IDENTIFYING THE DETERMINANTS AND CHARACTERISTICS OF MOTHERS' INCOME IN RURAL MALI

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ABSTRACT

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This study investigates the determinants and characteristics of women's income in Mali. Malian men and women do not entirely pool their incomes within the household, and women's income is particularly important in influencing child health and nutritional outcomes. The study estimates two different models: an income determinants model and a model that describes different categories of women based on their income-generating activities. Results from model 1 show that women in the irrigated rice zone have the highest incomes, ceteris paribus, followed by women in the coarse grains zone. The cotton zone produces the lowest women's incomes, despite having the highest men's and household income levels. Other significant determinants include the women's age, being married to the head of the household, the composition of the household and asset levels. In the second model, different income-generating activities have different impacts on incomes, depending on the region in which the women live. Women in the cotton and coarse grains zones receive the highest marginal benefit from participating in the sale of wild products, such as shea butter, but not in the irrigated area, where more profitable agricultural activities exist for women. The results imply that agricultural growth and higher household incomes do not automatically lead to gender equity or better welfare for women and children. In the cotton zone, particularly, complementary interventions are needed to counteract the negative impact of cotton production on women's incomes.

To my parents, for everything

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1. INTRODUCTION

1.1 Problem Statement

Despite great strides in reducing global child undernutrition rates over the past few decades, child malnutrition in Africa remains problematic. Sub-Saharan Africa has experienced the smallest percentage decrease in malnutrition prevalence[1] (3.9%) of any region between 1970 and 1995. The number of malnourished children increased by 70 percent over the same period (Smith and Haddad, 2000). Rural Mali is no exception. A study of the linkages between child nutrition and agricultural productivity growth in Mali (LICNAG) revealed that by 18 months, 25% of children are wasted and 40% are stunted (Tefft, Kelly and Staatz, 2003).

Abundant studies have attempted to identify and measure the determinants of child malnutrition. It is generally accepted that higher income, and specifically mother's income, leads to increased food expenditures and better child nutrition. One study by the International Food Policy Research Institute found the effect of women's income to be positive on household calorie level, food expenditures, child weight for height and child survival. In every case, the effect of women's income was more significant than that of men's income (Quisumbing et al., 1995). Thomas (1997) reported that a greater share of household budget under the control of women is more likely to be spent on household services, health and education. In Mali, the LICNAG study points to a higher (and significant) correlation between mother's expenditures and height-for-age (HAZ) scores relative to father's expenditures or total household expenditures (Tefft, Kelly and Staatz,

[1] Share of children who are malnourished.

2003). However, despite this empirical evidence, there is a lack of key information on the sources and determinants of women's income in Mali. This paper attempts to address this knowledge gap.

Household Economic Models

The differing effect of mothers' and fathers' income on child nutritional status challenges traditional household economic models that depict households as utility-maximizing units motivated by stable, uniform preferences. In such models, the household is assumed to act in the same way as an individual; all resources are pooled and then reallocated to achieve common objectives (Thomas 1992). Under this assumption, any income that enters the household – whether it is under the control of the mother, father or head of household – will have identical impacts on the nutritional status of household children.

However, as the above studies demonstrate, who controls income does matter when explaining child malnutrition. This suggests that individual members can, and often do, have separate, different, and sometimes conflicting preference functions. Given these different preferences, researchers have developed new models to describe household behavior. One such model, the bargaining model, posits that individual members pursue their own interests, given their relative bargaining position in the household. Bargaining power is determined, in part, by an individual's income-earning power and "threat point" – the point at which the individual believes he or she will be better off outside the household unit than within it (Zeitlan et al. 1995).

Another model, termed the "implicit contracts" model by Folbre, "sees the family as governed by culturally determined expectations about the entitlements and obligations of

individuals in different positions with the household unit (Zeitlan et al. 1995). In this relationship, each spouse contributes to the well-being of the household, although they do so in a fairly restricted, well-defined and socially recognized manner. The separate priorities of husbands and wives are often reflected through gender-specific expenditures (Fapohunda 1989). These traditional and cultural norms serve both to decrease the time and energy expended in bargaining over alternative allocations of resources, and to define the upper and lower bounds on acceptable behavior within which bargaining can occur (Zeitlan et al. 1995).

In rural Mali, there is a strong implicit contract between husbands and wives regarding the responsibilities of each to the household. Lilja et al. (1996) also found evidence of a bargaining relationship that resulted in higher wages for work on communal fields paid to women who were able to exert their bargaining power. Incomes earned by husbands and wives are not pooled (Wooten 2003; Ward et al. 2004); each, therefore, needs to have his or her own source of resources to fulfill their obligations.

In general, men in Mali are responsible for providing cereals and, in the wealthier households, meat. Women, in turn, provide the condiments and sauce ingredients for the meals and may supplement food supplies with purchases of fruits, vegetables and meat or fish. In addition to these primary obligations, men pay for luxury items, such as tea, sugar (for tea) and cigarettes, taxes, children's school fees, clothes for themselves (and sometimes for their wives and children) and some ceremonial costs. Women buy clothing for themselves and their children and pay for expenses connected to weddings and circumcisions (Wooten 2003; Ward et al. 2004). Both women and men contribute to the

costs of health care, although women tend to pay for traditional health remedies, while men cover the higher costs of modern health care (Tefft and Kelly 2004). Gifts are also paid for and given by both men and women, although they are more important for women, dependent males and poorer households than male heads of household and members of wealthier families (Wooten 2003). In this sense, the practice of gift-giving is a form of insurance; by investing in extended family relationships and social networks, women are improving their bargaining position within their marital relationship and decreasing the risk of asset loss under traditional practices of inheritance and/or polygamy (Fapohunda 1989).

While these gender-specific expenditures are widely accepted, there exist ample examples where these norms are not respected. Some men provide their wives with money to purchase sauce ingredients, while women increasingly have to cover household expenses (e.g., cereals) traditionally charged to men due to economic hardship (Ward et al. 2004). Ward et al. also observe that an individual's obligations change with a change in their relative income. An increase in women's income may elevate her financial responsibility to the household.

1.2 Objectives of the Study

Accepting the generally separate economies of men and women in Mali and the important role that mothers' income appears to play in alleviating child malnutrition, this study aims to understand the characteristics of women's income and identify the factors that determine different income levels attained by mothers. Specifically looking at the characteristics and determinants of mothers' income in Mali offers several advantages.

Describing income patterns and identifying the determinants of income and their relative importance provides useful information to policy makers designing programs to reduce poverty and malnutrition and improve gender equity. It is also a useful first step in efforts to model the determinants of malnutrition, as the estimated values of mothers' income can be used in lieu of the income/expenditure data, which are usually endogenous in such models. If the relationship between mothers' income and child nutrition holds up to multivariate analysis, knowledge of the determinants could serve as leverage points in the design of interventions to improve child nutrition through increases in mothers' incomes. The benefits of increasing mothers' income far exceed its direct effect on child nutrition. Women with income are likely to be better off, have more bargaining power to affect household decisions, and are better able to provide health care for children and assist with clothing and school expenditures.

2. SETTING AND DATA

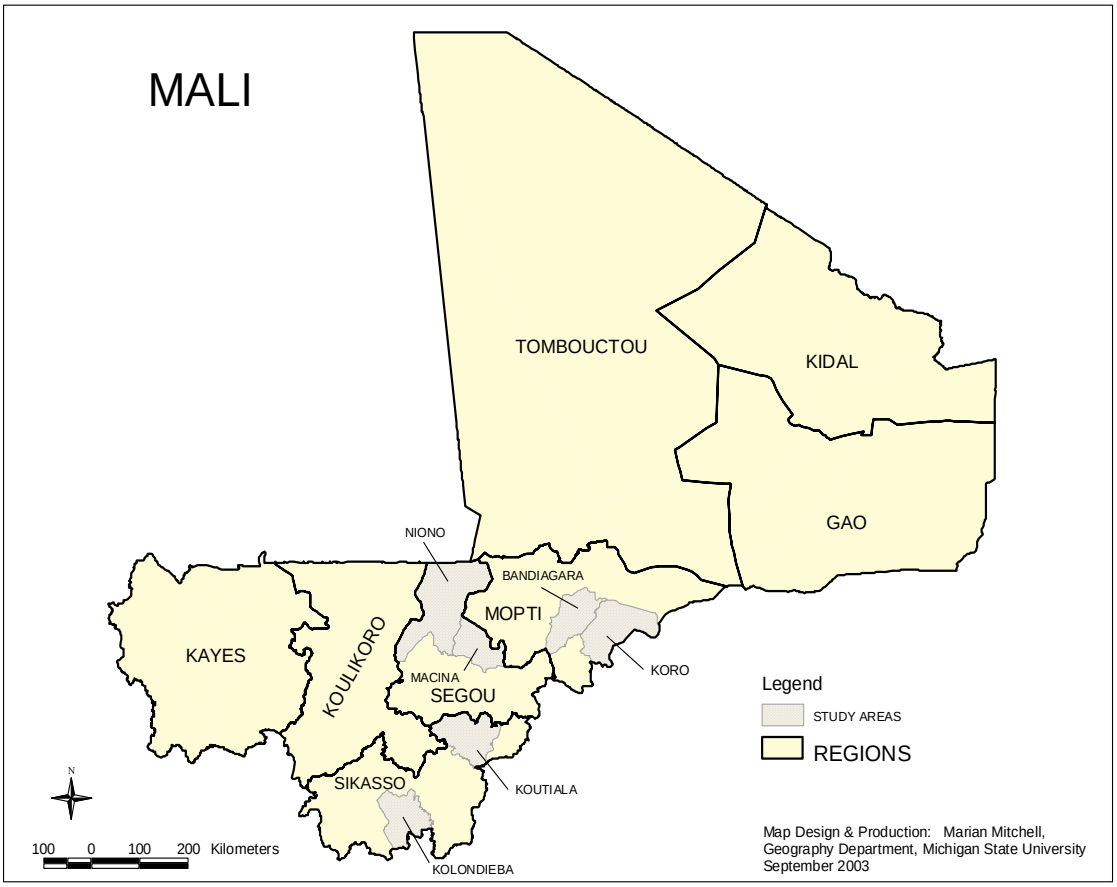
2.1 Description of Survey Zones

Analysis in this study is designed to add value to an existing study of the linkages between child nutrition and agricultural productivity growth in Mali (LICNAG)[2]. The LICNAG survey data cover three agricultural production systems experiencing different levels of productivity and economic growth: the irrigated rice growing area in the Segou region, the cotton-growing area of the Sikasso region, and the millet/sorghum zone in the Mopti region (see Figure 1 for map of Mali and survey zones). The Segou and Sikasso regions have been characterized by significant increases in agricultural production through intensive and extensive agriculture practices, respectively, in the late 1990s. Conversely, Mopti has experienced stagnant cereals productivity growth and slow overall production growth (due largely to area expansion) during the past decade.

While these three production systems define their respective regions, agricultural activities are diverse in each. In addition to cotton production, Sikasso is one of Mali's most important rain-fed cereals zone. Since the mid-1980s, the region has accounted for approximately 30% of national sorghum and maize production (Tefft and Kelly 2004). Rice farmers in the Segou region take advantage of irrigation schemes in the *Office du Niger* to grow vegetables (mainly tomatoes and onions) in the dry season, and also cultivate rainfed cereals in upland fields surrounding the irrigated areas. Cultivation of traditional grains in the Mopti region is supplemented by dry-season onion production and a heavier dependence on livestock.

[2] Funded through the Food Security II Cooperative Agreement between USAID and MSU. Information on the study can be found at http://www.aec.msu.edu/agecon/fs2/mali_nut/index.htm

Figure 1: Map of Study Areas



Additionally, these three regions differ with respect to the involvement of state-sponsored agencies in rural and agricultural development. In the cotton zone, the *Compagnie Malienne pour le Développement des Textiles* (CMDT) has been involved in research and extension, input supply and credit, output marketing, and processing activities for the cotton sector. It has also, at times, provided support to cereal production, livestock, forestry and rural infrastructure and services (Kelly and Staatz 2006). In Segou, the *Office du Niger* (ON) has provided similar services for the rice sector. Recent institutional reform of the ON has narrowed the responsibilities of the agency to infrastructure and water management, transferring most of its other functions to farmers.

The Mopti region has depended largely on non-governmental organizations (NGOs) and poorly-funded extension services for development assistance.

Each of the three production zones is further divided into administrative zones, or *cercles,* two of which were chosen in each zone for their divergent levels of infrastructure and agricultural opportunities. The key characteristics of the three regions and six zones are summarized in Table 1.

2.2 Sampling Methods and Data

The data include household-level information for 750 households[3] with children under five years of age. These households represent a subset of the Demographic and Health Survey (DHS III) undertaken by the Malian government. The DHS rural households were selected using a two-stage cluster sample technique. In the first stage, 38 "Sections d'Enumeration" (SEs) used by the Malian Census Bureau were systematically selected from each of Mali's administrative regions. In the second stage, households were selected from a complete list of households for each SE. The resulting DHS sample is representative nationally and for each of the regions, but is not representative at the level of *cercle* (Tefft and Kelly 2004).

For the LICNAG survey, sampling was purposive at the regional and *cercle* levels to examine the effects of (1) different agricultural production systems (i.e., cotton, irrigated rice and millet/sorghum) and (2) different levels of infrastructure on child health and

[3] For the purpose of this study, a household is defined as an agricultural production unit or "work-eat" group. It consists of members engaged in common production and consumption, and may include more than one "nuclear" family (husband, spouse(s) and unmarried children).

Table 1: Characteristics of Survey Zones

Production Systems	Regional Characteristics	Zones	Zone-level Characteristics
Cotton System (Sikasso)	High rainfall (1000-1500 mm annually); in addition to cotton, region is largest producer of rain-fed cereal crops (maize, sorghum); high livestock ownership Intervention of CMDT for cotton and cereal inputs, marketing, credit and rural infrastructure Large extended families under strong patriarch; dominated by Bambara and Mianka ethnic groups.	Kolendieba	New cotton zone; farmers tend to be less experienced and have less animal traction equipment than farmers in Koutiala
		Koutiala	Old cotton zone; farmers well established and infrastructure better developed than in the newer zone; little diversification outside of cotton and cereal crops
Irrigated Rice System/ (Segou)	Rainfall equals 500-750 mm annually; floodplains along the Niger River delta suitable for irrigated rice and recession agriculture; diversification into horticultural crops; livestock and fishing also important Institutional reform of Office du Niger in recent years, improved irrigation infrastructure and technological innovations Smaller, nuclear family structure; diverse ethnic population, including Bambara, Bozo, Mianka, Sarakole and Fulani	Niono	Located in part of irrigation scheme with full water control and upgraded irrigation infrastructure; primary occupation of households is rice production; dry-season horticultural production common; better access to transport than Macina
		Macina	Water control less developed than in Niono; for some households, production of rainfed millet and sorghum crops is more important than irrigated rice; sample includes important share of households whose primary occupation is fishing.
Millet/Sorghum System (Mopti)	Rainfall equals 500-750 mm annually; millet/sorghum produced in rainy season, onions are produced in dry season; livestock important part of production system Rural and agricultural development mainly through NGOs and extension service Extended family structure; dominated by Dogon ethnic group	Bandiagara	Some households have access to water retention structures that permit onion cultivation during the dry season; road and market access easier than in Koro; migration to provide harvest labor in *Office du Niger* irrigated perimeters common.
		Koro	Few dry season agricultural opportunities, as wells tend to dry up; difficult access to/from major urban centers.

Source: Kelly et al., 2004

nutritional status. Within each of the *cercles*, sampling was random at the household level.[4]

The data collected in the LICNAG survey are comprised of monthly anthropometric measurements for the children, and information on household demographics, assets, individuals' expenditures and agricultural production and non-farm activities. Data were collected for the period between May 2001 and April 2002 using bi-monthly interviews with a variety of household members. In addition to the bi-weekly interviews, a Knowledge, Attitudes and Practices (KAP) survey was administered to the parents of 457 children <2.5 years of age. Focus discussion groups with men and women were held, as well as health center interviews, mayor interviews and surveys of village infrastructure.

Of the 1615 mothers of children under the age of five years who were weighed for the study, 984 were retained for this analysis. Five hundred forty-five were dropped because either the woman or her husband did not provide information on their respective expenditures. Thirty-eight women were dropped because they did not report involvement in any income-earning activities, despite having positive expenditures. Another 46 were dropped due to insufficient data on the woman and/or her household.

Forty-one percent of the cases dropped came from the Mopti region, compared to 38% from Sikasso and 21% from Segou. There are some significant differences between the women retained in the study and those who were dropped. On average, the women retained in the sample were 3.2 years older than their excluded counterparts. Forty-four percent of the women retained in the sample were married to the head of the household,

[4] See Tefft and Kelly (2004) for a detailed description of sampling methods.

compared to 33% in the overall sample. The woman's average level of schooling and her position within the family (i.e., wife order[5]) were not significantly different. The average size of the household was significantly larger in the dropped cases, which is likely due to the disproportionate number of dropped cases from the Sikasso and Mopti regions relative to those from Segou. It is also extremely difficult to track individuals' income and expenditures accurately for households with more than 50 people. Total household income was not significantly different between the two populations for the Sikasso and Segou regions. Households retained for the analysis in Mopti had a significantly higher average household income than those that were dropped.

[5] The majority of ethnic groups (and total population) in Mali are Muslim and practice polygamy. Each man can have a maximum of four wives. The term "wife order" in this paper refers to whether a woman is the first, second, third or fourth wife. A negative relationship between wife order and income implies that the first wife has a higher income than the second wife, who in turn has a higher income than the third wife, etc.

3. CONCEPTUAL MODEL AND HYPOTHESES

The goal of this research is to describe key characteristics and identify the determinants of mothers' income in three agricultural production zones in rural Mali. The study focuses on testing hypotheses about factors thought to be correlated with incomes for a sample of mothers with children under the age of five years who participated in a study on the determinants of child malnutrition.[6] These factors include various individual-, household- and community-level assets and labor availability along with community characteristics that serve as an "enabling environment" for women to earn income. The conceptual model can be presented as follows:

$$Y = f(\mathbf{a}, \mathbf{b}, \mathbf{c}, \mathbf{d}, \mathbf{e})$$

Where Y is the income level of the mother, **a** is a vector of human capital, **b** is a vector of social capital, **c** is a vector of physical capital and cash flow, **d** is a vector of labor input and **e** is a vector of community characteristics.

3.1 Human Capital

Components of human capital that are hypothesized to contribute to increased women's income include her own level of schooling and experience gained through informal education, the level of schooling of her husband and the woman's nutritional and health status. One would expect the income-earning capacity of a woman to increase with her level of schooling. Hill and King (1994) attribute both market and non-market benefits to women's education, including higher family income, increased own-earnings, increased labor productivity, improved health and nutrition and greater fertility control. However,

[6] See Tefft and Kelly (2004) for the preliminary results of this study.

other empirical studies have produced indeterminate results on this issue. Studies of female non-farm income in Ghana and Uganda showed negative and positive influences of education, respectively (Canagarajah et al., 2001).

Similarly, it is hypothesized that being married to an educated husband will have a positive effect on a woman's income. This may occur through several paths. First, in its *State of World Population*, the UNFPA (2002) reports that households with educated members have more secure employment, higher incomes and better access to economic assets and credit. Access to these assets may improve a woman's capacity to earn income even if she, herself, has not directly benefited from educational opportunities. Second, a study investigating human capital and labor allocation in rural Pakistan (Fafchamps and Quisumbing, 1998) found that households with better-educated males diverted labor resources away from low-productivity activities toward higher-return nonfarm work.[7] It is possible, then, that an educated husband is more likely to encourage his wives to pursue more lucrative activities outside the home. For a review of the returns to investment in education, see Psacharopoulos and Patrinos (2004).

It is expected that the health and nutritional status of the woman will have a positive effect on her income, in that healthier women have more time available for agricultural production and nonfarm activities and work more productively. The positive relationships between nutritional status and labor productivity, health and wages, and health and incomes are supported by Haddad and Bouis (1991), Schultz (2005) and Bloom and Canning (2000), respectively. However, in a review of studies investigating

[7] In the case of Pakistan, where *purdah* prevents many women from engaging in activities outside the home, women did not experience the same returns to nonfarm income from education as their male counterparts.

nutrition/productivity links, the authors find the linkages to be less consistent for women than for men (Kennedy and Garcia, 1994).

3.2 Status and Social Capital

Robison and Stiles define social capital as "a person's or group's sympathy that provides another person or group potential benefits, advantages, support and access beyond that which might be expected between strangers in an exchange relationship" (2000, 3). Several factors contribute to the sympathy a woman receives; each has implications for her ability to earn income. At the individual level, these include her age, whether she is in a polygamous marriage, her status within the household (first, second, third or fourth wife) and ethnicity. It is hypothesized that a woman's capacity to earn income is positively correlated with her age. As the woman becomes older, she can pass household chores to younger girls, allowing more time for other work. A woman's age may also be an indicator of experience and knowledge gained from sources other than formal education. Whether or not a woman is in a polygamous marriage can have contrasting effects. Having co-wives may reduce the amount of housework required by each woman; however, limited resources (e.g., land) may have to be shared amongst the wives. For wives in a polygamous relationship, we expect to see a negative relationship between the wife order and income earned. As a husband acquires more wives, the first wife is relieved from many household duties. Ethnicity can be significant if cultural norms dictate whether or not women are educated and can work outside the home, and if these norms differ significantly amongst ethnic group. Poulton and ag Youssouf (1998) argue that the latter does not hold in Mali. They claim that – due to migration and inter-marriages – ethnicity has become a very fluid concept, giving it less influence in Mali

than it may have in other places.[8] Still, certain ethnic groups do tend to engage in certain economic activities (e.g., the Bozo are associated with fishing, while Fulani depend heavily on livestock and milk).

At the household-level, aspects of a woman's social capital that are hypothesized to influence her income include the position of her husband within the household and the demographic make-up of the household's members. The husband's position in the household is critical. In the Malian context, a "household" may be comprised of several "nuclear families" within the extended family. The household is defined by those members who are engaged in common production and consumption. As such, one patriarch controls most of the income, assets and expenditures, giving other adult males very little decision-making power and control over financial resources. A woman who is married to the head of household may therefore have greater access to household resources, such as using the household's animal-drawn equipment to plow her personal fields or using household cash to invest in nonfarm activities.

At the community level, it is hypothesized that the number of village-level associations will have a positive impact on incomes. Village associations are an important source of credit for women who often do not have the collateral to qualify for formal bank loans. Associations organized around income-generating activities also provide labor- and resource-sharing opportunities for women.

[8] Conversely, in their intra-household analysis on access to resources in Southern Mali, DeGroote and Coulibaly (1998) found ethnicity to be an influential variable.

3.3 Physical Capital and Financial Resources

A women's ability to generate income is hindered by the competing demands on her time, including agricultural production, domestic production (including food preparation and the collection of fuel and water) and reproduction. Assets and technologies which increase women's productivity in both agriculture and home production are expected to have a positive effect on women's income by allowing for more time to engage in other activities, without sacrificing additional time, their children's welfare or their own health and nutritional status (Quisumbing et al. 1995). Other household assets could have a more direct impact by providing income-generating opportunities to women (e.g., land and livestock to milk).

The impact of agricultural technology on women's incomes and welfare is more complicated. As opposed to assets which reduce the time required to perform certain activities (such as energy-efficient stoves), agricultural technology packages often require increased labor input. This higher demand for labor is often met by women, pulling them away from their own-income activities to work on communal fields (Kumar 1987). Conversely, Lilja et al. (1996) found the introduction of new agricultural technologies in southern Mali to have a positive effect on wages paid to women for work on communal lands. They also found that technology, proxied by land under cotton cultivation, reduces the female-male wage differential by generating new income streams for women. These effects are magnified when woman have the ability to bargain and/or refuse to work on communal fields. This last point is critical to the discussion on technology. It is often not the technology itself that affects women's income, but rather, the rules governing who gets the income streams generated from the new technologies. If a woman controls

the income streams herself, presumably she would not adopt the technology if it made her worse off. Where women do not have a voice in how their labor is utilized, they may see their welfare decrease as a result of the technology.

The income level of a woman's husband can have contrasting effects on her own income. Under certain production systems and household structures, non- or low-remunerated work by women on their husbands' fields may simultaneously increase the men's incomes while suppressing those of the women. If married couples pool their income or allocate resources to their best use, then a husband's income could positively influence his wife's earning capacity by providing the capital necessary to start certain income-generating activities. Even where funds are not given directly, a women may benefit from her husband's income if he, for example, provides better nutrition to the family, hires labor that frees up the wife's time or provides access to income-generating assets. As with physical assets and technology, informal institutions and the woman's social capital will determine if, and to what degree, she can access her husband's earnings to increase her own.

3.4 Labor

A woman's income level will likely be influenced by the intensity of time and effort she dedicates to income-generating activities. The time a woman has to participate in extra-household activities, in turn, will depend on both the size of the household and the composition of its members. It is plausible that households with more members can diversify their activities, enabling them to engage in more non-farm activities (Canagarajah et al. 2001), depending on the amount of land they cultivate. Specifically, it

is hypothesized that having more women who share common household responsibilities (such as cooking and collection of fuelwood and water) will reduce the time that each dedicates to these chores, allowing more time to explore other work. If few women and girls are responsible for the childcare and cooking of a large family, time to participate in other work will be limited or nonexistent.

3.5 Enabling Environment

An enabling environment is a set of interrelated and interdependent conditions such as policies, laws, institutional mechanisms (both formal and informal), infrastructure and resources which facilitate the ability of women to earn income.[9] These conditions are defined at the levels of community and/or region; however, a women's ability to take advantage of the environment may differ at the individual- and household-levels.

At the community level, it is hypothesized that levels of infrastructure, such as water resources and schools, should have positive effects on women's income. Nearby wells or public water faucets will reduce the time women spend gathering water, allowing them to devote more time to activities outside the home. The presence of schools could be indicative of private and public investment in the community and reduce the hours per day that mothers need to care for school-aged children. Schools also provide an opportunity for women to generate income by selling snacks and drinks to students. Proximity to markets could reflect an overall healthier economy and opportunities for commerce. Evidence from MSU work in Africa shows that proximity to markets leads to

[9] This definition is adapted from "Enhancing Participation of Women in Development through an Enabling Environment for Achieving Gender Equality and the Advancement of Women" (DESA, 2005).

higher household income, which could be expected to carry over to higher women's incomes (Dioné 1989).

Location may play an important role in determining mothers' income. However, interpreting location variables is difficult because they can capture a variety of climatic, economic and social factors. For example, one might expect higher incomes in the rice-producing region of the *Office du Niger* relative to the cotton and course grains regions, due to the existence of irrigation mechanisms for gardens and more non-farm activities. However, a dummy variable for this zone might also be picking up income differences due to the formal and informal institutions that exist in the regions, such as the different historical approaches to agricultural and rural development taken by the *Office du Niger* and *CMDT*, and household structure. Households in the rice-growing region tend to be smaller and more nuclear, while the cotton and millet/sorghum zones are more likely to have many nuclear families living in the same household. In the extended families, productive assets (equipment) and income from household fields (cotton, cereals) are controlled by the patriarch of the extended family rather than by the heads of the individual nuclear families. The mean numbers of members per household are 24.27 for Sikasso, 18.97 for Segou and 22.69 for Mopti.

4. EMPIRICAL ESTIMATION AND RESULTS

This study attempts to measure the effect and relative influence of the determinants of mother's income in rural Mali and provide information on the activities in which women participate. This will be done with two different empirical models. The first model focuses on the determinants of mothers' income, based on the conceptual model discussed above. The second model will build on the first model by adding dummy variables to represent participation in the different activities by which women earn income. Since the causality of participation in these activities and income levels is not clear, these variables were excluded from the first model. However, they do provide a better profile of what women who earn different levels of income look like, as participation in different activities are more specific indicators of the opportunities and constraints faced by women than the determinants alone.

4.1 Model 1: Determinants of Mothers' Income

4.1.1 Dependent and Explanatory Variables Employed

The explanatory variables in the model of the determinants of the mothers' incomes represent the different kinds of capital and "enabling environment" discussed in Chapter 3. The choice of explanatory variables, described below, was guided by the hypothesized factors thought to be positively or negatively associated with mothers' income, information from the literature and the available data.

The natural logs of mothers' expenditure data were used to represent income, the dependent variable. The natural log was chosen to minimize the effect of extreme values.

Only women who had positive expenditures were considered for this study, since it is unclear whether the 23 percent of women (373 cases) with no reported expenditures are a result of missing data or truly have no income. The latter is unlikely in the Malian context.[10] Expenditures were utilized in lieu of income because of the difficulty in collecting information on earned income and for the ability of expenditures to reflect long-run income potential (Haddad et al. 2002). Careful measures were taken during the interviews to assure that only expenditures made with money earned by the interviewee were recorded. Specifically, there was a question on the survey regarding the "source of money" for the expenditure that indicated whether the money spent was earned by the respondent, someone else or whether it represented general household income managed by the head of the household. The responses to this question were used to assign the expenditures to the person who actually paid for them. For all respondents (male and female), expenditures on cereals were excluded from the analysis, since males – particularly the heads of household – may be responsible for provisioning the children of several wives and other dependents. Inclusion of cereal expenditures would increase the incomes of males relative to women.

Human capital variables were represented by the number of years that the mother and her husband attended formal school. There is nothing in the data set to represent the women's health or nutritional status, so these are necessarily excluded from the model.[11] Several variables represent the mothers' status and social capital. Mother's age was represented

[10] If we were confident that all zero expenditures were true zeros, a Tobit regression would be preferable to least squares. However, it is reasonable to believe that the number of women with no income is much lower than 23 percent, and that "zeros" in many cases represented missing responses, not zero expenditures. In this case, including the cases with "zero expenditures" in the analysis would introduce a bigger bias due to measurement error than taking them out.

[11] Mother's height was recorded for women participating in the KAP survey. It was not found to be significant when the model was run on the smaller sub-sample of women.

by a continuous variable. Her position within the polygamous marriage (1, 2, 3 or 4) was found to be insignificant when represented by both continuous and dummy variables, and was therefore dropped. A dummy variable representing whether the woman was involved in a monogamous or polygamous marriage was also dropped because its coefficient was not significantly different than zero. Ethnicity was dropped from the model because it was found to be insignificant for all ethnic groups and including it added a significant number of parameters to the model. In addition, members of the same ethnic group tend to live in the same area, and thus ethnic group dummy variables are highly correlated with the location variables.

A dummy variable indicated whether or not the husband was the head of the household. If he was the head, then his expenditures included not only his personal expenditures, but also major expenditures for the entire household which fell under his control, with the exception of cereals and agriculture equipment. All else equal, we would expect the expenditures for a husband who is "head" to be much higher than for a husband who is "dependent" within the extended family. We also assume that a woman married to the head (versus a dependent male) will have better access to common household resources for pursuing her own income generating activities and fewer household tasks.

A continuous variable was used to represent the number of village-level associations. This variable considers *all* the associations reported to exist in the village. There is no indication of whether the women included in the survey were active members or beneficiaries of the associations.

Several variables were used to represent household assets. Time-saving assets that were considered include energy efficient stoves (which require less wood, and hence, less time spent gathering wood) and whether or not there was a well in the compound. Both of these assets were found to be insignificant and ultimately dropped from the model. Measures of assets that represent household wealth and potential access to resources by the women include the value of livestock holdings per adult equivalent, total household and individual land holdings, an index measuring agricultural equipment, and an index of vehicles per adult equivalent. The livestock variable includes non-traction cattle, goats, sheep and pigs. The average value of each animal per zone at the time of the survey was used to calculate total value. Total household land holdings were measured in hectares and divided by the number of adult equivalents. The estimated area (in ha) of women's fields was reported by the heads of households, and not explicitly measured. The agricultural equipment index is calculated based on the "completeness" of the full animal traction chain and its perceived contribution to productivity.[12] The vehicle variable is an index based on the relative cost of motorcycles, mopeds, bicycles and animal-drawn carts, divided by the number of adult equivalents in the household. There were no cars or trucks owned by households in the sample. These assets were found to be significant in models determining per capita household income from the same data set. The natural logs of husbands' expenditures were used to represent husbands' income, following the same assumptions cited above for mothers' expenditures. These values include cash expenditures only and do not include the value of production for home consumption or

[12] A full animal traction chain includes two oxen and one plow. This combination of assets is given a value of 1, and is weighted higher than having one ox and two plows or three oxen and no plow. The total value of the index is a summation of the weights of full and partial traction chains. The full list of weights can be found in the appendix.

expenditures on major assets. When cereal production and expenditures are factored into total expenditures, total "incomes" are much higher across all zones.

A variable to represent the intensity of effort and time with which the women labored in income-earning activities could not be found in the data. As a proxy for the potential time available to her for these activities, a variable was created to indicate the ratio of females aged 10 and 45 to other members of the household. Women within this age range often share the responsibility of household chores, including cooking, childcare and laundry. The greater the number of people for which each woman performs these duties, the less time she would have available for other activities. The numbers used in this calculation were adjusted to account for the amount of time (in months) that each member was present in the household.

Dummy variables were used to indicate if the mother lived in the Kolendieba, Macina, Niono, Bandiagara or Koro zones. Koutiala, which experiences the lowest mean income levels for women, was omitted; the impact of this zone is reflected in the constant term. The distance between the village and the nearest market is measured in kilometers. A dummy variable represents whether there is a school in the village.

4.1.2 Estimation Strategy

The dependent variable, mother's expenditures (*ME*), was hypothesized to be determined by vectors of explanatory variables, denoted by *V*, *W*, *X, Y* and *Z* and indexed by *j, k, l, m* and *n,* respectively. The basic model took the following form:

$$ME_i = \alpha + \sum_{j=1}^{J} \beta_{1j} V_{j,i} + \sum_{k=1}^{K} \beta_{2k} W_{k,i} + \sum_{l=1}^{L} \beta_{3l} X_{l,i} + \sum_{m=1}^{M} \beta_{4m} Y_{m,i} + \sum_{n=1}^{N} \beta_{5n} Z_{n,i} + \varepsilon_i \qquad (1)$$

where i denotes the observations for each mother included in the analysis
α is the constant term
V is a vector of human capital variables
W is a vector of social capital variables
X is a vector of physical capital variables
Y is a vector of labor variables
Z is a vector of community characteristics (enabling factors)
β_1 is a J × 1 vector of parameters associated with the human capital vector, V
β_2 is a K × 1 vector of parameters associated with the social capital vector, W
β_3 is an L × 1 vector of parameters associated with the physical capital vector, X
β_4 is an M × 1 vector of parameters associated with the labor vector, Y
β_5 is an N × 1 vector of parameters associated with the enabling factor vector, Z,
and ε_i is the error term.

To determine whether equation (1) can be estimated using ordinary least squares (OLS), the endogeneity of certain explanatory variables was tested. Endogenous variables are influenced by some of the same forces that influence the dependent variable being studied, resulting in correlation between the concerned variable and the error term. When explanatory variables are endogenous, OLS gives biased and inconsistent estimates of their causal effect on the dependent variable (Bound et al. 1995). By contrast, instrumental-variables estimation, such as two-stage least squares (2SLS), will yield parameter estimates that are both consistent and efficient.

Endogeneity of variables was determined using the Hausman-Wu instrumental variables (IV) test (following Smith and Haddad 2000). The test is performed in two steps. First, the potentially endogenous variable(s) is (are) regressed on the remaining variables (assumed to be exogenous) and the predictors, or "instruments," of the endogenous variable(s). These instruments should be correlated with the endogenous explanatory variable but have no direct association with the dependent variable (Bound et al. 1995).

To test the endogeneity of one of the physical capital variables, $X_{1,}$ in equation (1), given instruments $H_{11},\ldots, H_{1g}$, the following estimating equation is used:

$$X_{1,i} = \omega + \sum_{j=1}^{J} \delta_{1j} V_{j,i} + \sum_{k=1}^{K} \delta_{2k} W_{k,i} + \sum_{l=2}^{L} \delta_{3l} X_{l,i} + \sum_{m=1}^{M} \delta_{4m} Y_{m,i} + \sum_{n=1}^{N} \delta_{5n} Z_{n,i} + \sum_{g=1}^{G} \eta_g H_g + \psi_i \ . \quad (2)$$

In the second step of the test, the dependent variable, *ME*, is regressed on all explanatory variables plus the predicted residuals from equation (2), $\hat{\psi}_i$:

$$ME_i = \gamma + \sum_{j=1}^{J} \varphi_{1j} V_{j,i} + \sum_{k=1}^{K} \varphi_{2k} W_{k,i} + \sum_{l=1}^{L} \varphi_{3l} X_{l,i} + \sum_{m=1}^{M} \varphi_{4m} Y_{m,i} + \sum \varphi_{5n} Z_{n,1} + \varpi \hat{\psi}_i + \Omega_i \ . \quad (3)$$

The null hypothesis is that the explanatory variable is not endogenous. If the coefficient on the predicted residuals, ϖ, is statistically significant, the null hypothesis is rejected and OLS will not yield unbiased and consistent estimates.

However, before the Hausman-Wu test is performed, the credibility of the instruments must be tested (i.e., whether the instruments are proper substitutes for the potentially endogenous variables). This is accomplished using two tests: a "relevance test" and an "overidentification test."[13] The relevance test is an F-test on the joint significance of the instruments. If the F-statistic is significant, the instruments are considered to be relevant to the variable they attempt to explain. The overidentification test examines whether the instruments directly affect the dependent variable other than through the potentially endogenous variable they replace. It tests whether there is a correlation between the

[13] See Smith and Haddad (2000) for a thorough explanation of these tests.

instruments and the error term from the IV estimation. The test is performed in several steps. In the first step, the predicted residuals from the 2SLS regression of mothers' expenditures are calculated, as in equation (2). These predicted residuals are then regressed on the exogenous variables and the instruments:

$$\psi_i = \tau + \sum_{j=1}^{J} \phi_{1j} V_{j,i} + \sum_{k=1}^{K} \phi_{2k} W_{k,i} + \sum_{l=2}^{L} \phi_{3l} X_{l,i} + \sum_{m=1}^{M} \phi_{4m} Y_{m,i} + \sum_{n=1}^{N} \phi_{5n} Z_{n,i} + \sum_{g=1}^{G} \phi_{5g} H_g + \zeta_i \quad (4)$$

Next, the statistic $N \times R^2$, where N is equal to the number of observations, is calculated. $N \times R^2$ has a chi-squared (χ^2) distribution, with degrees of freedom equal to the number of instruments minus the number of potentially endogenous variables. Under the null hypothesis, the instruments are uncorrelated with the error term and the model is correctly specified. If the null is rejected, the model is overidentified by the instruments.

If a suitable instrument fails the Hausman-Wu test (i.e., the variable is endogenous to mothers' expenditures), 2SLS will be used to estimate the model in two stages. In the first stage, each of the explanatory endogenous variables is regressed on the entire set of exogenous variables (Pindyck and Rubinfeld 1998), as in equation (2). In the second stage, the dependent variable is regressed on its remaining exogenous variables and the predicted values of X_1:

$$ME_i = \alpha + \sum_{j=1}^{J} \vartheta_{1j} V_{j,i} + \sum_{k=1}^{K} \vartheta_{2k} W_{k,i} + \sum_{l=2}^{L} \vartheta_{3l} X_{l,i} + \sum_{m=1}^{M} \vartheta_{4m} Y_{m,i} + \sum_{n=1}^{N} \vartheta_{5n} Z_{n,i} + \theta \hat{X}_{1,i} + \upsilon_i . \quad (5)$$

The variables tested for potential endogeneity to mothers' expenditures include the husbands' expenditures, the equipment and vehicle indices and the value of household-

level livestock holdings. Husbands' expenditures are likely to be endogenous if some of the same household assets or production systems, for example, determine the expenditures of both the husbands and wives simultaneously. Since the household-level assets are controlled by men, there is less theoretical evidence to indicate endogeneity of these variables.

After selection of the estimation model, the model was tested for heteroskedasticity. Heteroskedasticity is found, most often with cross-sectional data, when the variance of the error terms is not equal across realizations. Heteroskedasticity is caused if (1) the variance of the dependent variable increases (or decreases) with an increase in the level of the dependent variable, (2) the variance of the dependent variable increases (or decreases) with a change in the levels of the explanatory variables, (3) there are outliers in the data, or (4) there is specification bias (e.g., missing variables or incorrect functional form). Pindyck and Rubinfeld (1998) expect to find heteroskedasticity in models that use expenditures as the dependent variable. They propose that low-income individuals are likely to spend at a rather steady rate, while the spending patterns of high-income variables are relatively more volatile. As a result, the variances associated with high-income families are likely to be greater than their low-income counterparts.

For heteroskedastic models estimated by OLS, parameter estimates remain unbiased and consistent, although not efficient. However, the variance estimates of OLS estimators are both biased and inconsistent, yielding biased t- and F-statistics, which cannot be used for hypothesis testing. To test for heteroskedasticity using the Breusch-Pagan test, we first estimate the model with least squares, assuming no heteroskedasticity. For simplicity, the

model in equation (5) will be presented with all the explanatory variables under one vector, $\boldsymbol{X}$:

$$ME_i = \alpha + \sum_{k=1}^{K} \delta_k X_{k,i} + \nu_i \tag{6}$$

We then compute the squared residuals, $\hat{\nu}_i^2$, and regress these on the explanatory variables thought to be responsible for causing the heteroskedasticity:

$$\hat{\nu}_i^2 = \gamma + \sum_{k=1}^{K} \rho_k X_{k,i} + u_i \tag{7}$$

The Breusch-Pagan test statistic, $B\hat{P}$, is constructed from the results of this auxiliary model:

$$B\hat{P} = N \times R^2 \sim asy\chi_k^2 \tag{8}$$

where the degrees of freedom, *k*, is equal to the number of restrictions in the auxiliary model.

The null hypothesis of constant variance in the error terms, or homoskedasticity, is rejected if the p-value associated with $B\hat{P}$ is less than 0.05 (5% significance level). If heteroskedasticity is accepted, the standard errors will be corrected using White's heteroskedastic-robust covariance matrix estimator. White's method obtains the corrected standard errors of each coefficient in equation (6) as follows:

$$\text{var}\left(\hat{\delta}_j\right) = \frac{\sum \hat{u}_{ji}^2 \hat{v}_i^2}{\left(\sum \hat{u}_{ji}^2\right)^2} \tag{9}$$

where $\hat{v}_i$ are the residuals obtained from the original regression (6) and $\hat{u}_i$ are the residuals obtained from the auxiliary regression (7) (Gujarati 2003).

Results of endogeneity and heteroskedastic tests

The Hausman-Wu test revealed that husbands' expenditures are endogenous to those of their wives at a significance level of 1%. Since the credibility tests performed on the instruments show them to be both relevant ($F = 27.41$) and not overidentified ($\chi^2 = 3.45$), two-stage least squares (2SLS), as discussed above and presented in equation (5), was chosen to estimate the model.[14] [15]

The age and education level of the head of the household were used as instruments to test for the endogeneity of the agricultural equipment index, the value of the household-level livestock holdings and the vehicle index. The instruments passed the relevance and overidentification tests for all three of the potentially exogenous variables. However, the explanatory power of the instruments was very weak ($R^2 \leq 0.01$). The data do not contain anything else that is an appropriate instrument. The Hausman-Wu statistics for the equipment index and the value of household-level livestock holdings were not significant at the 10% level. These variables are therefore assumed to be exogenous (the latter was found to be insignificant in determining mothers' expenditures and ultimately dropped

[14] The instruments used to predict husbands' expenditures can be found in the appendix.
[15] Variables that were exogenous to mothers' expenditures but endogenous to husbands' expenditures were excluded from the first-stage of the 2SLS estimation.

from the model). The vehicle index was found to be endogenous, but was sensitive to the choice of instruments. Since it is unlikely that a woman's income influences the purchase of these assets, and the relationship between the instruments and the vehicle index is weak (R-squared < 0.01), the non-instrumented estimates are presented in the analysis.[16] An alternate 2SLS estimation with the vehicle index excluded can be found in the appendix.

The Breusch-Pagan test statistic was significant at the 1% level. We therefore reject the null hypothesis that standard errors are constant across the sample. Heteroskedasticity was corrected using White's heteroskedastic-robust covariance matrix estimator.

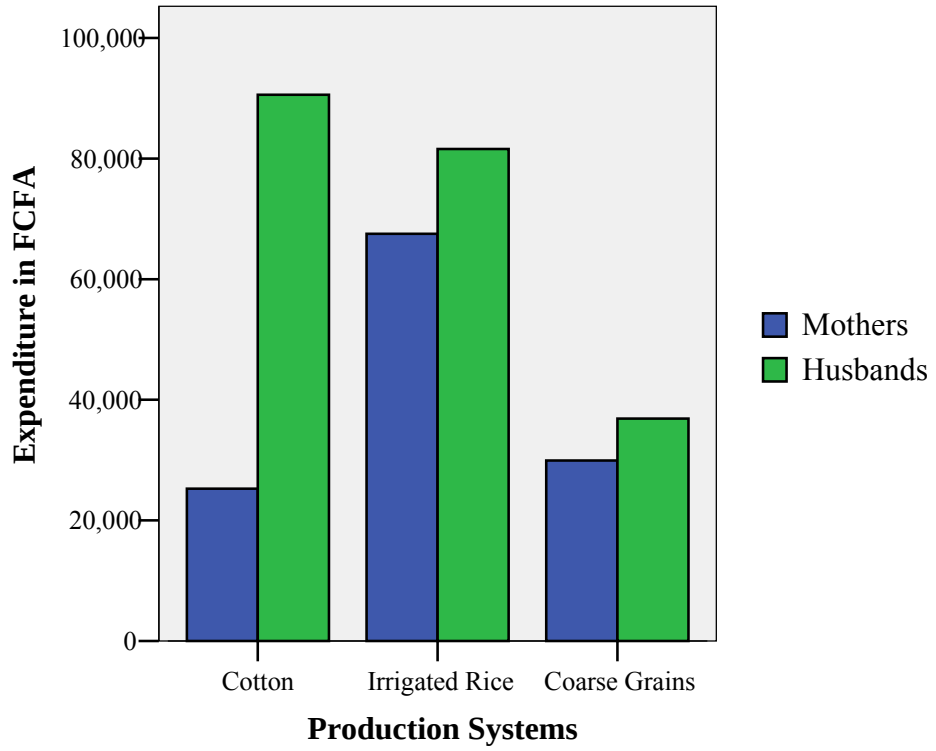
4.1.3 Empirical Results

Descriptive Analysis of Mothers' and their Husbands' Expenditures

Figure 2 shows average expenditures for mothers and their husbands in the three agricultural production regions included in the study. Mothers in the irrigated rice-growing region of the *Office du Niger* have the highest average expenditures, followed by mothers in the millet zone and, finally, the cotton-growing zone. Within the rice-growing region, Niono, with better infrastructure and off-season production, has higher average expenditures than Macina. Mothers in the Bandiagara zone of the millet/sorghum region have higher average expenditures than those in Koro, which is to be expected due to Bandiagara's better access to markets and water retention structures for gardening. In the cotton region, Kolendieba exhibits higher average expenditures, despite having less experienced producers and less animal traction equipment than Koutiala.

[16] According to Bound et al. (1995), the use of instruments that jointly explain little of the variation in the endogenous variable can do more harm than good. If this weak relationship does exist, then even a small correlation between the potential instruments and the error can seriously bias estimates.

Figure 2: Mothers' and their husbands' average annual expenditure by production system



Source: Calculated from the data
a Only positive expenditures are calculated in averages
b 1 US$=560 FCFA

Amongst husbands, the cotton-growing region exhibits the highest average expenditures, followed by the irrigated rice zone and those producing mainly coarse grains (Figure 2). As expected, fathers' average expenditures exceed those of the mothers in every region. Koutiala, which exhibits the lowest average expenditures of all the zones for the mothers, has the highest average expenditures for the fathers, reflecting perhaps a very hierarchical household structure where men control most income and expenditure decisions and women have few opportunities to earn their own money. This large difference in expenditures is also driven, in part, by the large number of husbands in the Sikasso region who have multiple wives. Husbands with several wives are expected to cover the

expenditures for which he is responsible (e.g., school fees, modern health care, taxes, clothes for holidays) for all his wives and their children. Conversely, a mother is only responsible for expenditures relating to herself and her own children. Table 2 gives the percentage of husbands in each region who are in polygamous relationships.

Analysis of the expenditures did reveal differences in the items purchased by men and women. However, the frequency and relative value of expenditures for different items do not appear to differ substantially between regions for either sex. This implies that the levels of expenditures for men and women in the Sikasso region are not simply a result of greater financial responsibilities for men in Sikasso relative to men in the other regions.

An analysis of the summary statistics reveals other differences between regions (see Table 3). Both women and men in the Segou region have significantly more education than their counterparts in Sikasso and Mopti, although the average level of formal education is less than one year for both genders across all regions.[17] Significantly fewer women are married to the head of the household in Mopti than in Sikasso or Segou (39%

Table 2: Number of wives per husband by region

	Number of wives per husband						
Region	1	2	3	4	% monog.	% polyg.	Total
Sikasso	152	130	15	8	49.8%	50.2%	305
Segou	202	73	10	2	70.4%	29.6%	287
Mopti	126	70	16	0	59.6%	40.4%	126
Total	480	273	41	10	59.7%	34%	804

Source: Calculated from data.

[17] A t-test for equality of means is used to test for significance.

Table 3: Summary statistics for key characteristics by region

	All	Sikasso	Segou	Mopti
Variables	Mean (Std. dev)	Mean (Std. dev)	Mean (Std. dev)	Mean (Std. dev)
Mother's expenditures (in FCFA)	**40,771**	**25,265**	**67,528**	**29,924**
	(47,532)	(23,324)	(59,747)	(42,257)
Human Capital				
Years of formal education of mother	0.23	0.13	0.44	0.10
	(1.07)	(0.67)	(1.58)	(0.61)
Years of formal education of husband	0.66	0.61	0.89	0.44
	(1.86)	(1.84)	(2.10)	(1.52)
Social Capital				
Age	29.6	28.7	29.8	30.9
	(7.7)	(7.8)	(7.3)	(7.8)
Husband is head of household	0.44	0.46	0.47	0.37
	(0.50)	(0.50)	(0.50)	(0.48)
Number of village-level associations	3.0	2.3	2.9	4.0
	(2.1)	(1.4)	(1.0)	(3.1)
Physical Capital and Financial Resources				
Agricultural Equipment index	0.18	0.22	0.19	0.11
	(0.13)	(0.14)	(0.12)	(0.09)
Vehicle Index	0.22	0.26	0.22	0.17
	(0.21)	(.18)	(0.26)	(0.17)
Husband's expenditures (in FCFA)	79,094	97,787	88,299	39,276
	(103,153)	(121,041)	(105,682)	(42,315)
Labor				
Ratio of females aged 10-45 to other household members	0.39 (.152)	0.41 (0.15)	.38 (0.17)	0.38 (0.13)
Enabling Environment				
Distance to market in kilometers	8.74	7.23	8.42	11.40
	(8.27)	(3.97)	(12.07)	(6.22)
School = 1	0.66	0.82	0.74	0.31
	(0.47)	(0.38)	(0.44)	(0.47)

Source :Calculated from survey data

compared to 46% and 47%, respectively).[18] The average number of village-level associations is highest in Mopti, while the average agricultural and vehicle indices are highest in Sikasso.

[18] The numbers of women married to the head of the household in the full sample (n= 1615) for Sikasso, Segou and Mopti are 35%, 40% and 24%, respectively.

Multivariate Analysis

Figure 2 shows that women in the irrigated rice-growing region of the *Office du Niger* have the highest average expenditures, followed by mothers in the millet/sorghum system and cotton region, respectively. However, these averages do not reveal information concerning the variables believed to influence incomes. A 2SLS regression (with fathers' expenditures instrumented) was thus carried out to isolate the independent effect of each variable, holding all others constant. Table 4 presents the results.

Eleven of the variables thought to be significant in determining mothers' income in Mali were indeed significant at the 1, 5 or 10 percent level. Variables that were removed from the model because they were insignificant include position of the mother within the family (i.e., wife order), whether her marriage was polygamous, ethnicity dummy variables, the value (in FCFA) of household livestock, total per-capita land holdings, area of mothers' fields and the presence of wells and energy-efficient stoves in the household compound. Seven variables with significance levels greater than 10% were retained in the model, including mothers' and their husbands' level of formal education, the number of village associations, husbands' expenditures, "distance to market" and the location variables for Kolendieba and Bandiagara. The location variables were retained to show how each zone compares to a single constant, the Koutiala zone. Number of associations was retained because it just surpassed the 10% significance level and was significant in other versions of the model. The other four variables were retained because there is a strong underlying theoretical reason to keep them there, despite their significance level. Distance to market becomes significant in the next model, and is therefore also kept in this model for comparison reasons.

Table 4: Determinants of mothers' income in Rural Mali: 2SLS regression results
Dependent variable = (natural log of mothers' expenditures)

Explanatory variables	Coef.	t-test	Sig.
Human Capital			
Years of formal education of mother	.018	0.43	
Years of formal education of husband	.019	1.03	
Social Capital			
Age	.026	5.74	***
Husband is head of household	.191	1.78	*
Number of village-level associations	.036	1.60	
Physical Capital and Financial Resources			
Agricultural equipment index	-1.008	-2.31	**
Ag. Equipment index * Segou Region	.943	1.71	*
Vehicle index per adult equivalent	.780	4.45	***
Natural log of husband's expenditures (instrumented)	.178	1.34	
Labor			
Ratio of females aged 10-45 to other household members	.352	1.76	*
Enabling Environment			
Distance to market in kilometers	-.006	-1.27	
School = 1	.434	3.96	***
Kolendieba = 1	.199	1.32	
Macina = 1	.881	4.10	***
Niono = 1	1.097	5.35	***
Bandiagara = 1	.374	1.42	
Koro = 1	.483	1.96	**
Constant Term	6.239	4.37	***
Prob > F	0.00		
R-squared	.3010		

Source: Estimated from survey data
Notes: The number of observations is 984.
* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level

The education level of both the mothers and their husbands were found to be insignificant in the model. However, this may be explained by the small variation across observations, and the failure of a formal education variable to capture knowledge obtained through informal education and experience. Over 94% of the women included in the study have no formal education, compared to 84% of their husbands. In Mali today, only 32% of girls complete primary education (MCC 2006), and the majority of these are situated in

the capital and other urban centers. Of the women and men who have some formal education, 53% and 45% of them, respectively, are found in the Segou region, where mothers' average expenditures are the highest.

There is a positive and significant relationship between mothers' age and expenditures. As a woman gets older, household duties are passed to younger wives and/or other female members of the household. As a result, the woman has more time to devote to income-generating activities. However, this effect may be minimized somewhat by the fact that all the women in the sample have children under the age of five years.

Women appear to benefit from being married to the head of the household, holding all else constant. Women married to heads may have better access to household-level assets, such as land for private fields, equipment to plow these fields or cows to milk. Additionally, the status afforded to the head's wife may limit the time she spends on household chores relative to the wives of dependent males.

There is a positive but marginally insignificant relationship between the number of associations in the village and women's expenditures. While other studies have shown women to benefit from participation in a cooperative (see Saito, 1994), it is likely that the variable did not capture this relationship adequately. Our data do not specify whether the women in our sample directly participated in these associations or benefited indirectly.

Both time-saving asset variables – having a well and/or an energy inefficient stove in the compound – were found to be insignificant to mothers' income. The insignificance of these variables could be explained if, as Wooten (2003) notes, unmarried girls are

primarily responsible for household tasks, such as gathering water and firewood and child care. In the poorer households, the cheapest labor-saving device for a mother may be a young girl. Thus, in proposing labor-saving devices, their cost needs to be evaluated relative to the (low) financial cost of the alternative technology – using someone else's labor.

Assets found to have a significant influence on mothers' expenditures include a higher vehicle index and the agricultural equipment index. Having transportation options in the household is positively correlated, and could be used to drive to markets and towns to buy inputs or sell products.[19] The effect of agricultural equipment is not uniform across regions. A higher agricultural equipment index exhibits a negative relationship to mothers' expenditures for the Sikasso region and a positive relationship for women in Segou. The coefficient for Mopti, which has the lowest levels of equipment, is not significant. In Sikasso, the possession of more equipment could indicate that more hectares of cotton are planted, resulting in higher demand on women's time for unpaid labor to assist with the harvest and weeding. This result contradicts the findings of Lilja et al (1996), which state that the introduction of agricultural technologies in Sikasso increased women's wages for agricultural labor on communal lands and reduced inequality between men and women. Conversely, the effect of agricultural equipment on women's income is positive in the Segou region. Here, access to this equipment may provide women with better field maintenance and water control on lands planted to horticultural crops in the dry season. Additionally, it is plausible to expect that the

[19] As noted earlier, the exogeneity of this variable is questionable, so causality should be interpreted with caution.

equipment index variable is correlated with better access to controlled irrigation. If so, this variable may be picking up some of the effects of better water control.[20]

The value of livestock holdings per adult equivalent was found to be insignificant in determining mothers' expenditures, despite being significant to total household income/capita. This is telling of women's access to these assets, controlled by the men in the household, and specifically, the head of the household. A more precise instrument would be to isolate female possession of small ruminants and chickens, which are more fluid than cattle and oxen in their ownership, and may fall under the control of women. Both total household land holdings (per capita) and the estimated areas of women's personal fields (in ha) were insignificant in the analysis. In Lilja (1996), the latter was found to be significant and negative in determining the daily female wage rate on communal fields, as the granting of these personal fields by the head of household is considered part of the compensation for communal work.[21] In the same study, women's earnings on private fields were sixteen times higher than mean incomes from the communal fields, and represented the single greatest source of income for five of the six regions under study.

The level of the husband's expenditures has an insignificant effect on the expenditures of his wives. This lends support to the hypothesis that women and men in Mali have separate economies. As demonstrated in Figure 1, the expenditures of women in the cotton zone are relatively low, despite high levels of expenditures on the part of their

[20] The data do not allow for us to control for the effect of irrigation directly.
[21] Women are granted temporary use right to these fields from the head of the household. As stated by Lilja (1996), "the implicit rent for the private field is paid in terms of the 'obligatory' production of vegetables for the household consumption." This obligation reduces the women's ability to produce more profitable crops for the market.

husbands. This would indicate that programs that aim only to improve men's incomes (such as credit for the purchase of agricultural equipment) do not have a complimentary effect on women's incomes. This is not to say, however, that women do not benefit at all from being married to a high earner: women may still benefit from their husband's expenditures on food, medicine, etc. (although the high levels of child malnutrition in the cotton zone indicate that higher men's earnings do not increase the welfare of other household members).

As hypothesized, the number of females aged 10 to 45 relative to other members of the household has a positive and significant effect on the women's income. Women in this age range tend to share the responsibility for household chores, such as cooking, cleaning and childcare. A higher female to "other" ratio would thus indicate less work per female and more time available to devote to activities outside the home. This variable is likely associated with age, since the older women would be relieved from chores before younger girls.

The effect of having a school in the community is positive and significant. This does not reflect better education for the mothers, since this was controlled for in the model. Rather, the presence of the school could indicate a greater amount of investment in the community by its members, the government, and/or non-governmental agencies. A school will also reduce the amount of time that women are taking care of young children during the school year, although this effect is likely dampened for the women in our sample who all have children under the age of five years. Finally, schools may present a market for women selling snacks and drinks to students.

Distance to market is negatively correlated as we would expect, although the significance falls just above the 10% level. This may indicate that women's income-earning activities are contained within the village in which she lives, such as petty commerce in agricultural products. By comparison, distance to the market is significant for both the women's husbands and total household income/capita, suggesting that men rely more on the larger market system for their income. It can also be interpreted to mean that remoteness alone is not adequate to discourage agricultural and non-farm activities and that overall regional infrastructure, discussed above, is more important (Canagarajah et al. 2001).

The zone dummies account for regional differences not controlled for elsewhere in the model. The coefficients represent the marginal benefit of living in each of the zones relative to living in Koutiala, which is situated in the cotton-growing region and experiences the lowest average women's expenditures. As expected, living in the irrigated rice-growing region has the highest marginal effect on income relative to the base, holding other variables constant. Within this region, Niono had a higher coefficient compared to Macina. Surprisingly, these zones were followed by Kolendieba in the cotton-growing region and Koro in the coarse grains region. Bandiagara was not significantly different than the base. This indicates that the factors driving expenditures in the Mopti region above those in the Sikasso region were captured in the model. Other factors captured in the location dummies could be overall regional infrastructure, ethnicity, cultural norms that dictate women's place in the work arena, distance to the capital city and production capacity of the land.

As discussed at the end of Chapter 2, the sample of women retained for our analysis was more likely to be married to the head of the household than the women who were dropped. Since women married to the household head have higher expenditures than those married to dependent males, holding all else equal, it is likely that the average expenditures depicted in Figure 2 are higher than those found in the true population. Similarly, the average expenditures of the husbands are likely inflated due to the over-representation of heads of households.

4.2 Model 2: Profiles of women earning income

To exploit available information on the income-earning activities of women in our sample, a second model was estimated which added activity dummy variables to the 17 variables used in the previous model. Inclusion of these variables helps to identify further the characteristics of women with varying levels of expenditures. As participation in different activities is often conditional on the women's income and access to resources, we cannot establish a causal path from activity to income (i.e., participation in the activities are not "determinants" of income). However, women participating in activities associated with lower incomes are likely facing resource constraints and barriers to entry of higher-return activities. It is expected that these outcomes will be region-specific. The data do not allow us to perform capital budgets to determine the average return on investment associated with each activity.

4.2.1 Additional Explanatory Variables Employed

Dummy variables were used to indicate the mothers' participation in various income-generating endeavors. Eight different activities were identified from the data: non-farm, agricultural labor and gardening, sales of cereals, rice or "other" agricultural products, animal sales, animal product sales and collection and sale of wild products. Two sources of information, drawn from two different questionnaires, were used to determine the woman's participation in each activity.[22] In the first, the woman was asked to report any income that she earned since the last interview date (bi-monthly), and to name the activity by which she earned it. In the second, the woman was asked to give the source of money for each expenditure made during the interview period. For each of the income activities listed above, the woman was given a value of one if she identified the activity in either of the questionnaires. Unfortunately, the data do not allow one to capture the intensity with which she was involved in the activity or the amount of resources which were invested. The percentage of women participating in each activity by region is presented in Table 5.

The non-farm variable is the broadest in scope, since the expenditure questionnaire does not allow for further disaggregation. The large majority of non-farm activities identified in the income questionnaire involve some form of petty commerce – including the purchase and re-sale of agricultural products – followed by crafts. Very few women were involved in high-input or skilled trades.

[22] Since the interviews were carried out periodically throughout the year, seasonality in expenditures is captured.

Table 5: Number of women participating in income-generating activities by region

Region	Total Women	Activities							
		Non-farm	Agricult. Labor	Animal Sales	Animal Prod. Sales	Cereal Sales	Rice Sales	Other Ag Sales	Wild Product Sales
Sikasso	392	318 (81.1%)	97 (24.7%)	79 (20.2%)	13 (3.3%)	244 (62.2%)	103 (26.3%)	283 (72.2%)	89 (22.7%)
Ségou	333	273 (82.0%)	75 (22.5%)	61 (18.3%)	26 (7.8%)	149 (44.7%)	184 (55.3%)	264 (79.3%)	13 (3.9%)
Mopti	261	198 (75.9)	1 (0.4%)	107 (41.0%)	41 (15.7%)	164 (62.8%)	33 (12.6%)	204 (78.2%)	40 (15.3%)
Total	986	789	173	247	80	557	320	751	142

Values in parentheses represent the percentage of women in the region engaged in each activity.
Source: Calculated from data.

Agricultural activities, such as transplanting and weeding rice fields, are distinctly identified from the sale of own-production agricultural goods. The latter include the sale of rainfed cereals, rice and "other" agricultural products. Rainfed cereal sales include millet, sorghum, maize and fonio and exclude rice. "Other" agricultural products include high-value horticultural crops such as tomatoes, cucumbers, onions and melons, as well as pulses (including groundnuts), sesame, leaves and legume hay. Horticultural products are most prevalent in the irrigated-rice region of Segou, while pulses dominate in Mopti and Sikasso.

Wild products include the sale of all products that are collected rather than produced or purchased. Examples include *karité* (shea nut butter), *soumbala* (a spice made from the African locust tree and used in sauces) charcoal, fuelwood, baobab leaves and honey (Sundberg, 1989). The collection of most of these products is from common pool resources: permission to harvest is given by the chief of the village. Shea nuts are the exception. For those trees found in the fields and fallow lands of particular families, permission to harvest is given by the head of the household (Becker 2000). Most wild products include some form of processing to add value. Shea nut butter is the most transformation-intensive and the most profitable.

To examine the different income effects of each activity by region, interaction variables were created by multiplying the regional and activity dummy variables. Those found to be significant were retained in the model. It is expected that the diversity (i.e., number) of activities in which the mother participates will be reflected in her earnings. While in some cases, participation in only one activity may signal specialization and a high level

of intensity, it is more likely that these women lack the time and/or opportunity to engage in multiple activities. On the other extreme, women who spread themselves too thin cannot devote significant time or resources to any one of the activities. It is therefore hypothesized that women who engage in a middle-range number of activities will have the highest incomes. Categorical variables were created to represent the number of activities. Participation in one activity is omitted from the model; its effects will be picked up by the constant. Women participating in two to four and five to eight different activities were each represented by a dummy, respectively.[23] Table 6 shows the number of activities in which women participated by region.

Table 6: Number of activities per mother by region

	Number of different activities per mother								
Region	1	2	3	4	5	6	7	8	Total
Sikasso	41	123	69	83	62	10	4	0	392
Ségou	23	77	125	65	35	3	3	2	333
Mopti	37	61	89	45	24	4	1	0	261
Total	101	261	283	193	121	17	8	2	986

Source: Calculated from data.

4.2.2 Estimation Strategy

Model 2 is estimated with two-stage least squares (2SLS), in similar fashion to the first model, but with an additional vector of variables representing participation in income-generating activities. In the first stage, the natural log of fathers' expenditures is predicted using a set of instruments, denoted by $H_{11},\ldots H_{1g}$, and the exogenous variables determining mothers' expenditures:

[23] The number of activities could not simply be represented by a continuous variable because of the issue of multicollinearity between the number of activities and the dummy variables for the individual activities.

$$\hat{X}_{1,i} = \varsigma + \sum_{j=1}^{J} \lambda_{1j} V_{j,i} + \sum_{k=1}^{K} \lambda_{2k} W_{k,i} + \sum_{l=2}^{L} \lambda_{3l} X_{l,i} + \sum_{m=1}^{M} \lambda_{4m} Y_{m,i} + \sum_{n=1}^{N} \lambda_{5n} Z_{n,i} +$$

$$\sum_{f=1}^{F} \lambda_{6f} A_{f,i} + \sum_{g=1}^{G} \lambda_{7g} H_{g,i} + \mathrm{E}_i \qquad (9)$$

where A is a vector of income-generating activities, and λ_6 is an F × 1 vector of parameters associated with these activities. In the second stage, the estimated value of the dependent variable from equation (9), $\hat{X}_{1,i}$, is added as a regressor in the model for mothers' expenditures:

$$ME_i = \eta + \sum_{j=1}^{J} \rho_{1j} V_{j,i} + \sum_{k=1}^{K} \rho_{2k} W_{k,i} + \sum_{l=2}^{L} \rho_{3l} X_{l,i} + \sum_{m=1}^{M} \rho_{4m} Y_{m,i} + \sum_{n=1}^{N} \rho_{5n} Z_{n,i} +$$

$$\sum_{f=1}^{F} \rho_{6f} A_{f,i} + \lambda \hat{X}_{1,i} + \upsilon_i \qquad (10)$$

As with the previous model, this model was found to be heteroskedastic with a p-val < 0.0005, and was corrected using White's heteroskedastic-robust covariance matrix estimator.

4.2.3 Empirical Results

The significance of a few of the variables in the first model changed with the addition of the activity dummy variables (Table 7). The significant negative relationship between mothers' expenditures and distance to market indicates that for women involved in the different activities, those closer to the market tend to have higher expenditure levels. Being married to the head of the household loses its significance. This may indicate that being married to the household head provides a woman the means to participate in

Table 7: Determinants of mothers' income in Rural Mali: 2SLS regression results

Explanatory variables	Coef.	t-test	Sig.
Human Capital			
Years of formal education of mother	.024	0.68	
Years of formal education of husband	.007	0.48	
Social Capital			
Age	.017	4.25	***
Husband is head of household	.123	1.38	
Number of village-level associations	.031	1.50	
Physical Capital and Financial Resources			
Agricultural equipment index	-.716	-1.99	**
Ag. Equipment index * Segou Region	.809	1.67	*
Vehicle index per adult equivalent	.624	3.86	***
Natural log of husband's expenditures (instrumented)	.227	2.12	**
Labor			
Ratio of females aged 10-45 to other household members	.452	2.60	***
Enabling Environment			
Distance to market in kilometers	-.009	-1.70	*
School = 1	.408	4.18	***
Kolendieba = 1	.534	3.65	***
Macina = 1	1.266	4.82	***
Niono = 1	.982	3.88	***
Bandiagara = 1	.325	1.44	
Koro = 1	.675	3.23	***
Income-generating activities			
Participation in:			
Non-farm activities	.196	1.78	*
Non-farm activities * Ségou Region	.286	1.73	*
Agricultural labor	-.203	-2.44	**
Animal sales	.468	6.75	***
Animal product sales	.373	2.43	**
Cereal sales (excl. rice)	.151	1.50	
Cereal sales * Segou Region	-.614	-4.20	***
Rice sales	.357	3.47	***
Rice sales * Sikasso Region	-.599	-4.30	***
Other agricultural sales (incl. horticultural crops and pulses)	.310	3.17	***
Sale of wild products	.620	5.83	***
Sale of wild products * Ségou Region	-.605	-3.31	***
Participation in two to four distinct activities	.668	4.01	***
Participation in four to eight distinct activities	.930	4.46	***
Constant Term	4.508	3.88	***
Prob > F	0.00		
R-squared	.5166		

Source: Estimated from survey data

Notes: The dependent variable is natural log of mother's expenditures. The number of observations is 984. *, **, *** indicate significance at the 10, 5 and 1 percent level, respectively.

different activities (e.g., access to household livestock). After these activities are accounted for, being married to the head does not add to a woman's expenditures. The natural log of the husband's expenditures gains significance in the second model. This is harder to explain, and could be due to problems with the instrumental variable. Finally, the Kolendieba zone becomes significantly different from the constant, Koutiala. Kolendieba and Koutiala are both found in the cotton region. The insignificant difference between the two zones in the previous model is likely a result of the women having access to similar income-generating activities. The significant difference in this model indicates that there is something else going on between the two zones that is not accounted for. Once activities are controlled for, Bandiagara is not significantly different than the constant.

The activity dummy variables provide information on the relationship between participating in a certain activity and the mothers' income levels. Seven of the eight activities had a significant relationship with income across the three regions. Cereal sales were insignificant for Sikasso and Mopti, but significant for the Segou region.

Of the significant activities, earning income through agricultural labor was associated with lower incomes. This was surprising, particularly for women in the rice-growing region of Segou, who report significant earnings from transplanting rice (See Box 1). Since many women engaged in this particular activity are paid in-kind with rice, which they in turn sell, it is possible that the benefits are captured in the "sale of rice" variable (discussed below). The negative coefficient for the Sikasso region could indicate that women who resort to working on others' fields do not have opportunities to produce their

own crops or engage in other income-generating activities. Only one woman in the Mopti region participated in this activity, so it is not possible to gauge its impact on incomes.

Of the agricultural products produced by, or given to, the women, the sale of cereals – including sorghum, millet, maize and fonio – had the smallest marginal impact on incomes. The coefficient was positive but marginally insignificant for women in the Sikasso and Mopti regions, where more profitable opportunities are limited. Conversely, the coefficient is negative and significant for women in Segou. This implies that in this region, there is an opportunity cost of selling traditional grains instead of engaging in more profitable activities, such as rice and horticultural crop production. Women who sell cereals, therefore, likely lack access to these other opportunities (e.g. land, irrigation, inputs).

The effect of the sale of rice is positive and greater than that for cereals in Segou and Mopti, and negative for women in Sikasso. The large difference in coefficients can be due to several factors. First, the technologies for growing rice differ greatly between the regions. Segou is the main rice-growing region in the country and is dependent on irrigation schemes. Yields of greater than six tons per hectare are common in this region, compared to an average yield of 1.54 tons per ha for the country (FAOSTAT, 2004). In Sikasso, rice is predominantly rain-fed and grown by women. Unlike Segou, where rice is grown for the market, women in Sikasso do not typically sell their crop (Kelly). Women who are selling in this region may do so because they are in an economic or food crisis.

The sale of "other" agricultural crops is positive for women in all regions, with a coefficient of 0.310. However, the data do not allow for further disaggregation into

Box 1. Women's Role in Agricultural Production in the Office du Niger

Women play an important role in agricultural production in the Office du Niger. Women's participation in rice production is typically limited to the transplanting and harvesting of rice in fields controlled by men, although examples do exist of female-headed rice parcels (both individual and cooperatives). Women have been credited for the widespread adoption of transplanting techniques in the ON, which were responsible for significant gains in yields in the late eighties and early nineties. Women are preferred more often than men for this task because they reportedly produce work of higher quality (Bélières et al., 2003). Since 1992, the formation of women's "working groups" specifically for transplanting and harvesting have become common. In 2000, these groups were responsible for completion of these tasks on 69% of the fields on rehabilitated land (Bélières et al., 2003). Women are compensated with cash and/or payment in kind. While women are usually paid for work completed on their familial lands, it is reported that women are working less frequently on lands controlled by their head of household (Osté, 2001).

It is common for women to invest the money earned during the rainy season rice campaign in horticultural production (Kelly, personal comm.). Typically, women produce horticultural crops in the off-season on land controlled by male members of their families. It is estimated that 10 to 20% of the land is used in the dry season for gardening (Bélières et al., 2003; Aw and Diemer, 2004). Use of this land is provided freely, although women are required to pay the water fee out of their profits.

Osté (2001) cites several examples of group gardens cultivated by women's associations. The first market gardening perimeter specifically for women was installed in Macina in 1984. Group gardens can now sporadically be found in districts throughout the Office. According to Osté (2002), women's gardening plots produced an annual gross revenue of 420 000 FCFA (640 euros). The level of revenues realized by women depends on the availability of land, the differing levels of investments, and degree of processing. The cultivation of onions (shallots) is often the most practical due to their low perishability. In the ON, the cultivation of onions was found to be more than twice as profitable as the cultivation of rice (Osté, 2001). Total revenues from gardening in the Office du Niger in 1999 are estimated at 18.3 million euros (Chohin-Kuper et al., 2002).

different categories of crops. It is likely, therefore, that the coefficient masks significant differences between high-value crops, such as horticultural crops and groundnuts, and lower-value crops, such as leaves and hay. With irrigation and stronger market linkages, Segou produces more horticultural crops than the other regions. It is possible that the differences in crop production are being captured by the location dummies.

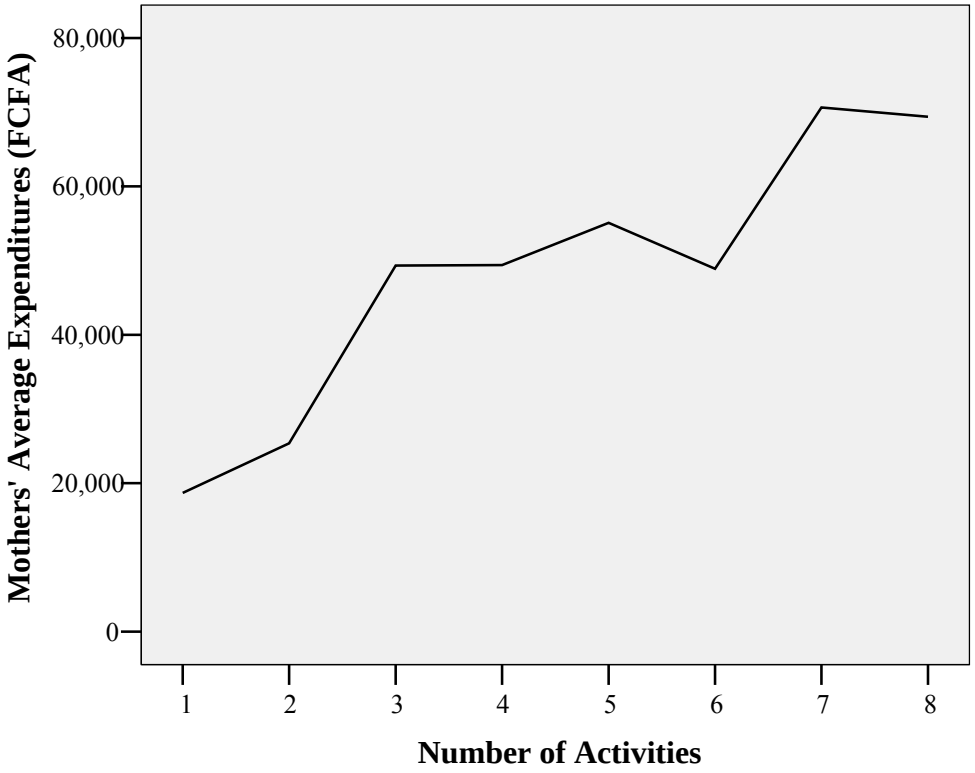
Eighty percent of the women in the sample earned income through non-farm sources. For women in Sikasso and Mopti, the activity yielded a coefficient of .196 – which lies within the range of coefficients associated with the sale of agricultural crops. For women in Segou, however, the coefficient increases to .482. Unfortunately, the variable does not distinguish between different types of non-farm activities. Therefore, it is unclear whether this difference is driven by a different set of activities in the regions or results from a more active and dynamic market system in Segou. The higher average incomes in Segou relative to Mopti and Sikasso could allow women there to invest more resources in higher-return activities. In addition, the more dynamic economy in the Office du Niger may increase the demand for non-agricultural products, making those activities more profitable for women.

Women who sold animal products, including milk, eggs, butter and skins, saw a positive marginal benefit of participating in the activity. Over half of these women reside in the Mopti region. The coefficient on this variable (.373) was greater than those for the agricultural and non-farm activities. However, the relatively few women who reported income from this source (3.3% for Sikasso, 7.8% for Segou and 15.7% for Mopti) indicate that access to animal products is limited. This observation is corroborated by the insignificance of total household livestock assets on women's income. Conversely, women who sell animals (poultry and small ruminants) under their own control see the log of their expenditures increase by .468, holding all other variables constant. Twenty-five percent of women across the sample sold at least one animal during the survey period, with the highest percentage of women coming from the Mopti region (41%).

Finally, there is the large marginal benefit of participating in the collection and sale of wild products for women in Sikasso and Mopti. For women involved in shea butter production in Sikasso, this outcome is consistent with other studies that place shea among the most profitable activities for rural women in Mali (Sundberg 1989; DeGroote and Coulibaly 1998). However, for women in Mopti, where shea nut trees are not found, this result is more surprising. Here, women engaging in this activity are largely restricted to low-input, low-return products, such as fuelwood and baobab leaves. Collection and sale of these products may represent one of the few income-opportunities for these women. Conversely, women from Segou – with more attractive activities – do not significantly gain from the sale of wild products. Shea is also less present in this region than in the south.

It was hypothesized that women who practice some diversification of income-generating activities would have a higher marginal benefit than women who participate in either one or many activities. However, our data show that more is better (Figure 3). Women who participated in five to eight different types of activities had higher average expenditures than women engaged in one to four types of activities. This result holds up to multivariate analysis (Table 8). However, it should be noted that only 15% of women fall into the latter category, and looking at the averages masks the variation within the categories. Amongst women in the top decile of expenditures, only two participate in six or more types of activities.

Figure 3. Mothers' average expenditures by degree of income diversification



Source: Calculated from data
1 US$ = 560 FCFA

5. DISCUSSION AND CONCLUSIONS

Several of the results presented above merit further discussion. First is the large (and significant) discrepancy between female and male income, particularly in the cotton zone (Figure 1). Here, average husbands' expenditures are nearly four times the value of their wives'. This gap decreases when the heads of households are removed, although dependent males still earn, on average, more than three times their wives do. This indicates that agricultural growth and higher household incomes do not automatically lead to gender equity or better welfare for women and children.[24] Conversely, production systems that depend on cheap family labor may lead to greater intra-household inequities.

Women in the cotton zone also fare worse than their female counterparts in the irrigated rice and millet/sorghum regions. This raises questions about family structure, access to resources and opportunities to work off of communal lands in the different regions. A fundamental issue is whether the production of cotton is dependent on a large family structure and high levels of non- (or low-) compensated family labor. Indeed, a study of "Cotton and Gender Politics in Cote d'Ivoire" revealed that "male household heads now find it necessary to contest women's [activities].....in their attempt to control their wives' labor" (Bassett 2002). Social mechanisms employed by the heads of households to restrict women's own-activities included limiting the number of days per week that women could work on their own enterprises and giving women the right to consume food grown in the household fields only on days that they worked in them.[25] In the cotton-

[24] This is based on studies, including one performed with these data, that indicate a positive and significant correlation between mother's income/expenditures and the nutritional status of children under 5 years. See Tefft and Kelly (2004).
[25] These mechanisms were not uniform across ethnic groups.

growing region of Mali, there is pressure for institutional change in family structure even among dependent males, who want to break the traditional control over productive assets and labor by the head of the household (Lilja 1996).

The government of Mali continues to promote cotton expansion as a means to reduce poverty. Clearly, if this strategy is to continue, complementary interventions are needed to counteract the negative impact on women's incomes.

Lilja (1996) found that a woman's perception of her right to refuse work on the communal fields had a significant and positive impact on her daily wage rate on those fields. However, only 15 percent on the women interviewed perceived having this right. Conversely, women in the *Office du Niger* region of Segou, where average women's expenditures are highest, are working less frequently on lands controlled by their head of household, due to higher compensation in others' fields and/or off-farm (Oste 2001).

In lieu of working on household lands in the rice zone, many women have formed "working groups" for transplanting and harvesting the rice. In 2000, these groups were responsible for completion of these tasks on 69% of the fields on rehabilitated land (Bélières et al. 2003). Using the terminology of Bassett (2002) and the notion of "scalar politics," participation in these working groups allows women to "jump" the scale of the household to secure their own income. "Jumping scales," as defined by Bassett, "is a sociospatial process in which a group seeks to transcend the routinized constraints of a specific scale (e.g., the household) by engaging in activities at a different scale (e.g., the village) to realize its objectives" (p. 353). Women who work in these groups may be less dependent on assets controlled by the household head, who may have motives to

undermine women's independent initiatives in order to secure their labor on communal fields.

Anthropological and/or sociological research is needed to investigate the links between production systems, household structure and women's autonomy. Econometric analysis does not shed light on *why* women in the rice zone have been able to benefit from increases in production while women in the cotton zone have not.

Human capital indicators, namely the education levels of women and their husbands, did not play a significant role in determining the women's income levels. However, this does not suggest a reason to stop investing in women's education. Data from many other countries (see, for example, Smith and Haddad, 2000) show the important link between education, women's incomes and child health. In rural Mali, there are simply not enough educated women for this to be reflected in the data. Also, there may be payoffs to non-formal education that the model failed to capture. Of the women in our sample, more than half of them who had at least some formal education, and 90 percent with five or more years of schooling, live in Segou, the region with the highest observed incomes for mothers.

Variables representing a women's social capital were significant and positive. First, the age of the woman is highly significant. In rural Mali, status comes with age. Senior women (and men) do not have obligations to the household economy. Once retired from these domestic roles, they can spend most of their time tending private plots or engaging in other activities (Wooten 2003). This also indicates that the youngest women, who are likely to have the youngest children, are the least likely to be earning the income needed

to care for them. When designing income-generating programs for women, one needs to be proactive in identifying income-earning activities in which younger women are likely (and able) to participate. Alternatively, the provision of support services that increase women's productivity and/or relax their time constraints will be beneficial.

All else equal, being married to the head of the household is significant for women's income levels, while being in a polygamous marriage and wife order were not. This would suggest that being a fourth wife to the head of household is generally more beneficial than being the first wife of a dependent male. This relates back to the issue of family structure discussed above. The low percentage of women married to the household head in the Mopti region (37%, compared to 46% and 47% in Sikasso and Segou, respectively) could contribute to the low average expenditures found in that region.

The discrepancy between husbands' and wives' incomes indicates that men benefit disproportionately from access to productive assets and inputs. This claim is supported throughout the literature.[26] In our study, the insignificance attached to household land and livestock holdings suggest that access to these assets is limited for women. The effect of agricultural equipment in the Sikasso region is significant and negative on women's incomes. As growth in cotton production is largely extensive, more equipment is an indicator of larger fields and increased demand for women's labor that is rarely remunerated.

[26] Aldermen et al. (1995) use econometric evidence to suggest that total household productivity could be increased by 10 to 20% if existing resources were shifted from male- to female-controlled plots; Saito et al. (1994) conclude that if women had access to the same inputs as men, productivity of identical crops would be approximately 15% higher in women's fields than in men's; Udry (1996) concluded that approximately 6% of output is lost because of inefficient factor allocation within the household.

There was a lot of controversy in Mali after the devaluation of the currency (FCFA) in 1994. Banks gave loans to men to purchase motorbikes, a move that was criticized as a frivolous waste of resources that could lead to over-indebtedness and a neglect of household responsibilities. However, our results show that women also appear to benefit from the household having invested more money in vehicles, which likely improve their ability to obtain inputs and market their output. It would be interesting to investigate this issue further to determine the specific effect of motorbikes vis a vis other vehicles, and to see if different regions and levels of infrastructure benefit disproportionately from these investments.

The significance of the zone dummies shows that there are zone-level characteristics that we have not captured in the model that are influencing women's ability to earn income. Certain zones may have stronger affiliations with non-governmental organizations or better access to government resources. There may simply be more income-generating opportunities in some zones relative to others. Isolating the prevalent activities found in each zone and better enumerating infrastructure, agro-climatic conditions and the state of the local economy could shed more insight on this phenomenon.

The second model offers some intriguing insights into the activities performed by women in the three regions under study. While we cannot conclude that participation in these activities leads to higher or lower incomes (causality is not determined), we can make some inferences about the women who participate in each activity. This information could help the targeting and design of projects by those interested in increasing women's

incomes. Future work should examine the costs of entry into certain activities and their respective net returns.

There are low barriers to entry into the non-farm sector. However, the wide level of participation across regions (ranging from 76% in Mopti to 82% in Segou) and relatively low marginal benefit mask a great diversity of activities included in this sector. Women with low access to resources can sell their labor for menial tasks such as pounding millet or doing laundry. Other activities, such as tailoring, require larger start-up costs, asset accumulation and skills. There is a significant and higher coefficient for women engaged in non-farm activities in Segou. This could signal more and/or better non-farm activities. Due to their higher average incomes, women in this region may be able to invest in higher-return activities, and the more dynamic local economy may generate higher demand for non-farm activities.

The negative coefficient associated with agricultural labor suggests that women who participate in this activity do not have resources to produce and market their own crops, which yield higher returns. This could be due to land constraints or inability to access other inputs, such as seeds and fertilizers. In the market-oriented cotton and rice zones, opportunities exist for women to work on others' fields. This contrasts with Mopti, where only one woman reported participating in this activity. This may have implications for resource-strapped and/or landless women, who are faced with few other opportunities to earn income.

Roughly 62 percent of women in both Sikasso and Mopti participate in the sale of rain-fed cereals. These women have incomes slightly higher than those who do not, all else

equal. The low return of this activity could signal that women are selling their crop right after the harvest when prices are low. It could also mean that women are selling cereals, which they were given for food preparation, in very small amounts to purchase condiments. Women who sell these crops in Segou have incomes significantly lower than women who do not, *ceteris paribus*. This indicates an opportunity cost to participating in this activity. Women who sell rain-fed cereals in this region do so at the expense of engaging in higher-return activities, such as selling rice. The constraints and bottlenecks to entering, or increasing their participation in, more lucrative activities need to be identified.

Over half of the women in Segou sell rice. Their marginal benefit is higher than for sale of any of the other agricultural crops. Conversely, women who sell rice in Sikasso have significantly lower incomes. As rice in Sikasso is primarily grown for home consumption, its sale may indicate some form of distress and/or lack of opportunities to earn income through other activities.

Almost 80% of women participated in the sale of crops other than cereals, rice or cotton. Across the zones, women who participated in this activity had higher incomes than women who did not, holding all else constant. However, the data do not distinguish between horticultural crops and peanuts, which tend to be high-value, and other crops, such as bean leaves and tubers. A subset of 372 women participating in an additional Knowledge, Attitudes and Practices (KAP) survey allowed us to investigate the incomes of women participating in "market gardening" (14.5% of respondents, of which 63%

reside in Segou). [27] On average, incomes of those who did participate were 70% higher than their counterparts who did not. This difference in incomes was only significant for women in Segou, pointing to the lack of gardening infrastructure and access to markets in the other zones. Studies by Wooten (2003), Becker (2000) and Ward et al. (2004) highlight the potential of market gardens for income generation and food security in Mali.[28]

Across regions, women who sold livestock and animal products had significantly higher incomes than women who did not, all else equal. The marginal benefit of participating in these activities is greater than for any other agricultural endeavor. In both categories, participation was highest in Mopti, where agricultural opportunities are limited and animal production is more widespread. Access to animals for sale is greater than access to animal products, which may be an indicator of the high cost of cows for the latter, and their control by the head of the household. Conversely, women typically sell poultry and small ruminants, which they buy with income earned through other activities (DeGroote and Coulibaly 1998).

Finally, participating in the sale of wild products was associated with the largest marginal benefit of any activity for women in Sikasso and Mopti (women in Segou benefited significantly less). This may be due to several factors. First, as common pool resources (with the exception of shea trees), most women have access to at least some wild products, regardless of personal or household assets. For poor women, this may be one of the few income-generating opportunities available to them. As such, these women would

[27] For the purpose of this analysis, a woman is considered to participate in market gardening if she reported that she sells the majority of produce that she is responsible for growing.
[28] All three studies focus on communities within 100 km of the capital city, Bamako.

experience extremely low incomes in the absence of this activity. Second, certain wild products, such as shea nut butter, can be highly profitable ventures. Women in southern Mali have reported in interviews that the production of shea nut butter is much more profitable than the sale of agricultural produce (Sundberg 1989).

The importance of wild products to women's income has serious implications with regards to tenure and sustainability. As a common pool resource, permission to harvest is given by the chief of the village. An exception is for shea nut trees, which belong to the family on whose land the tree is located. Permission to collect is thus at the discretion of the head of household. Women in households without such land ask and regularly receive permission to collect on the land of other households (Becker 2000). Since the activity is recognized as belonging almost exclusively to women, conflicts over their access are rare. However, as agricultural production (particularly cotton), expands into previously uncultivated areas, or as land in peri-urban areas is converted to non-agricultural uses, women have no formal protection over these productive assets. Policies which transfer legal rights to usufruct users should be considered. Secure land tenure for women may also encourage sustainable use of the resources.

It is obvious from this study that any analysis of women's incomes and activities need to be disaggregated by region. Activities that are profitable to women in one region – with a specific set of natural resources and assets – may lower incomes for women in other regions through foregone opportunities to participate in more appropriate activities. One set of national policy recommendations is unlikely to be successful given the huge intra-country diversity.

APPENDIX

APPENDIX A

Table 8: Summary statistics for regression variables

Variables	Mean	Std. Dev.	Min	Max
Individual Characteristics				
Age	29.634	7.684	13	53
Years of formal education	.382	1.407	0	9
Household Characteristics				
Natural log of husband's expenditures (instrumented)	10.693	2.959	8.052	13.106
Husband's years of formal education	.661	1.862	0	12
Father is chief of household = 1	.437	.496	0	1
Agricultural Equipment index	.182	.130	0	1.107
Agricultural Equipment index * Segou	.064	.115	0	1.043
Vehicles per adult equivalent	.222	.212	0	1.429
Ratio of females aged 10-45 to other household members	.390	.152	.042	1.377
Community Characteristics				
Distance to market in kilometers	8.737	8.268	0	60
Number of village-level associations	2.959	2.050	0	9
School = 1	.662	.473	0	1
Kolendieba = 1	.260	.439	0	1
Macina = 1	.198	.399	0	1
Niono = 1	.140	.347	0	1
Bandiagara = 1	.114	.317	0	1
Koro = 1	.151	.358	0	1

Source :Calculated from survey data
Note: All statistics based on 986 observations.

APPENDIX B

Table 9: Weights for the calculation of the Agricultural Equipment Index[a,b]

Full oxen chain (2 oxen and plow)	1.0
Additional full chain	.75
Cart	.50
Extra plow	.35
Extra pair of oxen	.35
Extra animal	.25
Cultivator	.25
Seeder	.25
Sprayer	.25

[a] Weights are based on farmer perception of the value of each animal/piece of equipment to production.
[b] Values are divided by the number of adult equivalents in the household.

Table 10: Weights for the calculation of the Vehicle Index[a]

Bicycle	1
Moped	3
Motorcycle	5
Car	8
Truck	10

[a] Values are divided by the number of adult equivalents in the household.

APPENDIX C

Table 11: First-stage regression for husbands' expenditures

Explanatory variables	Coef.	Std. error[a]	Sig.
Exogenous variables in ME regression			
Years of formal education of mother	.005	0.22	
Years of formal education of husband	.067	4.29	***
Mother's age	.010	1.62	
Husband is head of household	.539	7.54	***
Number of village-level associations	.061	2.51	**
Ratio of females aged 10-45 to other household members	-.148	-0.72	
Distance to market in kilometers	-.184	-3.70	***
School = 1	-.210	-2.10	**
Kolendieba = 1	-.381	-3.00	***
Macina	-.712	-5.72	***
Niono	.191	1.49	
Bandiagara	-1.302	-9.10	***
Koro	-1.109	-6.66	***
Instruments			
Husband's age	.052	2.59	***
Husband's age squares	-.001	-2.88	***
% time husband spent in village	1.502	2.23	**
Per capita land holdings (hectares)	.101	1.29	
Area of husband's fields (hectares)	.034	5.08	***
Constant Term			
Prob > F	8.167		
R-squared	0.00		
Adjusted R-squared	.3282		

Source: Estimated from survey data

Notes: The dependent variable is natural log of husband's expenditures (lnfaexp). The number of observations is 984.

* Significant at the 10 percent level

** Significant at the 5 percent level

*** Significant at the 1 percent level

APPENDIX D

Table 11: Determinants of mothers' income in Rural Mali: Comparison of 2SLS models with and without the vehicle index as an explanatory variable

	with vehicle ind.		without vehicle ind.	
Explanatory variables	Coef.	Sig.	Coef.	Sig.
Human Capital				
Years of formal education of mother	.018		.013	
Years of formal education of husband	.019		.022	
Social Capital				
Age	.026	***	.024	***
Husband is head of household	.191	*	.148	
Number of village-level associations	.036		.034	
Physical Capital				
Agricultural equipment index	-1.008	**	-4.32	
Ag. Equipment index * Segou Region	.943	*	.984	*
Vehicle index per adult equivalent	.780	***	--	--
Natural log of husband's expenditures	.178		.219	*
Labor				
Ratio of females aged 10-45 to others in hh	.352	*	.369	*
Enabling Environment				
Distance to market in kilometers	-.006		-.008	*
School = 1	.434	***	.453	***
Kolendieba = 1	.199		.227	
Macina = 1	.881	***	.870	***
Niono = 1	1.097	***	1.146	***
Bandiagara = 1	.374		.437	*
Koro = 1	.483	**	.567	**
Constant Term	6.239	***	5.904	***
Prob > F	0.00		0.00	
R-squared	.3010		.2867	

Source: Estimated from survey data

Notes: The dependent variable is natural log of mother's expenditures. The number of observations is 984.

* Significant at the 10 percent level

** Significant at the 5 percent level

*** Significant at the 1 percent level

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