HOW DO CKWS RESPOND TO PERFORMANCE – BASED INCENTIVES? 
THE CASE OF UGANDAN COMMUNITY KNOWLEDGE WORKERS

BY

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THESIS

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This paper analyses the response of agricultural extension workers to incentives generated by a Grameen Foundation-sponsored extension program. The effectiveness of extension services in agricultural development has been a subject of debates over a considerable period. However, it is acknowledged that access and transfer of agricultural knowledge and technology are critical in developing agriculture and improving food security, especially in rural areas of developing countries. This is the area in which extension workers play a role: they are the main actors in the delivery of agricultural services to rural and remote communities.

Using data from an extension project in Uganda, this study examines the performance of 440 Community Knowledge Workers (CKWs) based on the incentive structure established by the Grameen Foundation. It was found that after inflation adjustments, an average increase of 47% of the original salary pay resulted in an average increase of approximately 9% in the productivity level of CKWs and it reduced the presence of poor performers.

The poor performance of public civil servants has raised some concerns in the past and some argue that the lack of effective incentives and low levels of job satisfaction in government outreach and extension programs could be a factor. This study was conducted to provide quantitative evidence on incentive effects and its results enable a better understanding of how CKWs can be adequately incentivized. A discussion of the
appropriate investments and design that could be adapted in agricultural extension programs in the sub-Saharan African setting is also incorporated in this analysis.
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Chapter 1: Introduction

1.1 Context

Governments, aid agencies and farmer organizations have consistently shown interest in the potential for agricultural extension services to improve productivity levels of farmers worldwide. This potential is perhaps greatest in developing countries (Lavy 2007). Agriculture still plays a pivotal role in poverty and hunger reduction as it remains the principal source of income and employment for the majority of the world’s poor living in rural areas (FAO 2003). In order to improve agricultural practices and productivity, research is constantly conducted and innovative technologies are being created. The findings and technologies are then disseminated to farmers via agricultural advisory and extension services. Considered as the “teachers” of farmers, agricultural extension workers are responsible for the effective delivery of these services.

Agricultural extension and advisory services have undergone many scrutinies. Despite transforming from top-down to participatory approaches to increase its impact on agricultural development, extension delivery services still face difficulties and the low performance of agricultural extension workers is identified as one significant concern because they are responsible for the quality and distribution of these services. Grameen Foundation introduced the Community Knowledge Worker (CKW) initiative in Uganda, in which CKWs are peer-nominated farmers who use applications from their smartphone
devices to share and collect agricultural information to and from other smallholder farmers in their communities.

Grameen Foundation designed an incentive pay scheme in which these CKWs are paid based on the number of information searches and surveys they complete, and the number of farmers they contact. The CKW initiative was officially launched in 2009, but this study covers a period of 14 months, from March 2011 to April 2012. In June 2011, its output-based compensation levels were increased by nearly 83%, on average. The purpose of this study is to empirically analyze how Community Knowledge Workers (CKWs) responded to this increase in the given incentive structure. A common challenge for nongovernmental organizations (NGOs) is ensuring a certain level of performance among their community workers and since this paper will explore the effect of a compensation structure on a worker’s effort and output over time, some insights will be gained, especially for policymakers and researchers who wish to increase the effectiveness of extension programs.

The mission of NGOs is to motivate extension workers to perform according to the objectives of extension services and one apparent mean to create this driving force is through compensation incentives. The empirical literature on extension incentives is still limited due to a lack of appropriate data, such as the imperfectly measured worker output (Burgess and Ratto 2003). However, this study uses data from the Grameen Foundation CKW Initiative in Uganda, where the performance levels of CKWs are observed and

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1 Without taking into account inflation fluctuations over the 14-month period.
recorded over time. CKWs have targets each month and they receive a monetary award based on their performance levels. This analysis will quantify the incentive effects on the performance of CKWs.

1.2 Study Objectives

A large body of literature exists on agency theory and performance-based pay, but empirical work is still relatively limited. This study specifically uses empirical evidence to answer the following questions:

1. How do community extension workers respond to the incentives offered from the Grameen Foundation's CKW Initiative?
   a. What is the magnitude of the incentive effects on the CKW's performance?
   b. Do some CKWs respond to incentives more than others?

2. What is the best functional form and specifications to deal with panel and count data, like the one used in this analysis?

3. What policy implications are derived from the findings to improve the overall performance of extension services for agricultural development in a developing country context?
   a. What should be done to ensure that extension workers are adequately incentivized in the Sub-Saharan African setting?

1.3 Country of Study

This study focuses on agricultural extension agents and it uses a set of panel data gathered from the CKW initiative implemented in Uganda. A low-income country situated
in East Africa, Uganda is one of the first African countries to have adopted a decentralized, market-oriented, farmer-centered extension model. Called the National Agricultural Advisory Services (NAADS), this public agency was created in 2001 to further decentralize agricultural extension services through the promotion of market-oriented agricultural production, which would empower farmers to demand and control themselves agricultural extension services (Benin et al. 2007).

It used a public-private extension service delivery approach. Thus, even though the government did not provide and support all extension services, it remained critical in creating the enabling environment for the private sector, NGOs and other groups to deliver these services. Overall, NAADS had shown positive impacts on farm income, and on the availability and quality of services, but it also had its shortfalls. The president of Uganda Museveni announced the disbandment of NAADS in early 2014 due to misallocation of funds and poor performance. Nonetheless, NAADS makes Uganda an interesting country to study as there will be a general overview of the history and the changes undergone by the extension services provided in this African nation. The goal of this paper is to highlight key findings from the panel data in Uganda, summarize its consistency with the theory and identify some of the policy implications for other sub-Saharan African countries.

1.4 Structure of Thesis

There are seven chapters in this thesis. Chapter 1 introduces and summarizes the purpose of this study. Chapter 2 explains the significance of this study, describing extension services and the role of Community Knowledge Workers (CKWs) in agricultural extension
and advisory services. Next, Chapter 3 provides a background of extension services in Uganda. Then, it reviews the related literature and summarizes the evidence found on incentives and how rational individuals respond to them. In Chapter 4, the data and research design are featured. Chapter 5 discusses the econometric models used to analyze this count and panel data. Chapter 6 presents the results from the data analyses. Lastly, Chapter 7, the final chapter, restates the key findings from the Grameen Foundation’s CKW initiative in Uganda and discusses its implications on agricultural extension programs in a developing country context. It concludes with directions for future research.
Chapter 2: Background

This chapter introduces the concept of extension services. Extension has gone through many transformations over time and it has implemented programs that draw much controversy. This section also addresses the role of the extension agents, specifically CKWs, in agricultural extension and advisory services.

2.1 Overview of Extension Services

The original definition of extension was the bridge between farmers and research, and it was viewed as a service to share the research-based knowledge to the rural sector via technology transfer, and non-formal education (Davis 2008). The traditional model was simply depicted by the following flow diagram (Semana 1998):

\[
\text{Research} \rightarrow \text{Extension} \rightarrow \text{Farmer}
\]

Figure 2.1 Flow Diagram of the Traditional Extension Model

Researchers share their findings to extension service providers who, then, communicate the new information with farmers. Agricultural information can be easily spread among farmers and retains its value despite wide access, thus its low excludability and low rivalry characteristics explain why it was initially viewed as a “public good”. Since extension services are an important element in the flow of information that can improve farmers’ and other rural peoples’ welfare, governments often took the complete responsibility for extension delivery, with the hopes of increasing significantly food production (Anderson and Feder 2003; Feder et al. 2001).
In the African context, the main objectives of extension services were to increase agricultural production, improve yields, train farmers and transfer technology. These top-down models were often unsuccessful and the term “advisory services” was introduced to describe the incorporation of multiple sources of knowledge (Davis 2008).

Now, extension and advisory services are offered though a more participatory approach, where the public and private sector, and other groups are all actively involved. Davis (2008) defines agricultural extension as

“the entire set of organizations that support and facilitate people engaged in agricultural production to solve problems and to obtain information, skills, and technologies to improve their livelihoods and wellbeing.”

The major actors consist of governmental agencies, non-governmental organizations, producer and farmer organizations, private sector actors, such as media groups, agricultural input suppliers, purchasers of agricultural products and training organizations. Now, extension services do not only consist of the transfer of agricultural knowledge and technology, but also the facilitation and formation of farmers groups, marketing issues, and collaborations with other agencies and service providers...

2.2 Extension agents

In developing countries, the public sector, NGOs, private companies, and farmers’ organizations are delivering extension services to agricultural producers using a range of modalities because no single actor or agency is best suited to offer the wide ranges of advisory services to meet the needs of growers and of the rural communities. The very
poor are frequently served by NGOs and the government while services to large and commercial farmers usually involve the private sector.

In rural areas of Uganda, like in many parts of the developing world, the aim of extension services is to reach smallholder farmers from remote and agrarian communities and provide them with technical advice and skills on agricultural technologies, and on other relevant subjects like farm input supply, credit, marketing and farm management (Chapman and Tripp 2003). Agricultural extensions agents provide such information and knowledge to agricultural producers, so they have the most frequent contact with the small-scale farmers and they need to be properly trained to motivate these farmers to try and adopt new agricultural technology (FAO 2003).

Not all agricultural extension agents are the same. Public extension agents usually emphasize on agricultural production issues. There are private extension service providers, who supplement the services not fully covered by public extension, such as business-related practices, input supply, market support and processing… Non-profit private providers target remote areas and poor producers while private extension concentrates in high-value, cash crops and advantaged areas. NGOs typically work with farmer groups and community-based organizations on market-oriented services. Lastly, there are village or community extension workers who often supply input-related services. (Schwartz 1994)

There are different names that describe extension agents based on certain criteria, such as the role that they have and their area of expertise. Health Extension Workers (HEWs) provide a range of health care services in rural and underserved areas; and community health workers indicate trusted members of the served communities (Datiko
and Lindtjorn 2009). As previously mentioned, agricultural extension agents provide agricultural advice and information. The Grameen Foundation uses a model with extension agents called Community Knowledge Workers (CKWs), which are agricultural extension workers who are also farmers and trusted members of the targeted communities.

### 2.2.1 Community Knowledge Workers (CKWs)

The Community Knowledge Workers (CKWs) initiative was introduced in Uganda in 2008 as a pilot program by Grameen Foundation (Grameen Foundation 2010). Its objective is to close the information gap faced by Ugandan farmers in rural and isolated villages through CKWs and the aid of mobile technology (Campenhout 2012; Grameen Foundation 2014). These CKWs utilize mobile devices to connect farmers to information systems and given that they are farmers themselves, they can contextualize the knowledge and effectively circulate relevant information to farmers in their respective regions (Grameen Foundation 2010).

CKWs are recruited locally by their peers, then screened, trained and monitored by the Grameen Foundation. They are provided with an Android smart-phone whose role is to assist them in collecting and disseminating information (Grameen Foundation 2010), and these mobile devices have batteries that are rechargeable via renewable energy, such as solar power or bicycle (Gohring 2011).

ICT and mobile phones are increasingly being used in developing countries to reach farmers in isolated places as they reduce transaction costs. In the CKW model, there are three mobile applications that can be used: CKW search, CKW survey, and CKW pulse. CKW
search allows CKWs to submit questions from farmers about topics ranging from local weather conditions, crop management to market prices. CKW survey is used for field data collection and CKW pulse allows CKWs to communicate with headquarters. In addition, directories (e.g. the list of traders in different regions) are provided. (Campenhout 2012)

One powerful advantage of the CKW project is that the information is directly accessible to a resident of the community; the CKW understands the local context and then, he/she can explain the information in a less technical matter to other farmers for a better grasp and use of the information. CKWs are also able to reach many farmers for a relatively low cost since the information is exchanged through mobile phones in a matter of seconds. (Campenhout 2012)

Campenhout 2012 examined the effect of CKWs on farmers in Uganda by monitoring only CKW searches. He found that the CKW intervention in communities led to positive impacts. Major findings included: a shift to market-oriented crops grown (maize, beans, and coffee), higher average farm-gate prices for maize, greater access to extension services, increased knowledge on market prices and improved agricultural practices.

His findings suggest that farmers’ attitudes are open to information and extension. This is consistent with the findings from the Grameen Foundation pilot program, in which CKWs commented that farmers tended to trust the information delivered to them because they saw CKWs also adopt the techniques they promoted (Grameen Foundation 2010).

Grameen Foundation officially launched the Community Knowledge Worker (CKW) Initiative in Uganda in 2009, and today it has reached more than 176,000 farmers (Grameen Foundation 2014). Evidence has been found supporting the hypothesis that
CKWs have positive effects on farmers (Campenhout 2012). In this study, 440 CKWs are followed and the number of searches they completed per month between the period of March 2011 and April 2012 are studied.

2.3 Performance of Extension Workers

Few studies have been done on the work performance of extension workers, but a rather large body of literature exists on the poor performance of public civil servants. One associated concept with performance is job satisfaction (Asadi et al. 2008; Naff and Crum 1999). Naff and Crum 1999 studies American public sector employees and the relationship between public service motivation and their attitudes and behaviors to understand their different values and responses to incentives, compared to private sector employees. They found strong relationships between public service motivation and job satisfaction, performance, intention to remain in the position and support for the government’s efforts.

In developing countries, there are low numbers of public servants, and their work is often criticized for being of poor quality, inefficient and inaccessible (WB 2004). The lack of motivation and proper incentives often explain this inadequateness.

Looking at the case of public school teachers, it is often found that primary school teachers, particularly in sub-Saharan Africa, are often poorly motivated (Bennell and Akyeampong 2007). Lateness, absenteeism and laziness are some of the common poor behaviors that teachers often demonstrate, compromising schooling quality and learning outcomes (Shafiwu and Salakpi 2013).
Bennell and Akyeampong 2007 found that poor motivation and inadequate incentives have adverse impacts on the behavior and overall performance of primary school teachers. For example, due to living and working conditions in rural areas, rural schools attract less qualified and experienced teachers. Also, low pay forces public servants to find additional sources of income, which takes their attention away from teaching, negatively, impacting the quality of education.

Although there exists limited studies concerning agricultural extension workers and their work performances, the case of extension agents is not different either. Literature suggests a strong positive relationship between the level of job satisfaction and job performance of extension workers (Asadi et al. 2008; Banmeke and Ajayi 2005; Onu et al. 2005). Asadi et al. 2008 investigated the relationship between the personal characteristics of 52 extension workers in Southern Iran and their job satisfaction levels. They found the monthly salary and marital status were two variables that explained the variances in the job satisfaction levels. Extension workers with higher amounts of monthly salary and married extension workers were more likely to have a higher level of job satisfaction. Meanwhile, there was some evidence suggesting that extension workers with low salary and facing unfair promotion policy led to negative job satisfaction.

Banmeke and Ajayi 2005 found no significant relationships between the personal characteristics of the extension agents and the level of job satisfaction in Edo State, Nigeria. Training and the years of experience did matter and affected job satisfaction of extension workers. Another similar study by Onu et al. 2005 found that interpersonal relationship, organizational policies and conditions of service were found to be strong predictors of job
satisfaction. This study raised concerns about the behavior and performance of teachers, which is directly related to low job satisfaction and motivation.

Though performances of Health Extension Workers (HEWs) are not often measured, HEWs are found to have a positive impact in communities when accompanied with an appropriate environment. Datiko and Lindtjorn 2009 discovered that the involvement of properly trained HEWs improved detection and treatment success rate of tuberculosis in southern Ethiopia. Whereas Medhanyie et al. 2012 blame a combination of poor knowledge and competencies, and poorly equipped health centers for preventing HEWs in Ethiopia from playing a key role in improving health facility deliveries, and skilled birth attendance.

Gautam and Anderson 1999 recognize the effectiveness of public agricultural extension service as a controversial issue. Looking at the case of Kenya, Gautam and Anderson assess the economic returns of agricultural extension after revisiting the results of a study by Bindlish and Evenson (1993, 1997) on the training and visit (T&V) system of management for extension services. They pinpoint the shortcomings of cross-sectional data and technology specification used in Bindlish and Evenson’s study. They showed that an empirical analysis that includes data errors and model misspecification led to very different results. Bindlish and Evenson 1993 found the returns from extension to be positive and very high. After running many robustness tests, Gautham’s and Anderson’s results cannot support a positive rate of return on the investment in T&V; in fact, they cannot argue that T&V had an impact in Kenya between 1982 and 1990, which is the exact opposite of the results from Bindlish and Evenson. When region-specific effects are taken into account, a positive return to extension cannot again be recognized. However, panel
data would have been able to control better regional effects. Gautham and Anderson 1999 caution future empirical analyses on extension services to reduce the potential of misleading policy implications and inadequate recommendations.
Chapter 3: Literature Review

The purpose of this literature review is to provide some background information on the transformations of extension services undergone in Uganda. The second part gives information on the factors that determine the quality of extension. The last section discusses the literature on incentive pay and its role in the delivery of extension services.

3.1 Uganda

The Republic of Uganda is a low-income country situated in eastern and central Africa. Landlocked, it is bordered by South Sudan on the north, Rwanda on the southwest, Tanzania on the south, the Democratic Republic of the Congo on the west and Kenya on the east. Based on July 2013 estimates, the Ugandan population reaches 34,758,809 (CIA World Factbook 2014). 38% of Ugandans live on less than $1.25 a day and subsistence farming still dominates as the main source of household earning (WB 2014; UBOS 2013). 77% of the Ugandan population lives in rural areas and half of rural households’ expenditures consist of food, drink and tobacco. (UBOS 2013)

Uganda has a total area of 241,038 square kilometers (km²), 75% of which is available for cultivation and pasture uses. Land is reasonably evenly distributed throughout the country, with an average landholding is roughly 2.2 hectares. Currently, less than 30% of total arable land is being use for cultivation. (GOU 2014)
3.1.1 Agriculture in Uganda

The Ugandan economy still demonstrates a heavy dependence on agriculture. Uganda is fortunate to be surrounded by an abundance of natural resources and agriculture is the most important sector, employing more than 70% of the work force (CIA World Factbook 2014; UBOS 2013). It uses most of its food production for domestic consumption, with the exception of few export crops (Gollin and Rogerson 2007). Most common crops include pulses, such as plantains, beans, starchy roots, like cassava, sweet potatoes, cereals, such maize, millet, sorghum, and other crops including coffee, groundnuts, and sesame. (Gollin and Rogerson 2007; FAOSTAT 2014)

In Uganda, nearly all agricultural production happens on smallholder plots. There exists an active, small commercial agricultural sector as well but export crops take less than 8% of the total cropped area. Subsistence farmers are found in both remote areas and in cities, but there is a higher concentration of farmers in rural regions, where conditions are aggravated by low levels of physical infrastructure (such as roads, electricity and piped water) and limited market access. (Gollin and Rogerson 2007)

The northern region of Uganda is known to be the home of the most poor while the central region, where the capital Kampala lies, has the lowest percentage of poor in the country. Food, drink and tobacco still accounts for a significant amount of expenditures in rural households, reaching 50%. (UBOS 2013)

After analyzing the role of the agricultural sector in Uganda, Gollin and Rogerson 2010 found that agricultural productivity improvements can have a relatively large impact on the economy. This confirms that agriculture is an opportunity for future economic
growth. The Ugandan agriculture sector is also the provider of food self-sufficiency and food security; thus, any improvements could lead to a higher degree of food security (GOU 2014). This is where extension services are applicable.

3.1.2 Extension in Uganda

One of the efforts to address poverty and food security in sub-Saharan Africa is focusing on increasing agricultural productivity through enhancing agricultural research and extension. Agricultural extension is one of the key sectors that can improve farmer’s knowledge to new agricultural technology (Opira and Lung’ahi 2013; Kasirye 2013).

Uganda has gone through different models of agricultural extension services (AES) and though each model faced their own challenges, Uganda is recognized as one of the few African countries that heavily invest in these extension services and create an enabling environment for agricultural development. Since 1986, the government has actively supported policies aimed at boosting production and export earnings (CIA World Factbook 2014). In 2001, it launched the National Agricultural Advisory Services (NAADS) program and since then, Uganda is known as one of the first African countries supportive of the pluralistic and demand-driven AES (Opira and Lung’ahi 2013). However, NAADS remains troubled with high transportation costs, low productivity and the large size of its quasi-subistence agriculture sector (Gollin and Rogerson 2007).
3.1.3 History of Extension

Historically, extension in Uganda has been under-effective, partly because the messages delivered were supply-driven rather than sensitive to specific needs of farmers. Also, extension itself was under-resourced to deliver any messages at all. Semana (2008) provides a brief historical account on the extension situation in Uganda. Starting in the late 1890s, during early colonialism, planting materials and research stations were being established in Uganda to conduct agriculture and forestry research. Then, in 1920, chiefs, expatriate field officers and African instructors began Uganda’s first extension work: they distributed these planting materials, disseminated messages on how to grow crops and enforcing laws regarding proper agricultural practices and land use. Cash crops at the time were: coffee, cotton, rubber, and tobacco.

Starting in 1956, extension switched its focus on providing technical advice and support, where credit or subsidized inputs would be given to selected progressive farmers. There was an inadequate number of trained extension staff, so some farmers had to demonstrate to others but many selected farmers took advantage of their special treatment and alienated other farmers.

From 1964 to 1972, the Research-Extension-Farmer Linkage model was introduced to promote technology development and dissemination. At this time, USAID also added the “help farmers help themselves through education” element in extension services. In this same period, Uganda experienced significant agriculture output growth rates, averaging 10% per year (GOU 2014).
During the following decade, the extension system collapsed and negative growth rates were witnessed. Years of political turmoil led to low productivity, dormancy and disorganization (Semana 2008). The agricultural sector was ravaged by economic mismanagement, inadequate public infrastructure and services, disinvestment by private sector and shortage of foreign exchange for importation of agricultural inputs. In the end, agriculture returned to subsistence production. (GOU 2014)

Starting in the mid-1980s, emphasis was put on rehabilitating infrastructure and restoring basic services. Duplication, conflict and confusion resulted from extension services provided by both non-governmental organizations (NGOs) and different public ministries. An Agricultural Policy Agenda of the Economic Recovery Programme was issued to address those shortcomings, in which farmers’ participation, dialogue, partnerships were encouraged (Semana 2008).

Despite reforms being made, agricultural extension system continued to decline. Farmers’ access to such services significantly diminished: extension only served few farmers and delivered non-effective messages and approaches, leading to low responsiveness to farmers’ needs. Decentralization, liberalization, privatization, cutbacks led to downsizing fields and the districts could not maintain extension role in their staff. (Semana 2008; GOU 2014)

In 1997, the Plan for the Modernization of Agriculture (PMA), a component of the Poverty Eradication Action Plan (PEAP), was introduced. PMA established the National Agricultural Advisory Services (NAADS), the overseer of extension services in the country from 2001 to 2014. (GOU 2014; Kalyango 2014)
3.1.4 Present Extension: NAADS, its disbandment and the Uganda Agricultural Extension Service

The National Agricultural Advisory Services (NAADS) program was established as one of the 7 pillars of the Plan for the Modernization of Agriculture (PMA) in 2001 to respond to the weak supply-driven traditional agricultural extension services in Uganda.

Its objective was to ensure that Agricultural Advisory Services (AADS) are “demand-driven, efficient, sustainable and market-targeted” (GOU 2014) by incorporating the following 5 components:

1) Advisory and information services to farmers
2) Technology development and linkage with markets
3) Quality assurance in terms regulations and technical auditing
4) Private sector institutional development
5) Programme management and monitoring

NAADS was first operational in 16 districts and later, it was present in all districts of the country. It operated through farmer groups, forums of communication between agricultural extension agents (AEAs) and farmers, enabling farmers to make decisions concerning the type of advisory services needed. NAADS also intended to target the poor and women. (GOU 2014)

According to an internal review by GOU, NAADS has led to many improvements: increase in agricultural income, empowerment of farmers in decision-making and demand for specific technologies, etc. However, it had failed to target the very poor. To enhance and reach out to poor households, government AEAs were to provide most of the advisory
services while NGOs and private AEAs will focus on specialized topics, not covered by the government (Opira and Lung’ahi 2013). Though NAADS was renewed in 2010 as a result of its successes and continued potential, it was recently dissolved to reduce budget expenses (Kalyango 2014). Unexpectedly, early in the year of 2014, the Ugandan president Museveni announced his plan to dissolve NAADS and the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) ordered NAADS to be disbanded in all districts due to non-performance and mismanagement of funds (The State of House of Uganda 2014; Kalyango 2014). The main goal of this change was to reduce the amount of money previously being spent on wages, workshops and seminars. The military force has been deployed to help with the restructuring of NAADS throughout the country and other changes are to be followed but details are still missing. However, to this day, it is known that the Uganda Agricultural Extension Service will replace NAADS and it will adopt a single spine extension system. (The State of House of Uganda 2014; Kalyango 2014)

3.1.5 Grameen Foundation in Uganda

The Community Knowledge Worker (CKW) initiative was introduced as an unique agricultural EAS program in Uganda to address some of the weaknesses and challenges of other existing EAS programs. This initiative bridged the communication gap between community members and agricultural information by creating and accessing a database that provides information on weather forecasts, market prices, agricultural best practices, and directory of input suppliers etc. (Grameen Foundation 2010)
Ultimately, the goal of the Grameen Foundation is to transform CKWs into Village Enterprise Service Providers where they will earn income without depending on Grameen and its partners. It trains them to perform specialized activities such as quality assurance specialist, mobile money agent, agricultural input agent, and weighing specialist for harvested crops, etc. (Grameen Foundation 2010)

CKWs are given access to smart phones and solar charging stations for their personal use. Grameen also offers CKWs monthly financial incentives based on their performance levels. To be considered a high performer at the end of the month, a community knowledge worker (CKW) is expected:

1) To complete 48 searches for farmers using the agricultural database and,

2) To register 15 new farmers in the data system

Using the CKW platform, records of all searches are automatically stored. Also, the GPS coordinates where the search, survey or farmer registration occurred are recorded. The information is then used to assess pro-rata the incentives based on performance. (Grameen Foundation 2010; Campenhout 2012)

Furthermore, after completing their expected duties, CKWs have the opportunity to earn additional money by using their solar chargers to charge their neighbors’ mobile phones for a fee. (Grameen Foundation 2010)

NAADS was considering adopting the CKW model for its extension services. In addition to providing one-on-one, hands-on extension services, NAADS had planned to explore expanding their roles to include providing proactive services that will benefit
groups of farmers, for example: through demonstration plots, farmer trainings, or farmer
groups formation. (GOU 2014)

3.1.6 Conclusion

Agricultural extension services in Uganda have changed over time, responding to challenges and circumstances. However, with the establishment of NAADS, reforms have been made in agricultural extension policies to empower farmers. AES has become demand-driven, client-oriented and farmer-led. Significant improvements have been made but extension services in Uganda still face many weaknesses. NAADS was disassembled and yet is seen from the new Uganda Agricultural Extension Service. Both the public and private sectors provide such service but their agents are different and their performance affect the overall impact of the extension services.

Uganda needs effective extension services. The literature of extension in Africa shows that it is not easy to provide and ensure effective and good quality extension.

3.2 Extension Services

As previously mentioned, agricultural extension services play an essential role in agricultural development. Both the private and public sector take part in the provision of these services. (Mubangizi et al. 2004)

New challenges are constantly arising when it comes to increasing food production, thus agricultural extension services are always under constant pressure to respond to these changes. One of the first significant changes made was putting an end to the traditional public extension systems. These systems are often described as outdated, top-
down, paternalistic, and inflexible. They also failed to cope with dynamic demands of modern agriculture and they were often subject to bureaucratic inefficiencies. (Obaa et al. 2005)

Decentralization policies have been seen as the most effective approach to increase responsiveness of governments to people’s needs by providing demand-driven rural services and empowering communities to determine their development (Opira and Lung’ahi 2013).

The public extension system was also criticized for its cost, lack of efficiency, and failure to pursue programs that foster equity. In sub-Saharan African countries, structural adjustment programs (SAPs) accelerated this process: public sector spending was retrenched and extension services suffered. Privatization of government services was done via contracting, decentralizing, cost sharing, cost recovery and withdrawal from selected services. (Obaa et al. 2005)

The World Bank and other donors supported this privatization process, especially promoting “contracting extension” with the hopes to expand extension coverage and improve performance and impact (Obaa et al. 2005). In Uganda, the extension system was monopolized by the public sector. After being criticized for the weak linkages between research establishments, extension services and farmers, for the use of top-down, non-participatory approaches, for high levels of bureaucracy and irresponsiveness to farmers’ needs, NAADS was introduced in the PMA in 2001. (Mubangizi et al. 2004)
The private sector was encouraged to contribute to extension services. Under NAADS, the public sector still funds extension and advisory services but private sector is contracted by farmer institutions to deliver these services. (Mubangizi et al. 2004)

Obaa et al. 2005 examines the effectiveness of the new “private service provider advisory” system. An assumption of homogeneity among farmers was made and the needs of minority and primary groups were ignored. They found that the complicated and lengthy enterprise selection process also mismatched the time-bound contracts for service providers (Obaa et al. 2005). However, private service providers’ objectives are to maximize their profits and they tend to limit their investment in the development of their staff. (Mubangizi et al. 2004)

Even under NAADS, major weaknesses were detected: lack of resources, inadequate information, expensive/availability Internet resources, and limited information sharing amongst PSPs and with public extension staff, and with translating the information. (Mubangizi et al. 2004)

In addition, there was no effort to target Private Service Providers (PSPs) by information sources and information quality assurance was lacking. There existed no standard procedures to ensure the quality of the information before disseminating it to farmers (Mubangizi et al. 2004). Extension quality depends on the performance of extension workers. Therefore, understanding the incentives for effort may be central in extension delivery efficacy and quality.
3.3 Incentives

According to Vroom’s Expectancy Theory, motivation depends on the outcomes that individuals expect from their actions. The theory states that individuals are motivated if the following three conditions are met: they believe that there is a positive correlation between effort and performance; if the favorable performance results in a desirable reward; and if the reward satisfies an important need (Redmon 2014). The three conditions are known as expectancy, instrumentality and valence respectively and Vroom concludes that the force of motivation is the product of these three components. In order for this force to be high, all components must also be high.

Incentives and motivators are considered different because incentives are manipulated and controlled by managers and leaders to get employees to do desired tasks while motivators are intrinsically controlled. However, incentives and motivators are similar if the incentive is constructed based on something the employee desires to work towards (Mathibe 2008).

Locke and Latham 2006 supplement this theory through their own Goal Setting theory, in which specific and difficult goals enhance an employee’s motivation because they focus on reaching a specific performance. Bennell and Akyeampong 2007 confirmed that specific, challenging goals increase an employee’s motivation if they are formed through employee participation and that are reinforced by feedback.

Another theory worth mentioning is the Equity theory, introduced by Wilson and Rosenfeld 1990. An example is the act of teachers comparing their own efforts and rewards
with those of peers, who are not necessarily in the same profession. These comparisons affect self-perceptions and occupational status, which then influence Vroom’s expectancy theory (Bennell and Akyeampong 2007).

There are other theories on motivation but Vroom’s Expectancy theory, Locke and Latham’s Goal Setting Theory, and the Equity theory by Wilson and Rosenfeld seem to be the ones most applicable to the developing country setting.

3.3.1 Agricultural Extension Agents (AEAs)

In Uganda, agricultural extension agents (AEAs) are affiliated with different entities: the government, nongovernmental organizations and NAADS. NGOs usually provide demand-driven services; NAADS provides pluralistic and demand-driven advisory services but the government still continues with its traditional agricultural extension system. (Opira and Lung’ahi 2013)

Findings demonstrate that AEAs associated with NGOs and NAADS provide services to a significantly larger share of farmers under their jurisdiction than government AEAs. This study explains that this is possibly due to the greater effectiveness of pluralistic and demand-driven approaches and the better incentives given to non-governmental AEAs. (Opira and Lung’ahi 2013)

Other key findings were that female AEAs are more likely to provide advisory services to female farmers; NAADS and NGOs are more likely to serve women than government. Lastly, AEAs trained by NGOs reached a larger share of farmers due to better incentives provided by NGOs and better working facilities.
3.3.2 Incentives and Motivation for Community Knowledge Workers

Cash payments for surveys and mobile airtime transfers are all incentives for CKWs. From the beginning, they received t-shirts, a CKW logo, certificates, marketing materials and posters, which further motivate them. CKWs admitted taking pride in their role because they were recognized in their respective communities and they have become more knowledgeable since becoming a CKW. They feel that their services are needed. (Grameen Foundation 2010)

3.3.3 Performance-Related Incentives

Incentives influence individual’s behavior and strongly suggest that people will respond to a change in their compensation, but there still does not exist a large body of evidence to assess theoretical arguments on optimal incentive schemes in the private and public sector (Burgess and Ratto 2003). Performance-related pay (PRP) is believed to motivate employees to work harder or more productively. Using these financial incentives coupled with employee’s performance has become a popular strategy in many sectors (Marsh and McCaffrey 2012). However, these incentive contracts are more common in the private than in the public sector. (Burgess and Ratto 2003).

Using data from the US Navy, Asch 1990 presents the response of Navy recruiters to an incentive plan that includes piece rates, quotas, prices, and standards with the goal of deriving compensation structures that elicit desired levels of efforts. Asch 1990 found that the timing of the rewards affects the allocation of effort over time. Some recruiters may procrastinate until they approach the rewards’ deadline and others would rather put forth
more efforts at the beginning to slow down as the deadline approached. Immediately after
winning an award, it was observed that recruiters enlisted fewer recruiters as a response.
Depending on the difficulty of winning rewards, quota levels and the recruiter's
preferences for leisure versus rewards, recruiters supplied more effort at a particular time
(Asch 1990).

Performance-related pay (PRP) is recognized to help recruit, retain and motivate
new employees and usually it enrolls better quality employees. The fact that good
performance is valued and rewarded attracts higher quality candidates and the theory says
workers will be motivated to perform better (Marsh and McCaffrey 2012).

There are several undesirable effects associated with PRP. It tends to neglect
unrewarded tasks: employees focus all their attention only on measurable tasks and
outcomes, often disregarding other aspects (Marsh and McCaffrey 2012). Findings from
Asch 1990 were consistent with this concept: right before the critical date, the number of
recruits rose but the quality of the candidates fell.

Competitiveness also arises from PRP, instead of cooperation. Mubangizi et al. 2004
found that there was limited, almost none, information sharing between PSPs and public
extension staff as a result of incentive structures. This unwillingness to assist colleagues
was common and any access to information seemed to depend on the initiative of PSP and
pre-existing friendships with some people from the source.

Another critical aspect is the cost of PRP. Administration includes monitoring,
appraisal and performance management. These are additional costs when hiring new
employees: the cost of administration and the wages. There is also a fear that failures and
problems encountered will be held against workers. This lack of openness about failings will prevent obstacles and lessons to be learnt.

PRP can also be misleading and complicated: disagreements and misunderstanding about goals often occur (Marsh and McCaffrey 2012). Johnson 1984 described the expectations can be vague, muddled or conflicting. Lastly, there is a possibility of de-motivating those who are not rewarded. Ability levels vary from person to person (Asch 1990). Those unrewarded will feel that their performance is unsatisfactory and they will respond either by improving or leaving the position (Marsh and McCaffrey 2012).

3.5 Concluding Remarks

Debates about extension services are ongoing. Due to SAPs, funding for extension services has decreased and the controversy over T&V and its inefficacy had reduced professionals’ confidence in the system.

Nevertheless, many reforms have been made to extension systems, and now it is often emphasized that agricultural extension services must be demand-driven, effective and participatory. As designed, the extension agents are the actors bridging the gap between agricultural research and farmers and according to Collinson (1982) and Nigel (1989), the critical link in the research-extension-farmer chain is between extension establishments and farmers. Extension workers are the ones trained to share and explain agricultural content from databases to smallholder farmers in specific regions.

If they are not given the proper incentives, Vroom’s expectancy theory predicts that they will not put forth the necessary extra effort to reach out and contact farmers to
increase agricultural productivity as a result. In Uganda, it was observed that extension workers from private sector went back to enter the public sector because the incentives structure was not adequate for the level of energy required to meet targets.

In order for PRP to be successful, certain supporting conditions must be met. The understanding of how the incentive program functions, the possibility of meeting targets, fairness, and a reasonable timeline are some of the factors that support its effectiveness and affect the quality of the performance of employees. Asch 1990 found that productivity rose over time when navy recruiters had a performance-based salary. Initially, recruiters invest their time finding human capital; then, they focus less on quality but on the number of enlistments. Once a reward is won, they decrease their effort levels and productivity may drop. Asch’s results insinuate that there might be a similar type of behavior among CKWs in Uganda.
Chapter 4: Data and Research Design

This chapter first discusses the dataset used in this study. Then, it presents the descriptive statistics of the CKWs and the variables that were created and used in this analysis.

4.1 Data background and description

841 CKWs were followed in the original dataset, of which 440 were used in the analysis. This is a result of data cleaning, in which observations of number of monthly searches exceeding 400 were dropped. The Grameen Foundation CKW program piloted in June 2010 but the dataset used includes the CKW's search records between March 2011 and April 2012. The data used in this paper contained 4,005 observations.

Each CKW is identified by an ID number, and by personal characteristics such as his/her gender, age, marital status and household status. Records on the performance level achieved by each CKW at the end of every month are available and it is based on the number of searches completed at the end of a given month. The number of months since the CKW has been active, meaning the moment when he or she had his or her first search, is also documented. The farmers with whom the CKW interacted are also taken into account as well as the sequence number and the category of the search done for the given farmer.

Further questions related to access to land, such as the number of acres of land owned or accessible by the CKW's household, and the sources of income other than farming in the CKW's household, are posed. Moreover, the amount of money earned in the
household and the top 3 major uses of the CKW’s household’s income were noted. Lastly, the geographical location of the CKWs was recorded.

4.2 Descriptive Statistics

440 CKWs were analyzed in this study. Table 4.1 presents the basic demographic information on these 440 CKWs. Approximately, 68% of the CKWs studied were male. Over 60% of the CKWs were between the ages of 26 and 45. More than 75% of the CKWs were married and close to two-thirds of the sample represent household heads.

Next, the sources of livelihoods were recorded for each CKW’s household. Table 4.2 shows that 94% of the CKWs reported receiving income from non-farm sources. Nearly 99% of CKWs recorded to have their own land or having some access to land. 40% of CKWs were located in the Western districts, while approximately 34% and 23% were from the Northern and Central regions of Uganda, respectively. Less than 3% of CKWs were from the Eastern districts of Uganda.
### Table 4.1 Demographic Characteristics of CKWs

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 440</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>300</td>
<td>68.18%</td>
</tr>
<tr>
<td>Female</td>
<td>140</td>
<td>31.82%</td>
</tr>
<tr>
<td><strong>Age Distribution</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 440</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ages 25 and younger</td>
<td>104</td>
<td>23.64%</td>
</tr>
<tr>
<td>Between ages 26 and 35</td>
<td>164</td>
<td>37.27%</td>
</tr>
<tr>
<td>Between ages 36 and 45</td>
<td>111</td>
<td>25.23%</td>
</tr>
<tr>
<td>Between ages 46 and 55</td>
<td>40</td>
<td>9.09%</td>
</tr>
<tr>
<td>Ages 56 and older</td>
<td>21</td>
<td>4.77%</td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 440</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>333</td>
<td>76.20%</td>
</tr>
<tr>
<td>Never married</td>
<td>74</td>
<td>16.93%</td>
</tr>
<tr>
<td>Divorced</td>
<td>17</td>
<td>3.89%</td>
</tr>
<tr>
<td>Widowed</td>
<td>13</td>
<td>2.97%</td>
</tr>
<tr>
<td><strong>Household Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 438</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Head</td>
<td>288</td>
<td>65.75%</td>
</tr>
<tr>
<td>Spouse</td>
<td>84</td>
<td>19.18%</td>
</tr>
<tr>
<td>Child</td>
<td>64</td>
<td>14.61%</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>0.46%</td>
</tr>
</tbody>
</table>
### Table 4.2 Selected Economic and Geographical Variables of CKWs

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income from non-farm sources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 440</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>415</td>
<td>94.32%</td>
</tr>
<tr>
<td>No</td>
<td>25</td>
<td>5.68%</td>
</tr>
<tr>
<td>Own Land</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 440</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>435</td>
<td>98.86%</td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>1.14%</td>
</tr>
<tr>
<td>Access to Land</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 440</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>439</td>
<td>99.77%</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>0.23%</td>
</tr>
<tr>
<td>Region</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = 440</td>
<td></td>
<td></td>
</tr>
<tr>
<td>North</td>
<td>151</td>
<td>34.32%</td>
</tr>
<tr>
<td>Center</td>
<td>102</td>
<td>23.18%</td>
</tr>
<tr>
<td>West</td>
<td>176</td>
<td>40.00%</td>
</tr>
<tr>
<td>East</td>
<td>11</td>
<td>2.50%</td>
</tr>
</tbody>
</table>

#### 4.3 Variables of Interest

The independent variables in the dataset were grouped into 3 categories: CKW characteristics, regional conditions, and the incentives indicator. To take into account characteristics of CKWs as individuals and as workers, the following variables were included:

1) Relation to Household Head (Self, Spouse, Child, Other)

2) Age (reported in months)
3) Sex
4) Marital Status
5) Poverty Score
6) Land Ownership
7) Access to Land
8) Nonfarm Income
9) Household Expenses
10) First Contact with Farmers
11) Month Active as a CKW
12) Phone Use
13) Category of Searches conducted

Regional variables were included to control for differences between the districts.

The district characteristics were represented by the following variables:

1) Region (North, Center, West, East)
2) Whether the District is Near a Large City
3) Rainy Season
4) The percentage of Households Below Poverty

To represent the incentives received and efforts, the two subsequent variables were used:

1) Post-Bonus Period
2) Presence of Bunching
4.3.1 Definitions and Descriptive Statistics of Variables

Table 4.3 reports the summary statistics for the dependent and independent variables used in this analysis. Next, the variables are further defined and described in details.

**Seq** is the total number of valid searches completed per month by a given CKW. MTN, the mobile network in Uganda, automatically recorded this information. It is used as a proxy to measure the productivity level of CKWs in the negative binomial count regression model, which is used in this analysis.

**LogSeq** is the logarithm of the total number of valid searches of a given CKW per month. It is also used as the dependent variable, representing the performance of CKWs in the log transformed ordinary least square (OLS) regression model used in this study.

**Bonus Period** is a dummy variable that represents incentives given to CKW to increase their performance. 1 indicates a rise in the level of the CKW’s salary payment after June 2011. The coefficient sign is expected to be positive. An increase in compensation payments encourages CKW to perform better in terms of searches completed per month. As shown in Table 4.3, 87% of the observations come from the period after June 2011.
### Table 4.3 Descriptive Statistics of Dependent and Independent Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measure</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Max</th>
<th>Min</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Searches</td>
<td>Count</td>
<td>71.41</td>
<td>58.31</td>
<td>399</td>
<td>1</td>
<td>4005</td>
</tr>
<tr>
<td>Logarithm of number of searches</td>
<td>ln(count)</td>
<td>3.90</td>
<td>1.03</td>
<td>6</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>Bonus offered after June 1</td>
<td>0/1</td>
<td>0.87</td>
<td>0.33</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>Clusters around performance levels A, B, C</td>
<td>0/1</td>
<td>0.18</td>
<td>0.39</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>CKW being a hld head</td>
<td>0/1</td>
<td>0.67</td>
<td>0.47</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>CKW being a hld child</td>
<td>0/1</td>
<td>0.14</td>
<td>0.34</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>CKW being a hld other</td>
<td>0/1</td>
<td>0.00</td>
<td>0.06</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>Age of CKW, in years</td>
<td>Count</td>
<td>34.79</td>
<td>11.11</td>
<td>75</td>
<td>18</td>
<td>4005</td>
</tr>
<tr>
<td>Sex of CKW</td>
<td>0/1</td>
<td>0.31</td>
<td>0.46</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>CKW married</td>
<td>0/1</td>
<td>0.77</td>
<td>0.42</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>CKW divorced/separated</td>
<td>0/1</td>
<td>0.04</td>
<td>0.19</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
</tbody>
</table>
Table 4.3 Descriptive Statistics of Dependent and Independent Variables (cont.)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measure</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Max</th>
<th>Min</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty Score</td>
<td>Count</td>
<td>55.31</td>
<td>18.08</td>
<td>102</td>
<td>6</td>
<td>4005</td>
</tr>
<tr>
<td>Whether the CKW owns land</td>
<td>0/1</td>
<td>0.99</td>
<td>0.10</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>Whether the CKW has access to land</td>
<td>0/1</td>
<td>1.00</td>
<td>0.05</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>Whether the CKW has a source of income other than farming</td>
<td>0/1</td>
<td>0.95</td>
<td>0.23</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>Improvements made to home</td>
<td>0/1</td>
<td>0.30</td>
<td>0.46</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>Income amount from non-farm income</td>
<td>Count</td>
<td>134348.60</td>
<td>425710.70</td>
<td>5000000</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>First time conducting searches for a particular farmer</td>
<td>0/1</td>
<td>0.08</td>
<td>0.28</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>The number of months the CKW has been active</td>
<td>Count</td>
<td>5.70</td>
<td>4.03</td>
<td>17</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>The district is located in the Northern region of Uganda</td>
<td>0/1</td>
<td>0.34</td>
<td>0.47</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>The district is located in the Central region of Uganda</td>
<td>0/1</td>
<td>0.23</td>
<td>0.42</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>The district is located in the Western region of Uganda</td>
<td>0/1</td>
<td>0.40</td>
<td>0.49</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>Variable</td>
<td>Measure</td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Max</td>
<td>Min</td>
<td>N</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>---------</td>
<td>------</td>
<td>--------------------</td>
<td>-----</td>
<td>-----</td>
<td>----</td>
</tr>
<tr>
<td>Whether the district has a big city</td>
<td>0/1</td>
<td>0.56</td>
<td>0.50</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>The search was done during the rainy season</td>
<td>0/1</td>
<td>0.54</td>
<td>0.50</td>
<td>1</td>
<td>0</td>
<td>4005</td>
</tr>
<tr>
<td>The share of households living below poverty in each district</td>
<td>Percentage</td>
<td>40.56</td>
<td>21.60</td>
<td>77</td>
<td>13</td>
<td>4005</td>
</tr>
</tbody>
</table>
**Bunching** is a dummy variable that indicates if the CKWs bunched themselves around the next performance level. This variable also is an indicator of incentives, once the CKW has reached the next performance level, they automatically receive a higher wage. 1 indicates that the CKW has reached specifically the following number of searches 1, 2, 3, 23, 24, 25, 26, 27, 35, 36, 37, 38, 39, 47, 48, 49, 50. The expected sign of this coefficient is negative because once the CKW reaches the next performance level, they will be less likely to conduct new searches since an additional search at this point will not lead to a higher income.

The household status is also included in this analysis. Approximately 67% of CKWs in this sample are household heads, followed by 18% being spouses.

**HldHead** is a dummy variable. 1 indicates that the given CKW is the head of the household. The expected sign of this coefficient is to be positive because the household head is typically the breadwinner of the family. As the head, the CKW is likely to make more searches to earn more, which can lead to a higher household consumption level.

**HldChild** is a dummy variable. 1 indicates that the given CKW is the child of the household. This coefficient can be positive or negative because if the CKW identifies himself or herself as a child, he or she still lives with or feels dependent on his/her parents. If he/she depends on his/her parents, his/her incentive to reach the optimal performance level would be minimal but if he/she takes care of his/her parents, his/her incentive to conduct searches would be higher.

**HldOther** is a dummy variable. 1 indicates that the given CKW is a household member, other than the head, spouse of the head, or a child in the house.
Grandparents, aunts, uncles, cousins are all possible household statuses of the CKW. Again, the coefficient can be positive or negative depending on the nature of the relationship between this member and the household head.

*AgeM* is a variable that indicates the age of the CKW in months. More than 60% of the CKWs are 35 years old or younger. The coefficient of this variable is expected to be positive. The older the CKW is, the more responsibilities he/she is expected to have and with societal pressures, they have to take care of their dependents. They will have higher incentives to perform better to have the possibility to earn more.

*Female* is a dummy variable and when it is equal to 1, it indicates a female CKW. 68% of this sample are male, and close to 32% are female. The expected sign of this coefficient is negative. One possible explanation is because female CKWs might face a harder time gaining the trust and maintaining a relation with farmers, especially with males one. Female CKWs usually have significant household tasks and may not be able to dedicate sufficient time to complete CKW duties. Another possibility is that men may be more deceiving than women; thus, they could lie in terms of the searches that they actually make for farmers.

The majority of the CKWs monitored are married (76%). Close to 17% have never been married and the divorced and widowed ones were less than 7% of the sample jointly.

*Divorc_Sep* is a dummy variable that equals 1 when the CKW is divorced or separated. The coefficient is expected to be positive because the given CKW is the
sole responsible for his/her household and has the incentive to perform well to earn a higher income.

**PovertyScore** is a variable that indicates the likeliness of being poor. Higher numbers mean less likely to be poor. The coefficient of this variable can be positive because the poorer a CKW is, the better it is believed they will perform to earn the chance to receive a higher income level. The coefficient could also be negative because the poorer the CKW, the less educated they may be and they might face more difficulties completing CKW activities. In the sample, the minimum score reported was 6 and the maximum was 102 with a mean of 55.

**OwnLand** indicates if the CKW owns land or property. The amount of land, in acres, that the CKW owns as a household is also available but not incorporated in this variable. The coefficient is expected to be negative. The more land the CKW owns, the more work and time is required to prepare the land, plant the seeds and harvest. Thus, the CKW will not concentrate on fulfilling his role as an extension worker. On average, 11.2 acres were reported and 99% of the observations indicate that the CKW owns land.

**AccessLand** is a variable representing if the CKW has the permission to farm on any land. This includes land that is owned by other people. The coefficient is expected to be negative because the more land that the CKW can work, the higher is the productivity potential and the CKW could earn more from higher yields/harvests, and land-work demands time and effort and he/she would not be able to focus on completing their duties as CKW.
**NonFarmIncome** is a dummy variable that indicates if farmers have sources of income other than farming. 1 means that the CKW receives some additional income from business, dairy, salary, quarry, charcoal, handiwork and/or government. A negative coefficient is expected because the CKW does not depend solely on their income earned from this position. He/she will not put all of his/her effort in completing 49 searches to earn the maximum income level. More than half of the CKWs with non-farm income reported earning income from business-related activities. Handiwork and Salary were the next two main sources.

**HomeImprvt** is a dummy variable that is 1 when the CKW identified home improvement as one the top 3 major expenses of his/her household’s income. Close to 30% of the observations indicated home improvements as one of their top expenses. The expected sign of this coefficient is to be positive because if the CKW already knows to which expense the income earned from this position will be allocated, the more effort he will put forth to increase his income, especially for home improvements, since it is an indication of their social status in the community.

**IncomeSelf** is a variable that estimates the amount of money the CKW earned in a month from nonfarm income sources. In order for this variable to be positive, the CKW must have other sources of income besides farming. On average, CKWs reported receiving 134,348.60 Ugandan shillings per month, which is equivalent to US$53.20 per month (under the exchange rate of 2,545 Ugandan shillings for USD$1.00). The coefficient is expected to be negative. If the CKW has other sources of income, he/she does not rely as much on the CKW earnings and may participate
only for some additional income. Thus, they do not have strong motivations to perform to their full abilities.

FirstContact is a dummy variable that indicates 1 when it is the first search completed by the CKW for a particular farmer. The expected sign of this coefficient is negative because both parties are more likely to focus primarily on developing their relationship with each other when they first meet. They might not be comfortable to discuss many things, especially the farmers’ problem. This was the case for less than 10% of the observations in this sample.

MonthsActive represents the number of months since the given CKW has done his first search. The expected sign of this coefficient is positive because of the theory behind the learning curve (Kostiuk and Follmann 1989). With time, the more experience CKWs gain and the better they can perform. However, it is also possible that their agricultural database is limited and with time, they are not able to meet their monthly targets. On average, CKWs were active for about 6 months.

Uganda has four regions (Republic of Uganda 2014). More than 40% of the observations had taken place in the Western region, followed by 34% in the Northern Region.

North is a dummy variable that indicates if the district in that record is located in the Northern region of Uganda. The expected sign of the coefficient is positive because the North is still recovering from a civil war. Residents in the north are still dependent on cultivation, and they still demand attention and need agriculture extension and advisory services.
**Center** is a dummy variable that indicates if the district in that record is located in the Central region of Uganda. The expected sign of the coefficient is negative because more business-oriented people live in this area. The country’s capital, Kampala, is also located in this region.

**West** is a dummy variable that indicates if the district in that record is located in the Western region of Uganda. This area is also business-centered, recognized for its game parks and reserves, and forest reserves. The expected sign of this coefficient is negative.

**LargeNearTown** is a variable that indicates whether the district headquarters is near a large city. 1 indicates that the district has a large city itself. The expected sign of this coefficient is negative: if the district lacks access to a nearby market, the more searches are expected by the CKWs. This could also be explained by the lack of easy access to information by rural farmers.

**RainySeason** is a dummy variable indicating if the month of the given record is part of the rainy season in Uganda. 1 represents the following months: March, April, May, September, October and November. The expected coefficient is positive. During the rainy season, farmers tend to have more questions and require some assistance. Thus during this period, the number of calls is expected to increase. Nearly 54% of observations were taken during the rainy season in Uganda.

**HlhdBelowPoverty** is a variable that indicates the percentage of households within a given district that live below the poverty line. The expected sign of the coefficient is positive because the poorer the community members, the more
assistance they will seek and CKWs will have a larger pool of farmers to assist. The Western region hold the district with the lowest percentage of households that live below the poverty line while the North has all the highest percentage of households below the poverty line starting at 53.2%.

All these variables presented were used in the statistical analyses conducted for this study.
Chapter 5: Methodology

Chapter 5 describes the research methodology used to measure the incentive effects on CKWs and their performance levels. First, a look into relevant literature is discussed, then the different models used in this study are introduced.

5.1 Measuring the Impact of Incentives

Empirical studies on measuring responses to incentives are still scarce and there are numerous reasons for this gap in literature. Data on worker output are often unavailable, worker’s output is imperfectly measured and company incentives plans are often unavailable (Asch 1990; Burgess and Ratto 2003).

Three studies were found that acted as examples for this analysis: Asch 1990, Lavy 2007 and Fransceschelli et al 2010. They will be discussed next.

To measure the effect of a given compensation structure on worker effort and output, Asch 1990 estimated reduced form regression equations using OLS. The dependent variable in her models was the number of enlistments completed by Navy recruiters and the independent variables included factors that varied depending on the recruiter, the time and the preferences of the recruiter.

Fixed-effect regression models were estimated, where recruiter attributes that are fixed over time, such as ability and attributes, were excluded and attributes that change over time, such as effort, were included. This was done to eliminate ability differences. Efforts can be affected by many factors: individual preferences,
reward requirements, market potential, resource availability and random changes (Asch 1990).

Fransceschelli et al. 2010 explored the incentive effects on low- and high-ability workers of two plants of Orion, an Argentinean textile firm. Their analysis used longitudinal data on worker productivity that included before and after changes in the plants’ payment scheme. Switching from an hourly-wage to a combination of a piece-rate scheme with a basic wage was found to have, on average, a strong overall positive effect of 28% on productivity. However, when they broke down the type of workers into low-ability workers, those seeking the basic wage and high-ability workers, those seeking the piece-rate component of the wage, they estimated a 29% increase in the average productivity of low-ability workers and a 26% increase for high-ability workers.

To measure the workers’ performance, a score was assigned to each of their tasks and the total number of points was used to indicate their performance levels. After the switch in payment, a premium, based on the number of points earned, was added to the same previous basic wage. To estimate the overall effects of performance-based pay on worker productivity, they used a two-way fixed effect error component model:

\[
\text{Lscore}_{it} = \alpha \text{dPPP}_{it} + \lambda_t + \mu_i + \varepsilon_{it}
\]

where \(\text{Lscore}_{it}\) is the logarithm of score for worker \(i\) in day \(t\) and \(\text{dPPP}_{it}\) is a zero-one indicator that equals unity in day \(t\) if individual \(i\) is working under a piece-rate scheme. Then, \(\alpha\) estimates the average percentage change in productivity induced
by the change in payment scheme. Finally, \( \mu_i \) is a time-invariant effect unique to worker \( i \), \( \lambda_t \) is a day effect common to all individuals in day \( t \), and \( \varepsilon_{it} \) is an individual time-varying error.

Then, they classified workers into high-ability workers (idpiece), those seeking the bonus and low-ability workers (idbasic), those seeking the basic wage. They further studied if the positive effect was driven by high-ability workers, using a model similar to their original two-way fixed effect error component model. However, this time, they included interactions between treatment and dummies that indicate types of workers.

\[
L_{\text{score}_{it}} = \alpha_1 (d_{\text{PPP}_{it}} \cdot \text{idbasic}) + \alpha_2 (d_{\text{PPP}_{it}} \cdot \text{idpiece}) + \lambda_t + \mu_i + \varepsilon_{it}
\]

In summary, their results revealed a similar effect of the change in the incentive scheme for both low- and high-ability workers.

5.2 Labor Supply Model

The labor supply model provides a framework for understanding and measuring the way that incentives affect individual’s effort output. As a starting point, the static labor supply model is examined, where the number of searches completed by a given CKW is the key measure of effort supplied by the CKWs.

The incentive structure and realignment put in place by the Grameen Foundation causes notches, discontinuities in the budget set of CKWs. According to the theory, in a frictionless world, bunching right after each performance level threshold established by the incentive structure should be expected. Slemrod 2013
explains that policy notches induce actors to change their behavior just enough to be situated on the beneficial side of a notch.

Assume that the CKW maximizes utility, which is a function of the unearned income available for consumption of other goods and leisure given his/her given ability. Let $y$ denote income, $l$ leisure and $n$ ability, then the CKW’s utility function can be presented as:

$$U = u(y, l; n), \quad \text{where } U_1 > 0 \text{ and } U_2 > 0$$

In a traditional model of labor supply choices, individuals optimize their behavior frictionlessly in response to policies that affect their incentives (Gelber et al. 2013).

The incentive structure features performance thresholds, which create jumps in the choice sets of CKWs. The notches created by the Grameen Foundation’s pay schedule after June 2011 are as follows. Just a few searches guarantee a D-level pay. The next notch appears at search #25, where the CKW is considered a C-level performer and the pay increases by 10,000 Uganda Shillings (UGX.) Then, at search #37, the CKW is considered a B-level performer and the pay increases again by 10,000 UGX. The last notch is at search #49, where the CKW reaches the highest performance level, A-level, and the pay increases again by 10,000 UGX. The salary levels increase in a stepwise manner, resulting in 3 major notches in total.

---

2 CKWs are not paid hourly but monthly and their salary is based on their performance level
3 Assume the CKW prefers more of each
Figure 2 presents the incentive pay schedule for the pre-bonus period from March 2011 to June 2011 and for the post-bonus period from June 2011 to April 2012. The discontinuous changes in the incentive pay based on the different levels of searches completed are illustrated. 16 to 24 hours of leisure represent D-level performance. Between 12 and 16 hours indicate the C-level performer, and between 8 and 12 hours of leisure represent the B-level performer. Any hour less than 8 hours of leisure indicates an A-level performance.

5.3 Econometric Model

The objective in this study is to examine if incentives matter when it comes to CKW’s performance levels. Do workers respond to the incentives created by the project? If so, how does their performance change? Do incentives matter more for some agents than for others? Next, the different approaches taken to analyze this panel count data are discussed. To measure the overall incentive effects, a negative
binomial count regression and a log-transformed OLS regression were ran. Then, following the example of Fransceschelli et al. 2010, interactions between treatment and dummies indicating the types of CKWs were included. Then, probit and chow tests were conducted to verify and better understand the incentive effects on high-performing and low-performing CKWs.

5.3.1 Poisson Model

For count data with mutually independent events observed over a certain unit of time, the Poisson model is generally used and the standard probability distribution is the Poisson distribution given by:

\[ f(k; \lambda) = \Pr(Y = k | \lambda) = \frac{\lambda^k e^{-\lambda}}{k!} \]

where

\[ \lambda_i = E(y_i | \lambda_i) = \text{Var}(y_i | \lambda_i) \]

In this sample study, \( y_{it} \) is the number of searches completed by CKW \( i \) in month \( t \) and \( \lambda_i \) is the Poisson parameter. \( \lambda_i \) is also defined as the mean or expected number of the Poisson distribution of searches as well as the variance. ("Regression Models" 2007)

The Poisson model, however, does not address over-dispersion and it ignores the panel structure of a dataset because of the assumption of independent sampling. Since there exists only one index, \( \lambda \), once the mean is known, the rest of the
distribution can be determined. However, in this dataset, the correlation among CKWs observations remains unresolved.

The negative binomial model and the Poisson log-normal model provide more efficient estimators (Mullahy 1986). Also a transformed OLS can be more appropriate for this data than a Poisson. Thus, in this analysis, negative binomial count and log-transformed OLS models were run as they were the most appropriate for the structure of this type of data.

5.3.2 Negative Binomial Count Regression: Model 1

The negative binomial regression is used as an alternative to the Poisson distribution for discrete data whose sample variance exceeds the sample mean. In cases of over-dispersion, the negative binomial distribution takes into account an additional parameter (α) that allows independence between the variance and the mean, unlike a Poisson distribution.

To model count data with over-dispersion, the formulation of the negative binomial distribution used is the following:

\[
\Pr(Y = y | \lambda, \alpha) = \frac{\Gamma(y+\alpha^{-1})}{\Gamma(y+\alpha^{-1}/\lambda)^{\alpha^{-1}} \Gamma(\alpha^{-1})} \frac{\lambda^y}{(\alpha^{-1} + \lambda)^y} 
\]

The two parameters of this distribution are: \(\lambda\) and \(\alpha\). \(\lambda\) still represents the mean or expected value of the distribution, as in the Poisson distribution, and \(\alpha\) is the over-dispersion parameter. Thus, when \(\alpha = 0\), the negative binomial distribution is the same as the Poisson distribution. To take into account cluster standard errors,
random-effects models for the negative binomial regression were used.

(“Regression Models” 2007; Winkelmann 2004)

5.3.3 Ordinary-Least-Squared Regression: Model 2

A simple linear model of the form \( u_{it} = x_{i}' \beta \) was not chosen because the model assumes the linear predictor \( x_{i}' \beta \) can assume any real value, but the count data used in this study constrains the linear predictors to be non-negative. The sample consists of 4005 observations, which can be treated as realizations of independent Poisson random variables, with \( y_i \sim \mathcal{P}(\mu_i) \) and mean \( \mu_i \) depends on a vector of explanatory variables \( x_i \).

To set this question up using a linear model, the logarithm of the mean is taken to transform the original positively skewed distribution into a normal distribution. Let \( y_{it} \) equal the log of the number of searches completed by CKW \( i \) at time \( t \) (in month), \( \log \mu_{it} \).

The transformed mean now follows a linear model:

\[
y_{it} = x_{i}' \beta_i = \log \mu_{it} \quad (2)
\]

The log-transformation is usually considered easy to work with computationally. In this model, the regression coefficient \( \beta_j \) represents the expected change in the log of the mean per unit change in the predictor \( x_j \). In other words, increasing \( x_j \) by one unit is associated with an increase of \( \beta_j \) in the log of the mean.

To obtain a multiplicative model for the mean itself, I exponentiated the transformed linear model: \( \mu_{it} = \exp(x_{i}' \beta) \). This represents a multiplicative effect of
the j'-th predictor on the mean: increasing $x_j$ by one unit multiplies the mean by a factor $\exp(\beta_j)$.

An advantage with using this model is that the effects of predictors in count are often multiplicative rather additive. Small effects for small counts and large effects for large counts are usually observed; thus the effect is in proportional to the count, working in the log scale. Unobserved heterogeneity in CKWs ability may be a problem to obtain better estimates. Thus, to address time-invariant unobserved CKW traits (characteristics, ability, and personality) and regional conditions, a fixed-effects model was used (Silva1997).
Chapter 6: Results

6.1 Data Interpretation Limitations

Challenges in measuring the quality and effectiveness of extension by extension agents have always existed. In the dataset used in this study, the performance level achieved by each CKW is the closest benchmark identified for measuring the effectiveness of CKWs. The performance level is the number of searches that CKWs complete per month for a period of 14 months. One downfall is that this proxy does not give much insight on the quality of the extension work provided to farmers in Uganda by these CKWs. The dataset consists of an unbalanced panel data.

Furthermore, knowledge on challenges concerning the recruitment and retention of extension workers is lacking. Factors that could contribute to attrition among CKWs are also missing. Without such information, results could overlook significant situational aspects (external and internal) that could influence the quality and effectiveness of extension in Uganda during that time period.

6.2 Econometric Model

The number of searches completed within a month is the proxy used to measure a given CKW’s performance and is the dependent variable in this model. On average, approximately 72 searches are done each month. The maximum number of searches completed in month was reported to be 399.
From the above table (Table 6.1), it is seen that the standard deviation implies that the unconditional variance of the count variable, Seq, is nearly 46 times larger than the mean. This indicates signs of over-dispersion in the Seq distribution. In this case, the Poisson model was not appropriate for this data because it assumes equi-dispersion within the data, which is when the expected mean is equal to the expected variance.

A Poisson goodness-of-fit test was done and it resulted in a large value of the chi-square and a significant test statistic, showing that the Poisson model is inappropriate for the distribution of this data. Thus, alternatives to Poisson regressions were used: the negative binomial count model and a transformed OLS model.

### 6.3 Negative Binomial Count Regression

The negative binomial model is more appropriate in cases of over-dispersion.

On the next page, are the results from the negative binomial regression:
<table>
<thead>
<tr>
<th>Coefficients</th>
<th>(P-Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HldHead</td>
<td>-0.005</td>
</tr>
<tr>
<td>HldChild</td>
<td>-0.036</td>
</tr>
<tr>
<td>HldOther</td>
<td>0.690</td>
</tr>
<tr>
<td>AgeM</td>
<td>0.000</td>
</tr>
<tr>
<td>Female</td>
<td>-0.036</td>
</tr>
<tr>
<td>Married</td>
<td>0.073</td>
</tr>
<tr>
<td>Divorc_Sep</td>
<td>-0.325</td>
</tr>
<tr>
<td>PovertyScore</td>
<td>0.002</td>
</tr>
<tr>
<td>OwnLand</td>
<td>-0.241</td>
</tr>
<tr>
<td>AccessLand</td>
<td>-0.655</td>
</tr>
<tr>
<td>Nonfarmincome</td>
<td>-0.096</td>
</tr>
<tr>
<td>HomeImprvt</td>
<td>0.103</td>
</tr>
<tr>
<td>IncomeSelf</td>
<td>-0.000</td>
</tr>
<tr>
<td>FirstContact</td>
<td>-0.229</td>
</tr>
<tr>
<td>MonthsActive</td>
<td>-0.007</td>
</tr>
</tbody>
</table>
Table 6.2 Results from Negative Binomial Regression (cont.)

<table>
<thead>
<tr>
<th></th>
<th>Coefficients (P-Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>0.013 (0.921)</td>
</tr>
<tr>
<td>Center</td>
<td>-0.222 (0.58)</td>
</tr>
<tr>
<td>West</td>
<td>-0.180 (0.107)</td>
</tr>
<tr>
<td>LargeNearTwn</td>
<td>-0.034 (0.395)</td>
</tr>
<tr>
<td>Rainyseason</td>
<td>0.097 (0.000)</td>
</tr>
<tr>
<td>HlhdBelowPoverty</td>
<td>-0.009 (0.000)</td>
</tr>
<tr>
<td>Bonus Period</td>
<td>0.294 (0.000)</td>
</tr>
<tr>
<td>Bunching</td>
<td>-0.542 (0.000)</td>
</tr>
</tbody>
</table>

N = 4005

When running the negative binomial regression, a likelihood-ratio test of \( \alpha = 0 \) was done to test for over-dispersion and the Chi squared coefficient was found to be significant (\( P < 0.005 \)). When the parameter \( \alpha \) is 0, there is no over-dispersion and the negative binomial distribution is identical to the Poisson distribution. In this case, however, \( \alpha \) is significantly different than zero, implying that the data is over-dispersed.

The negative binomial regression is often used to address over-dispersion and non-normal distribution. The results from this regression imply that the
number of searches completed by a given CKW is affected by the bonus offered after June 2011 and by the fact that the CKW has reached the next performance level.

The model equation for this type of regression is the log of the outcome predicted with a linear combination of the predictors:

\[
\log(\text{Seq}_{it}) = \alpha + \eta \text{Incentive} + \beta X_{it} + \gamma Y_{i} + \epsilon_{it}
\]

Where:

- \(X_i\): vector of CKW i’s characteristics
- \(Y\): vector of District characteristics
- \(\text{Incentive}\): vector of dummy variables, Bonus Period and Bunching

\[
\log(\text{Seq}) = \alpha + \beta_{1} \text{HldHead} + \beta_{2} \text{HldChild} + \beta_{3} \text{HldOther} + \beta_{4} \text{AgeM} + \beta_{5} \text{Sex} + \\
\beta_{6} \text{Divorc_Sep} + \beta_{7} \text{PovertyScore} + \beta_{8} \text{OwnLand} + \beta_{9} \text{AccessLand} + \\
\beta_{10} \text{Nonfarmincome} + \beta_{11} \text{HomeImprvt} + \beta_{12} \text{IncomeSelf} + \beta_{13} \text{FirstContact} + \\
\beta_{14} \text{MonthsActive} + \beta_{15} \text{North} + \beta_{16} \text{Center} + \beta_{17} \text{West} + \beta_{18} \text{NearLargeTwn} + \\
\beta_{19} \text{Rainyseason} + \beta_{20} \text{Population} + \beta_{21} \text{HlhdBelowPoverty} + \eta_{1} \text{BonusPeriod} + \\
\eta_{2} \text{Bunching} + \epsilon_{it}
\]

The regression results reveals that once the bonus offered after June 2011 is effective, on average, the productivity of CKWs increase by 7.5% and the number of monthly searches completed by a CKW is predicted to increase by 1.34. However, this impact is partially offset when CKWs bunched over the next performance level: it is predicted that the number of monthly searches completed will decrease by 0.58. Also being divorced or separated, or having a large income from nonfarm sources have a negative impact on CKW’s output.
6.4 OLS regression

Though Seq has a non-normal distribution, a simple log transformation converts it to a normal distribution see the Graph 6.1 and Graph 6.2 below. Thus, the dependent variable, Seq, was put through a log-transformation and analyzed. Estimation results are presented in Table 6.3.

The OLS regression has similar results as the negative binomial regression. From the results of the transformed OLS regression, it can be concluded that on average, increasing payment levels has a positive effect and improves worker productivity by approximately 10.2%. After the bonus offered after June 2011, the
number of searches completed by a CKW is predicted to increase by 1.49 and when CKWs bunch close to the next level, the number of searches completed is predicted to decrease by 0.47.

Graph 6.2 The distribution of the log transformed dependent variable Seq

To test the robustness of these findings, a fixed-effect model was run. After taking into account fixed effects, results do not differ much. All variables share the same signs and significance levels. Even worker productivity is still expected to increase by approximately 9.1%, and the number of monthly searches completed by a CKW is predicted to increase by 1.42 on average.
Table 6.3  Results from the OLS Regression and Fixed-Effects Regression

<table>
<thead>
<tr>
<th></th>
<th>OLS Coefficients (P-Value)</th>
<th>FE Coefficients (P-Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HldHead</td>
<td>0.037 (0.686)</td>
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<tr>
<td>HldChild</td>
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<td></td>
</tr>
<tr>
<td>HldOther</td>
<td>0.434 (0.000)</td>
<td></td>
</tr>
<tr>
<td>AgeM</td>
<td>0.000 (0.488)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>-0.008 (0.910)</td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>0.050 (0.622)</td>
<td></td>
</tr>
<tr>
<td>Divorc_Sep</td>
<td>-0.423 (0.001)</td>
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<tr>
<td>PovertyScore</td>
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<tr>
<td>OwnLand</td>
<td>-0.094 (0.524)</td>
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<tr>
<td>AccessLand</td>
<td>-1.173 (0.000)</td>
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<td>Nonfarmincome</td>
<td>-0.190 (0.123)</td>
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<tr>
<td>Home Imprvt</td>
<td>0.079 (0.192)</td>
<td></td>
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<tr>
<td>IncomeSelf</td>
<td>-0.000 (0.016)</td>
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</tr>
<tr>
<td>FirstContact</td>
<td>-0.334 (0.000) -0.293 (0.000)</td>
<td></td>
</tr>
<tr>
<td>MonthsActive</td>
<td>-0.009 (0.075) -0.006 (0.303)</td>
<td></td>
</tr>
</tbody>
</table>
Table 6.3  Results from the OLS Regression and Fixed-Effects Regression (cont.)

<table>
<thead>
<tr>
<th></th>
<th>OLS Coefficients (P-Value)</th>
<th>FE Coefficients (P-Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>-0.084 (0.673)</td>
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<tr>
<td>Center</td>
<td>-0.259 (0.134)</td>
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<td>West</td>
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</tr>
<tr>
<td>LargeNearTwn</td>
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</tr>
<tr>
<td>Rainyseason</td>
<td>0.145 (0.000)</td>
<td>0.137 (0.000)</td>
</tr>
<tr>
<td>Hlhd Below Poverty</td>
<td>-0.007 (0.050)</td>
<td></td>
</tr>
<tr>
<td>Bonus Period</td>
<td>0.396 (0.000)</td>
<td>0.354 (0.000)</td>
</tr>
<tr>
<td>Bunching</td>
<td>-0.757 (0.000)</td>
<td>-0.685 (0.000)</td>
</tr>
</tbody>
</table>

R-Squared 0.205 0.180
N = 4005
* Standard Errors adjusted for the 440 CKWs

6.5 Discussion of Results from Negative Binomial and Transformed OLS Regressions

6.5.1 Significant Variables at the 1% and 2% levels

The two variable indicators of incentives in this model, Bonus Period and Bunching, were significant. Bonus Period indicates the rise in CKW wage levels after June 2011 and the sign of its coefficient is consistent with the prediction. It is
interpreted as after the increase in wages in June 2011, CKWs perform better on average in terms of searches completed per month.

The dummy variable Bunching that indicates the CKWs who have just reached the next performance level also has the expected sign. The negative coefficient indicates that once CKWs reach the next performance level, they are less likely to conduct new searches.

The next significant variable in the results of both the negative binomial regression and the log-transformed OLS regression is HldOther, which is when the CKW is a household member, other than the head, spouse of the head, or a child. With a positive coefficient, it is not clear why these household members perform on average better in comparison to the spouses of the head. However, it could be that they feel responsible to contribute to the household expenses in addition to their own.

The next significant variable from the CKW's background is Divorc_Sep. According to both regressions, being divorced or separated negatively affects the performance level of the respective CKW. One explanation could be that divorce and separation are not culturally accepted practices in Uganda, alienating these CKWs from the community and hindering their ability to reach out and maintain contact with farmers. Another reason could be that these CKWs might have lost their farms or land from the separation, though the data does not show this. 9.7% of divorcees and separated reported not owning land. However, there are more female divorcees
than male (104 vs. 50) in the sample, so gender relations could be playing a role here.

NonFarmIncome and IncomeSelf both represent the CKW income generated from nonfarm activities. However, IncomeSelf was the one variable statistically significant with a negative coefficient, implying that on average CKW will not conduct as many searches if they earn a higher income from nonfarm-related activities but its coefficient suggest that it has a minimal effect on performance.

The dummy variable FirstContact indicates that this is the first search completed for a particular farmer by the given CKW. The negative coefficient implies that the focus of this meeting might be more on creating a lasting relationship than to discuss agricultural issues, similar to speculations made by Asch 1990. The farmer might also not be comfortable yet to open himself.

The last variable that was statistically significant at a 1% level was the indicator of a rainy season. As my prediction suggested, the coefficient is positive, expressing that on average, the number of searches is expected to increase during the rainy season.

### 6.5.2 Unexpected Variables

Some variables were significant in the negative binomial regression and not in the log-transformed OLS, and vice versa. The variable indicating that home improvement is one of the major expenses of a given CKW’s household generated a
positive coefficient in both regression models, consistent with initial hypothesis that if the CKW knows to which expense his/her income will be allocated, the more effort he will put forth to perform better since homes are also clear indications of the social status of residents in the community; but this variable was significant at a 1% level only in the negative binomial regression model.

Access to Land was the variable that was statistically significant in the log-transformed regression model, and not in the binomial regression model. With a negative coefficient, it is consistent with the initial hypothesis that CKWs do not perform as well on average if they have access to some land. The principal explanation remains that they have to concentrate on working their land instead of completing their duties as CKWs.

HlhdBelowPoverty returned a negative coefficient but was found statistically significant in both regression models, at a 1% in the negative binomial regression and at a 5% level in the log-transformed OLS regression. On average, it is suggesting that the higher the percentage of households living below the poverty line a district has, the lower is the number of monthly searches conducted predicted to be. One reasoning may be that because the farmers are poorer, their farm production is relatively low. With limited resources, they might be able to only afford a small amount of inputs and use small parcels of land. As a result, they might not have any motivation to ask questions or the information from CKW might not be applicable or feasible for them.
Though the gender was not found significant in either models, both models display a negative coefficient, implying that on average, male CKWs are reported to complete more searches than female ones. As previously speculated, this could be the result from gender relations. The male CKWs represented 85% of the household head in the sample and they search relatively more about market information, mobile money, and regional information that female counterparts.

Lastly, the variable showing the number of months that a CKW has been active will be discussed. With a negative coefficient, it could be an indicator of many things. First, it could be caused by the design of the program. If the database is limited or if the same problems and solutions arise repeatedly, then fewer searches will be needed as the CKW gains experience. Second, as the number of months the CKW has been active increases, the more he knows the system and may become discouraged and commit to other services.

6.5.3 Summary of findings

After running the negative binomial regression, the log-transformed OLS regression models and several robustness checks, the results from the incentive-indicating variables were similar. After the bonus was offered, on average, CKWs increased the number of their monthly searches by 1.42. It is also suggested that some CKWs do bunch at the notches created by the performance-based pay structure. When they do, it is predicted that the number of monthly searches completed will decrease by 0.52 on average.
6.6 Probit Results

By using the negative binomial and transformed OLS regressions, incentive effects are assumed to be linear. Yet, it is not always the case when measuring incentives. Lemieux and Milligan 2008 used a regression discontinuity approach to estimate the effects of social assistance on labor market outcomes. Borsch-Supan 2000 used probit models to show that incentives from European heterogeneous social security and pension systems negatively impact old age labor supply. Thus, a probit model was used to check the strong assumption that the effect of the bonus is continuously linear because it does not impose a functional form of linear regression models. A new dummy variable, called WeakPerformance, was created to indicate the grade level achieved by a particular CKW at the end of the month. 1 represented weak performers and indicated CKWs who received grade level D while 0 indicated stronger performers, CKWs who consistently reached levels A, B and C at the end of the month.

To model binary outcome variables, logit and probit regressions are commonly used (Nagler 1994). A probit model was chosen in this study because of the assumption of a normal distribution of errors. However, the choice of probit versus logit depends on the researcher’s preferences and results from both models tend to be very similar (Williams 2013).

Using the same specifications as in the negative binomial and transformed OLS regressions, a probit regression was run. The probit results, presented in Table
6.4, indicate that there is a significant negative effect of adding the incentives on the probability of being a poor performer (a reduction of 0.60 in the z-score of poor performers, with p<0.01).

3991 observations were used in the analysis. The likelihood ratio chi-square was 451.00 with a p-value of 0.00, which confirms that the model as a whole is statistically significant. Table 6.4 reports only the variables and the coefficients with their corresponding p-values from the probit results. The following variables were found statistically significant at a 1% level: Divorc_Sep, IncomeSelf, FirstContact, RainySeason, HlhdBelowPoverty, Bunching and the BonusPeriod. The variable indicating the central region of Uganda was also found statistically significant at a 2% level.

A positive coefficient indicates that the explanatory variables increases the probability of being a poor performer, so being a household head or child, a female, or divorced or separated, or coming from the Northern, Central or Western regions of the Uganda, or living in a district with high rates of households living below poverty increases the probability of the CKW performing poorly, ceteris paribus, as well as having access to land and receiving an income from nonfarm sources. While being married, or being older, having a lower likelihood of being poor, or earning a higher nonfarm income, being in the bonus period, making housing improvements, being active longer as a CKW, living in a district with a large city or being in a rainy season are all conditions that decrease the probability of the CKW being a poor performer.
The coefficients from the probit regression give the change in the z-score given a one unit change in the predictor. Thus, linear changes in the probit regression produce nonlinear changes in the probability of success (Williams 2013), suggesting that the effect of the bonus is not linear to the CKW performance. It also questions the relevance of the incentives to CKWs who have already reached performance level A, raising the question of whether or not incentives affect the different performing CKWs and if so, how? This could possibly be an explanation for the small bonus effect of 1.42 searches found in the regressions discussed in the previous sections.
Table 6.4 Probit Results indicating the negative effect of adding incentives on poor performers

<table>
<thead>
<tr>
<th>Weak Performance</th>
<th>Probit Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>HldHead</td>
<td>0.061 (0.432)</td>
</tr>
<tr>
<td>HldChild</td>
<td>0.162 (0.128)</td>
</tr>
<tr>
<td>AgeM</td>
<td>-0.000 (0.763)</td>
</tr>
<tr>
<td>Female</td>
<td>0.014 (0.824)</td>
</tr>
<tr>
<td>Married</td>
<td>-0.024 (0.753)</td>
</tr>
<tr>
<td>Divorc_Sep</td>
<td>0.674 (0.000)</td>
</tr>
<tr>
<td>PovertyScore</td>
<td>-0.000 (0.891)</td>
</tr>
<tr>
<td>OwnLand</td>
<td>0.200 (0.455)</td>
</tr>
<tr>
<td>AccessLand</td>
<td>0.653 (0.217)</td>
</tr>
<tr>
<td>Nonfarmincome</td>
<td>0.167 (0.129)</td>
</tr>
<tr>
<td>Home Imprvt</td>
<td>-0.062 (0.252)</td>
</tr>
</tbody>
</table>

N = 3991
HldOther was dropped in analysis
6.7 Effect on Low- and High-Performing CKWs

The next hypothesis is that the bonus has a low impact on A-level performing CKWs and a large impact only on CKWs that are performing below the 49 monthly searches. To understand the effect of these incentives on different performing CKWs, Chow tests were first completed.
6.7.1 Chow Tests: Incentive effects on High-performers and Low-performers

The change in the incentive structure simply involved an increase in salary levels according to the number of searches completed by each CKW at the end of the month. The compensation scheme remained the same. In the previous sections, the overall effect of this change was discussed and found to be small. The purpose of this section is to understand if the effect was driven by community knowledge workers who were already performing at an A level or by poor performing CKWs.

A Chow test is typically used to determine whether the data can be pooled together because it allows the comparison of coefficients estimated over different groups. In this case, the Chow test was chosen to test whether the behavior of CKWs changed according to their performance levels.

In order to predict the change in behaviors within the CKWs, the assumption that CKWs’ behavior is unique according to their performance levels was made. The model used was decomposed as follow:

\[
\begin{align*}
  y_{1it} &= \text{sum of } x_{1it} b_{1it} + u_i + a_{it} & \text{for A-level performing CKW} \\
  y_{2it} &= \text{sum of } x_{2it} b_{2it} + u_i + a_{it} & \text{for B-level performing CKW} \\
  y_{3it} &= \text{sum of } x_{3it} b_{3it} + u_i + a_{it} & \text{for C-level performing CKW} \\
  y_{4it} &= \text{sum of } x_{4it} b_{4it} + u_i + a_{it} & \text{for D-level performing CKW}
\end{align*}
\]

Next, a test for each characteristic \( i \) was completed:

\[
b_{1i} = b_{2i} = b_{3i} = b_{4i}
\]

to test whether the behavior for A-level CKWs is the same as for B-level CKWs, C-level CKWs, and D-level CKWs. The model estimated is similar to
model (2) but this time, interactions between treatment and dummies that indicate the performing levels of workers are included.

One challenge was to identify which workers are considered high performing and which are considered low performing. To classify the CKWs, I used the average number of searches completed at the end of the month before the change in the incentive structure took place.

The results are presented in Table 6.5. According to the Chow test results, all coefficients are different for an A-performing CKW, but some specific ones are significantly different. For the variable indicating the incentive effects, A-level CKWs performance was found to be different at a 1% significant level. When looking at the characteristics of CKWs, the gender, the income level from other sources and whether home improvements are among the top expenditures for CKWs (at a 3% significant level) are all factors that distinctly affect the performance of A-level CKWs. A-level CKWs also perform differently depending on their location, North or Center.

Table 6.5. Results from the Chow test for A-level performing CKWs

<table>
<thead>
<tr>
<th>Chi2 Coefficients (P-Value)</th>
<th>Bonus Period</th>
<th>7.27 (0.007)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bunching</td>
<td>17.57</td>
<td>(0.000)</td>
</tr>
</tbody>
</table>
Table 6.5. Results from the Chow test for A-level performing CKWs (cont.)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chi2 Coefficients (P-Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HldHead</td>
<td>1.67 (0.196)</td>
</tr>
<tr>
<td>HldChild</td>
<td>0.33 (0.563)</td>
</tr>
<tr>
<td>AgeM</td>
<td>3.50 (0.0613)</td>
</tr>
<tr>
<td>Female</td>
<td>8.06 (0.005)</td>
</tr>
<tr>
<td>Divorc_Sep</td>
<td>0.29 (0.588)</td>
</tr>
<tr>
<td>PovertyScore</td>
<td>0.15 (0.701)</td>
</tr>
<tr>
<td>OwnLand</td>
<td>0.49 (0.485)</td>
</tr>
<tr>
<td>Nonfarmincome</td>
<td>0.29 (0.5915)</td>
</tr>
<tr>
<td>HomeImprvt</td>
<td>4.93 (0.026)</td>
</tr>
<tr>
<td>IncomeSelf</td>
<td>7.68 (0.006)</td>
</tr>
<tr>
<td>FirstContact</td>
<td>0.48 (0.488)</td>
</tr>
<tr>
<td>MonthsActive</td>
<td>0.40 (0.527)</td>
</tr>
<tr>
<td>North</td>
<td>7.86 (0.005)</td>
</tr>
<tr>
<td>Center</td>
<td>10.94 (0.001)</td>
</tr>
<tr>
<td>West</td>
<td>4.54 (0.033)</td>
</tr>
<tr>
<td>Rainyseason</td>
<td>0.44 (0.505)</td>
</tr>
</tbody>
</table>
Variables that were not significantly different at a 5% or less level for A-level performing CKWs are the household status, the marital status of the CKW as divorced or separated, the age, the poverty score of the CKW, the number of months active, whether the CKW owned land, whether the CKW has an income from nonfarm sources, whether it is the first time the CKW is contacting a particular farmer and whether it was a rainy season.

The same tests were done for the remaining CKWs and similar results were found. When it came to the CKW’s household status and age (in months), there was no significant difference among different level performing CKWs.

Other interesting results found that the D-performing CKWs differed in performance when they were female, they own their own land, reported income from nonfarm sources, and were in the central and western regions of Uganda. B-performing CKWs differed in performance when it came to their poverty score, to whether they were divorced or separated, and if they were living in a district that had a large city.

Further exploration is needed to understand why there are still B-level and C-level performing CKWs. When comparing the differences between A-level and B-level performing CKWs, it is not clear that the new incentive structure impacted their performance differently as well as their household or marital status, their age or sex, whether they have nonfarm income, whether this was their first contact with a farmer, the number of months active as a CKW, and the rainy season. Whether one major expense goes to home improvements, their land ownership, their reported
income from nonfarm sources, if they are bunching or living in the central region of Uganda were factors that differentiated A-level from B-level performing CKWs.

6.7.2 Quantifying the Incentive Effects on Low- and High-Performing CKWs

Following Franceschelli et al. 2010 regression model, a new log transformed regression model was used. It included four new interaction variables: BonusAlevel, which is the interaction between A-performing CKW and the bonus period; BonusBlevel, which is the interaction between B-performing CKW and the bonus period; BonusClevel, which is the interaction between C-performing CKW and the bonus period; and BonusDlevel, which is the interaction between D-performing CKW and the bonus period. The results, displayed in Table 6.6, do show that the incentives have stronger impacts on A-level and D-level performing CKWs.

It was found that the effect of the bonus is an increase in the average productivity of A-level CKWs and a decrease in the average productivity of D-level CKWs. Results for B-level were not statistically significant but a small positive increase and a decent decrease were reported for B-level and C-level CKWs, respectively.

Robustness checks were done again, and results were similar, see Table 6.6. However, C-level and D-level CKWs lost their statistical significance. The results show that the change in incentive has had a different effect on each level-performing CKWs. The productivity of A-level and B-level CKWs increased, in response to the raise in salary levels. However, the productivity level of C-level and D-level CKWs
fell after the implementation of the incentive. It is not straightforward why B-level CKWs improve their performance by a mere amount but it is possible that the turnover rate for low-performing CKWs is higher than the one for high-performing CKWs.

Table 6.6 Decomposition of the incentive effect on different performing CKWs

<table>
<thead>
<tr>
<th>logSeq</th>
<th>OLS Coefficient</th>
<th>FE Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center</td>
<td>-0.058</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.701)</td>
<td></td>
</tr>
<tr>
<td>West</td>
<td>-0.023</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.872)</td>
<td></td>
</tr>
<tr>
<td>Near Large Town</td>
<td>0.016</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.743)</td>
<td></td>
</tr>
<tr>
<td>RainySeason</td>
<td>0.123</td>
<td>0.124</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>HlhdBelowPoverty</td>
<td>-0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.931)</td>
<td></td>
</tr>
<tr>
<td>BonusAlevel</td>
<td>0.470</td>
<td>0.264</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>BonusBlevel</td>
<td>0.061</td>
<td>0.359</td>
</tr>
<tr>
<td></td>
<td>(0.423)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>BonusClevel</td>
<td>-0.426</td>
<td>-0.164</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.363)</td>
</tr>
<tr>
<td>BonusDlevel</td>
<td>-1.223</td>
<td>-0.301</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.163)</td>
</tr>
<tr>
<td>Bunching</td>
<td>-0.737</td>
<td>-0.683</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
</tbody>
</table>

R-squared               | 0.359           | 0.273          |
N = 4005                |                |                |
* Standard errors adjusted for 440 CKWs
Table 6.6 Decomposition of the incentive effect on different performing CKWs (cont.)

<table>
<thead>
<tr>
<th>logSeq</th>
<th>OLS Coefficient</th>
<th>FE Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>HldHead</td>
<td>0.003 (0.964)</td>
<td></td>
</tr>
<tr>
<td>HldChild</td>
<td>-0.017 (0.842)</td>
<td></td>
</tr>
<tr>
<td>HldOther</td>
<td>0.169 (0.040)</td>
<td></td>
</tr>
<tr>
<td>AgeM</td>
<td>0.000 (0.905)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>-0.012 (0.795)</td>
<td></td>
</tr>
<tr>
<td>Divorc_Sep</td>
<td>-0.161 (0.044)</td>
<td></td>
</tr>
<tr>
<td>PovertyScore</td>
<td>-0.000 (0.543)</td>
<td></td>
</tr>
<tr>
<td>Own Land</td>
<td>-0.036 (0.717)</td>
<td></td>
</tr>
<tr>
<td>Access Land</td>
<td>-1.091 (0.000)</td>
<td></td>
</tr>
<tr>
<td>NonFarmIncome</td>
<td>-0.134 (0.124)</td>
<td></td>
</tr>
<tr>
<td>HomeImprvt</td>
<td>0.067 (0.070)</td>
<td></td>
</tr>
<tr>
<td>IncomeSelf</td>
<td>0.000 (0.073)</td>
<td></td>
</tr>
<tr>
<td>FirstContact</td>
<td>-0.318 (0.000)</td>
<td>-0.294 (0.000)</td>
</tr>
<tr>
<td>MonthsActive</td>
<td>0.004 (0.379)</td>
<td>0.006 (0.432)</td>
</tr>
</tbody>
</table>

R-squared 0.359 0.273
N = 4005
* Standard errors adjusted for 440 CKWs
6.8 Bunching

Notches are found to be useful in uncovering behavioral parameters because they induce actors to change their behavior just enough to be situated on the beneficial side of a notch (Slemrod 2013). Previous studies have used responses to kinks and notches to estimate price and income elasticity (Saez 2008; Kleven and Waseem 2013; Chetty 2012; Chetty et al. 2011). In this analysis, the distribution of the number of searches completed at the end of the month representing the effort of a CKW toward earning income is used to estimate bunching and price elasticities. Assuming the CKWs are rational agents and face no adjustment costs, they should bunch in the presence of a notch, which is the number of searches that take them to the next performance level. Before estimating the income elasticity of supply, this section presents graphical evidence of bunching among CKWs.

6.8.1 Evidence of Bunching

Graphs 6.3 and 6.4 display the observed bunching of CKWs before and after the bonus period, respectively. Before the bonus, it can be implied that optimization frictions were present: with the exception of the D-level target, a large share of CKWs were not clustering right above the notch. Instead, it seems that they were bunching right before the notch. After the bonus period, more CKWs were bunching at the strictly dominated regions above the notch, especially A-level CKWs. This is not too surprising because in the long run, behavior should be able to overcome some optimization frictions (Kleven and Waseem 2012).
Graph 6.3 Distribution of the number of searches before the bonus period

Graph 6.4. Distribution of the number of searches after the bonus period
Next, using the bunching at the notches, the implied income elasticities of labor supply were estimated.

6.8.2 Bunching: A Indicator of CKW’s income elasticity of labor supply

The next question of interest is whether or not the income elasticity of labor supply can be identified given the CKW's current performance level facing the Grameen Foundation’s incentive structure, and if so, how? The discontinuous notches in the choice set of CKWs are a result of the incentive structure that includes a higher salary pay for reaching a particular target. Thus, the behavioral response of CKWs to the notches can provide enough information to identify the income elasticity of supply (Saez 2010; Chetty 2012; Chetty et al. 2011; Slemrod and Sallee 2012).

Following Kleven and Waseem's method for estimating elasticities, I used the moments of the density distribution around notch points to determine the observed labor income elasticity with respect to the number of searches completed by the end of the month.

High ability CKWs faced a negative elasticity as their salary increased. The price elasticities of labor supply for A-level CKWs ranged from -0.06 to -0.02. Negative elasticities were also found for C level CKWs but their absolute values were higher (-0.65, -0.30), compared to those of A-level CKWs suggesting that C level CKWs face a more elastic supply of labor. B level CKWs' elasticities were in between A level and C level CKWs, ranging from -0.15 to -0.09.
The negative signs are somewhat surprising, but few studies have found that those with highly paid jobs may reduce the hours they work because their incomes are already high and more time for leisure activities become preferable (Rittenberg 2008; Blau 1993). Otherwise, the observed elasticities were found to be small, implying that all CKWs’ labor supply, regardless of the effort levels, was relatively inelastic in response to the change in the income level. This findings are not unusual given the existing literature (Kleven and Waseem 2013; Chetty et al. 2011). Small observed elasticities can be a result of obstruction by frictions. Kleven and Waseem 2013 finds that the short-run elasticity measures the actual observed behavioral response and despite the degree of bunching, optimization frictions prevent individuals to locate themselves in the strictly dominated regions.
Chapter 7: Conclusion

Existing literature already reveals that there is a connection between performances and incentives. The objective in this study was to examine how extension workers, called CKWs, responded to the incentives created by the Grameen Foundation’s project implemented in Uganda. Consistent with the current literature, it was found that the simple increase in salary levels in the compensation scheme for CKWs has an overall positive effect on CKWs’ productivity by approximately 9%. The transformed OLS regression shows that the increase in wage levels after June 2011 raises the number of monthly searches by 1.5 on average and this result is robust to different specifications, as was shown by the fixed-effect model.

The effects of performance-based payment on overall CKWs productivity were estimated by using two econometric models: a negative binomial regression model and a log-transformed OLS regression model:

\[
\text{LogSeq}_{it} = \sum \beta_i X_{it} + \lambda_t + \mu_i + e_{it}
\]

where \(\text{logSeq}_{it}\) is the logarithm of the number of monthly searches for CKW \(i\) in month \(t\) and \(X_{it}\) is a vector of dummy variables and count indicators that include CKW traits, District traits and Incentive.

The small increase of 1.5 in monthly searches led to further exploration on how the incentive effect differs according to the performance levels of the CKWs.
since the first results find that many workers improve their performance levels once the increase is introduced.

Results from a probit test showed that the assumption that incentive effects are linear might be incorrect. It also indicated that the incentives had a negative effect on weak performers. Thus, chow tests were ran to understand the impact of incentives on strong performers and weak performers. It was found that the overall behavior of A-level CKWs differs from the remaining performance levels CKW.

This finding is significant because it gives some insight to extension service providers seeking to implement the right incentives to ensure a certain performance level among agricultural agents, similar to CKWs. Prior research already confirms that pay-based on output stimulates performance and attracts more productive workers to the organizations but nongovernmental organizations often face challenges in creating the right incentives to motivate extension workers to perform according to the goals of their programs.

The results also suggested that the right incentives discourage weak performers. However, the reasons why some workers still do not reach the A-level, even after the increase in salary, remains to be further explored. Previous literature suggests that low-ability workers remain unaffected by a change in incentive levels, but it is also known that more productive workers tend to self-select into jobs with performance-based pay (Ewing 1996).

Another interesting aspect discussed in this analysis is the understanding of behavioral responses through notches. The incentive structure put in place by the
Grameen Foundation causes notches in the budget set of CKWs. The theory reveals that in a frictionless world, bunching should occur after each performance level threshold. In my data, there was some evidence of bunching, especially after the bonus period. Using these notches, price elasticities of supply were estimated for A-level, B-level and C-level CKWs and there were found to be negative and inelastic. Despite the presence of bunching and the small elasticities, the combination of these two is consistent with the idea that notches can lead to strong distortions in a rational agent’s behavioral response. However, it is important to identify and reduce the optimization frictions that are preventing the CKWs from properly bunching, especially in a developing country setting. Many factors could cause such frictions, such as physical constraints, limited network connectivity, and limited battery life of phone...

In future work, I suggest using a combination of number of searches and distinct visits to farmers as a measure for the performance of CKWs to discourage game. An in-depth look into the types of workers that are chosen for this program is also needed. This study lacked information on CKW’s education level, his/her household size, the number of children in the household, and the number of trainings they received. These are all factors that could affect their utility-maximizing choices.

Gender relations are another point that could further be researched. The sample was dominated by men, though originally the project aimed to have an equal gender distribution. This research also lacked cultural context. Though preliminary
analysis by Grameen Foundation founds that farmers are open to new information and agricultural practices, it is unsure of how CKWs are viewed in the Ugandan communities. How important are social networks in Uganda? Does being a CKW actually improve the socioeconomic status of the respective CKW, his/her households and the farmers in the community?

One advantage of this research is that it is a longitudinal study design. This allows stronger statements to be made on causality. Thus, an increase in performance-pay compensation levels does incentivize CKWs to perform better and it separates the strong and weak performers. The results from this analysis have some major implications for extension and provide additional insights for the future design of extension systems.

The goals of extension include the transferring of knowledge from researchers to farmers, advising farmers in their decision-making and educating farmers on how to make better decisions, enabling farmers to clarify their own goals and possibilities, and stimulating desirable agricultural developments. If NGOs are able to attract farmers motivated by concern for the public interest, their programs are more likely to report high levels of achievement.
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