id2(g,gg,h)   Intermediate demand for g in production of gg by h
fd2(g,f,h)    Factor demand for f in production of g by h
hfd2(f,h)     Household total use of factors
y2(h)         Nominal Income of household h
cpi2(h)       Consumer price index for household h
ry2(h)        Real income of household h
qc2(g,h)      Quantity of g consumed by h
hms2(g,h)     Marketed surplus of g in the household-economy
vms2(g)       Marketed surplus of g in the village economy
hfms2(f,h)   Marketed surplus of f in the household-economy
vfms2(f)     Marketed surplus of f in the village economy
hfsup2(f,h)  Tradable factor supply
ly2(f,h)     Labor income
fxy2(f,h)    capital income
fixfac2(g,f,h) fixed factor
yexog2(h)    exogenous income
```

* Difference between pre and post simulation suffixed with "D"

```
pD(g)          Price of g on the village markets
```

pvaD(g,h) Price value added for each household
 rD(g,f,h) Rent for inputs fixed in production of g by h
 wD(f) Wage for tradable inputs (common for the village)
 qpD(g,h) Quantity of g produced by h
 idD(g,gg,h) Intermediate demand for g in production of gg by h
 fdD(g,f,h) Factor demand for f in production of g by h
 hfdD(f,h) Household total use of factors
 yD(h) Nominal Income of household h
 cpiD(h) Consumer price index for household h
 ryD(h) Real income of household h
 qcD(g,h) Quantity of g consumed by h
 hmsD(g,h) Marketed surplus of g in the household-economy
 vmsD(g) Marketed surplus of g in the village economy
 hfmsD(f,h) Marketed surplus of f in the household-economy
 vfmsD(f) Marketed surplus of f in the village economy
 lyD(f,h) Labor income
 fxyD(f,h) capital income
 fixfacD(g,f,h) fixed factor
 yexogD(h) exogenous income

* Percent Change from base suffixed with "PC" pPC(g)
 Price of g on the village markets pvaPC(g,h)
 Price value added for each household
 rPC(g,f,h) Rent for inputs fixed in production of g by h
 wPC(f) Wage for tradable inputs (common for the village)
 qpPC(g,h) Quantity of g produced by h
 idPC(g,gg,h) Intermediate demand for g in production of gg by h
 fdPC(g,f,h) Factor demand for f in production of g by h
 hfdPC(f,h) Household total use of factors
 yPC(h) Nominal Income of household h
 cpiPC(h) Consumer price index for household h
 ryPC(h) Real income of household h
 qcPC(g,h) Quantity of g consumed by h
 hmsPC(g,h) Marketed surplus of g in the household-economy
 vmsPC(g) Marketed surplus of g in the village economy
 hfmsPC(f,h) Marketed surplus of f in the household-economy
 vfmsPC(f) Marketed surplus of f in the village economy
 lyPC(f,h) Labor income
 fxyPC(f,h) capital income
 fixfacPC(g,f,h) fixed factor
 yexogPC(h) exogenous income

;

* MODEL STARTS HERE:

* -----

VARIABLES

* Prices/values

P(g) Price of g on the village markets
 PVA(g,h) Price value added
 R(g,f,h) Rent for inputs fixed in production of g by h
 W(f) Wage for tradable inputs (common for the village)

* Production

QP(g,h) Quantity of g produced by h
 QVA(g,h) Quantity of value added created
 ID(g,gg,h) Intermediate demand for g in production of gg by h
 FD(g,f,h) Factor demand for f in production of g by h


```

HFD(f,h)   Household total use of factors
HFSUP(f,h) Household factor supply

* Income and consumption
Y(h)       Nominal Income of household h
CPI(h)     Consumer price index for household h
RY(h)      Real income of household h
QC(g,h)    Quantity of g consumed by h

* Market clearing
HMS(g,h)   Marketed surplus of g in the household-economy
VMS(g)     Marketed surplus of g in the village economy
HFMS(f,h)  Marketed surplus of f in the household-economy
VFMS(f)    Marketed surplus of f in the village economy
;

* Set initial values to the "0" calibration values
QP.l(g,h) = qp0(g,h) ;
ID.l(g,gg,h)= id0(g,gg,h);
FD.l(g,f,h)= fd0(g,f,h) ;
QVA.l(g,h) = qva0(g,h) ;
HFD.l(f,h)= hfd0(f,h) ;
Y.l(h)= y0(h) ;
QC.l(g,h)= qc0(g,h) ;
HMS.l(g,h)= hms0(g,h) ;
HFMS.l(f,h)= hfms0(f,h) ;
VMS.l(g) =vms0(g) ;
VFMS.l(f) =vfms0(f);
P.l(g) = p0(g) ;
PVA.l(g,h) = pva0(g,h) ;
R.l(g,f,h) = r0(g,f,h);
W.l(f) = w0(f) ;
CPI.l(h) = cpi0(h) ;
HFSUP.l(f,h) = hfsup0(f,h) ;

* MODEL
EQUATIONS
* Household level:
* Prices in the economy
EQ_PVA(g,h)   Defines prices as the household sees them

* Production block
EQ_QP(g,h)    Defines quantities produced
EQ_FD(g,f,h)  FOC: Defines factor demands
EQ_ID(g,gg,h) FOC: intermediate demands

* Income and consumption
EQ_Y(h)       Defines household income
EQ_QC(g,h)    Defines quantities of goods consumed by h

* Village-level:
* Market clearing
EQ_HMS(g,h)   Defines marketed surplus of the household
EQ_VMS(g)     Defines marketed surplus for the economy
EQ_FIXMS(g)   Clears market for non-tradable goods

EQ_HFMS(f,h)  Defines household factore marded surplus

```

```

EQ_VFMS(f)      Defines factor marketed surplus in the village
EQ_FIXF(g,f,h) Fixed factor constraint
EQ_FIXVF(ftv)   Factors tradable in the village only
EQ_HFSUP(f,h)  Tradable factor supply elasticity

* Useful output
* (those are definitional equations, not essential to the model itself):
EQ_CPI(h)      Defines cpi
EQ_RY(h)       Defines hh income in real terms

;

* Prices at the household level
EQ_PVA(g,h)..
PVA(g,h) =E= P(g) - sum(gg,idsh(g,gg,h)*P(gg)) ;

* Production block
*-----
* Cobb Douglas output:
EQ_QP(g,h)..
QP(g,h)*vash(g,h) =E=
pshift(g,h)*prod(f,FD(g,f,h)**pbeta(g,f,h)) ;
* Factor demands (resulting of a standard profimax)
* (value is rent or wage, depending whether it is a tradable factor or
not)
EQ_FD(g,f,h)$fd0(g,f,h)..
FD(g,f,h)*[R(g,f,h)$fx(f) + W(f)$ft(f)]
=E= QP(g,h)*PVA(g,h)*pbeta(g,f,h) ;
* Intermediate input demand (Leontieff):
EQ_ID(g,gg,h)..
ID(g,gg,h) =E= QP(g,h)*idsh(g,gg,h) ;

* Income and consumption
*-----
* Income is the value of all factor endowments + exogenous incomes
* factor values are evaluated at rent if fixed, at wage if tradable
EQ_Y(h)..
Y(h) =E= sum((fx,gp), R(gp,fx,h)*FD(gp,fx,h))
+ sum(ft$hfsup0(ft,h), W(ft)*hfsup(ft,h))
+ yexog(h) ;

* Consumption expenditure demand (result from solving a standard utility
maximization problem)
EQ_QC(g,h)$pva0(g,h)..
QC(g,h) =E= Y(h)*calpha(g,h)/ P(g) ;

* Village-level:
*-----
* Market clearing
EQ_HMS(g,h).. HMS(g,h) =E= QP(g,h) - QC(g,h) - sum(gg,ID(gg,g,h));
EQ_VMS(g).. VMS(g) =E= sum(h, HMS(g,h)) ;
EQ_FIXMS(gnt).. VMS(gnt) =E= vms0(gnt) ;

EQ_HFMS(ft,h).. HFMS(ft,h) =E= hfsup(ft,h) - sum(gp,FD(gp,ft,h)) ;
EQ_VFMS(ft).. VFMS(ft) =E= sum(h, HFMS(ft,h));
* Clearing rents and wages

```

```

EQ_FIXF(g,fx,h)$gp(g)..   FD(g,fx,h) =E= fixfac(g,fx,h) ;
EQ_FIXVF(ftv)..   VFMS(ftv)   =E= vfms0(ftv) ;

* Elastic Labor supply:
EQ_HFSUP(ftv,h)..
    HFSUP(ftv,h)/hfsup0(ftv,h) =E= W(ftv)**hfsupel(ftv,h) ;

* Useful output:
*-----
EQ_CPI(h)..
    CPI(h) =e= sum(g,P(g)*calpha(g,h));

EQ_RY(h)..
    RY(h) =e= Y(h) / CPI(h);

* Model defined in MCP form. Each equation is paired with its
complementary slack variable.
MODEL miniLEWIE /
EQ_PVA.PVA
EQ_FD.FD
EQ_QP.QP
EQ_ID.ID
EQ_QC.QC
EQ_Y.Y
EQ_CPI.CPI
EQ_RY.RY
EQ_HMS.HMS
EQ_VMS.VMS
EQ_FIXMS.P
EQ_HFMS.HFMS
EQ_VFMS.VFMS
EQ_FIXF.R
EQ_FIXVF.W
EQ_HFSUP.HFSUP
/ ;

* Fix prices for tradable goods and factors:
P.fx(gt) = p0(gt);
W.fx(ftw) = w0(ftw);
* Prevent the production/supply of exogenous goods/factors:
QP.fx("exog",h) = 0;
HFSUP.fx(ftw,h) = hfsup0(ftw,h);

* initialize rents and wages (to 1)
R.l(g,f,h)=r0(g,f,h) ;
W.l(f) = w0(f) ;
display P.l, PVA.l, R.l, W.l, QP.l, FD.l, ID.l, Y.l, QC.l, HMS.l, VMS.l,
VFMS.l, HFSUP.l, HFD.l, HFMS.l ;

* set iteration limit to 1 to check calibration, and increase it back to
10000 after check is done
*(if the calibration is done properly, it should be a solution to the
model, no iterations needed)
option iterlim = 1;
Solve miniLEWIE using mcp ;

```

```

option iterlim = 10000;

*$exit

* Aborts if model doesn't solve well
ABORT$(miniLEWIE.modelstat ne 1) "NOT WELL CALIBRATED IN THIS DRAW -
CHECK THE DATA INPUTS" ;
display P.l, PVA.l, R.l, W.l, QP.l, FD.l, ID.l, Y.l, QC.l, HMS.l, VMS.l,
VFMS.l, HFSUP.l, HFD.l, HFMS.l ;

** Appreciating the calibration
parameter ck1(g,h), ck2(g,h), esp(g,h);
ck1(g,h)=QP.l(g,h)-qp0(g,h);
ck2(g,h)=QC.l(g,h)-qc0(g,h);
esp(g,h)=0.0000000000001;
*$ontext
* Aborts if matrix not reproduced
loop((g,h),
ABORT$(ck1(g,h) ge esp(g,h)) "QP NOT WELL CALIBRATED - CHECK THE DATA
INPUTS" ;
ABORT$(ck2(g,h) ge esp(g,h)) "QC NOT WELL CALIBRATED - CHECK THE DATA
INPUTS" ;
);
*$offtext

* Base Parameters defined after the first run (no-shock)
* (these should all be obtained after 1 iteration only,
* and should not differ from the "0" parameters)
p1(g)      = P.l(g) ;
pva1(g,h)  = PVA.l(g,h);
r1(g,f,h)  = R.l(g,f,h);
w1(f)      = W.l(f) ;
qp1(g,h)   = QP.l(g,h) ;
id1(g,gg,h) = ID.l(g,gg,h) ;
fd1(g,f,h) = FD.l(g,f,h) ;
hfd1(f,h)  = HFD.l(f,h) ;
y1(h)      = Y.l(h) ;
cpil(h)    = CPI.l(h);
ry1(h)     = RY.l(h) ;
qc1(g,h)   = QC.l(g,h) ;
hms1(g,h)  = HMS.l(g,h) ;
vms1(g)    = VMS.l(g) ;
hfms1(f,h) = HFMS.l(f,h) ;
vfms1(f)   = VFMS.l(f) ;
hfsup1(f,h) = HFSUP.l(f,h) ;
fixfac1(g,fx,h) = fixfac(g,fx,h) ;
yexog1(h)  = yexog(h);

* *****
* SHOCK(s)
* *****
* This increases exogenous income of the poor by 1 dollar:
* 0.12 million=120 000 CFA par an pour un menage pauvre

```

```

* pour 100 menages pauvres=0.12*100
yexog("poor") = 0.12*100 ;

* This is the SOLVE statement for the simulation
* -----
Solve miniLEWIE using mcp ;
display P.l, PVA.l, R.l, W.l, QP.l, FD.l, ID.l, Y.l, QC.l, HMS.l, VMS.l,
VFMS.l, HFSUP.l, HFD.l, HFMS.l ;
display p1, pval, r1, w1, qp1, id1, fd1, hfd1, y1, qc1, hms1, vms1,
hfms1, vfms1 ;
display ck1, ck2
;

* Record values after simulation ("2" suffix)
p2(g)      = P.l(g) ;
pva2(g,h)  = PVA.l(g,h) ;
r2(g,f,h)  = R.l(g,f,h) ;
w2(f)      = W.l(f) ;
qp2(g,h)   = QP.l(g,h) ;
id2(g,gg,h) = ID.l(g,gg,h) ;
fd2(g,f,h) = FD.l(g,f,h) ;
hfd2(f,h)  = HFD.l(f,h) ;
y2(h)      = Y.l(h) ;
cpi2(h)    = CPI.l(h) ;
ry2(h)     = RY.l(h) ;
qc2(g,h)   = QC.l(g,h) ;
hms2(g,h)  = HMS.l(g,h) ;
vms2(g)    = VMS.l(g) ;
hfms2(f,h) = HFMS.l(f,h) ;
vfms2(f)   = VFMS.l(f) ;
hfsup2(f,h) = HFSUP.l(f,h) ;
fixfac2(g,fx,h) = fixfac(g,fx,h) ;
yexog2(h)  = yexog(h) ;

* Record differences from base
pD(g)      = p2(g) - p1(g) ;
pvaD(g,h)  = pva2(g,h) - pva1(g,h) ;
rD(g,f,h)  = r2(g,f,h) - r1(g,f,h) ;
wD(f)      = w2(f) - w1(f) ;
qpD(g,h)   = qp2(g,h) - qp1(g,h) ;
idD(g,gg,h) = id2(g,gg,h) - id1(g,gg,h) ;
fdD(g,f,h) = fd2(g,f,h) - fd1(g,f,h) ;
hfdD(f,h)  = hfd2(f,h) - hfd1(f,h) ;
yD(h)      = y2(h) - y1(h) ;
cpiD(h)    = cpi2(h) - cpi1(h) ;
ryD(h)     = ry2(h) - ry1(h) ; qcD(g,h)
= qc2(g,h) - qc1(g,h) ; hmsD(g,h) =
hms2(g,h) - hms1(g,h) ; vmsD(g) =
vms2(g) - vms1(g) ; hfmsD(f,h) =
hfms2(f,h) - hfms1(f,h) ; vfmsD(f) =
vfms2(f) - vfms1(f) ;
fixfacD(g,fx,h) = fixfac2(g,fx,h) - fixfac1(g,fx,h) ;
yexogD(h) = yexog2(h) - yexog1(h) ;

* Record Percent difference from base pPC(g)$p1(g)
= 100*pD(g) / p1(g) ; pvaPC(g,h)$pva1(g,h) =
100*pvaD(g,h) / pva1(g,h) ;

```

```

rPC(g,f,h)$r1(g,f,h) = 100*rD(g,f,h) / r1(g,f,h) ;
wPC(f)$w1(f) = 100*wD(f) / w1(f) ;
qpPC(g,h)$qp1(g,h) = 100*qpD(g,h) / qp1(g,h) ;
idPC(g,gg,h)$id1(g,gg,h) = 100*idD(g,gg,h) / id1(g,gg,h) ;
fdPC(g,f,h)$fd1(g,f,h) = 100*fdD(g,f,h) / fd1(g,f,h) ;
hfdPC(f,h)$hfd1(f,h) = 100*hfdD(f,h) / hfd1(f,h) ;
yPC(h)$y1(h) = 100*yD(h) / y1(h) ;
cpiPC(h) = cpiD(h)/cpi1(h) ;
ryPC(h) = ryD(h)/ry1(h) ;
qcPC(g,h)$qc1(g,h) = 100* qcD(g,h) / qc1(g,h) ;
hmsPC(g,h)$hms1(g,h) = 100*hmsD(g,h) / hms1(g,h) ;
vmsPC(g)$vms1(g) = 100*vmsD(g) / vms1(g) ;
hfmsPC(f,h)$hfms1(f,h) = 100*hfmsD(f,h) / hfms1(f,h) ;
vfmsPC(f)$vfms1(f) = 100*vfmsD(f) / vfms1(f) ;
fixfacPC(g,fx,h)$fixfac1(g,fx,h) = fixfacD(g,fx,h) / fixfac1(g,fx,h);
yexogPC(h)$yexog1(h) = yexogD(h) / yexog1(h);

display p2, pva2, r2, w2, qp2, id2, fd2, hfd2, y2, ry2, cpi2, qc2, hms2,
vms2, hfms2, vfms2 ;

display pD, pvaD, rD, wD, qpD, idD, fdD, hfdD, yD, ryD, cpiD, qcD, hmsD,
vmsD, hfmsD, vfmsD ;

display pPC, pvaPC, rPC, wPC, qpPC, idPC, fdPC, hfdPC, yPC, ryPC, cpiPC,
qcPC, hmsPC, vmsPC, hfmsPC, vfmsPC ;

display calpha, hfsupel;

```

Declaration of co-authorship

If a dissertation is based on already published or submitted co-authored articles, a declaration from each of the authors regarding the part of the work done by the doctoral candidate must be enclosed when submitting the dissertation.


1. Doctoral candidate
Name: M. Fidele Eric Sessou


2. This co-author declaration applies to the following article:
Unconditional Cash Transfer, child schooling and work :Experimental evidence from Mali

The extent of the doctoral candidate's contribution to the article is assessed on the following scale:

- A. Has contributed to the work (0-33%)
- B. Has made a substantial contribution (34-66%)
- C. Did the majority of the work independently (67-100%)

3. Declaration on the individual phases of the scientific work (A,B,C)	Extent
Concept: Formulation of the basic scientific problem based on theoretical questions which require clarification, including a summary of the general questions which, it is assumed, will be answerable via analyses or concrete experiments/investigations	c
Planning: Planning of experiments/analyses and formulation of investigative methodology, including choice of method and independent methodological development, in such a way that the scientific questions asked can be expected to be answered	c
Execution: Involvement in the analysis or the concrete experiments/investigation	c
Manuscript preparation: Presentation, interpretation and discussion of the results obtained in article form	c

4. Signature of all co-authors		
Date	Name	Signature
13/08/21	Christian H.C.A. Henning	

5. Signature of doctoral candidate		
Date	Name	Signature
13/08/2021	M. Fidele Eric Sessou	

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Execution: Involvement in the analysis or the concrete experiments/investigation	c
Manuscript preparation: Presentation, interpretation and discussion of the results obtained in article form	c

4. Signature of all co-authors		
Date	Name	Signature
13/08/21	Christian H.C.A. Henning	

5. Signature of doctoral candidate		
Date	Name	Signature
13/08/2021	M. Fidele Eric Sessou	

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- C. Did the majority of the work independently (67-100%)

3. Declaration on the individual phases of the scientific work (A,B,C)	Extent
Concept: Formulation of the basic scientific problem based on theoretical questions which require clarification, including a summary of the general questions which, it is assumed, will be answerable via analyses or concrete experiments/investigations	C
Planning: Planning of experiments/analyses and formulation of investigative methodology, including choice of method and independent methodological development, in such a way that the scientific questions asked can be expected to be answered	C
Execution: Involvement in the analysis or the concrete experiments/investigation	C
Manuscript preparation: Presentation, interpretation and discussion of the results obtained in article form	C

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