ECONOMICS, INSTITUTIONS, DEVELOPMENT, AND TRADE: ANALYSIS OF THE MALIAN COTTON SECTOR

By

VERONIQUE THERIAULT

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To my loved ones

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LIST OF ABBREVIATIONS

AOPP	Association des organisations professionnelles paysannes (Association of Professional Producers' Organizations)
APPP	Africa, Power, and Politics Programme
APROSCOM	Association professionnelle des sociétés cotonnières du Mali (Professional Association of Cotton Companies of Mali)
AVs	Associations villageoises (Village Associations)
BNDA	Banque nationale de développement agricole (National Bank of Agricultural Development)
CAGIA	Coopérative d'approvisionnement et de gestion des intrants agricoles (Provisioning and Management Agricultural Inputs Commission)
CFDT	Compagnie française pour le développement des textiles (French Company for Textile Development)
CIC	Commission intrants coton (Cotton Input Commission)
CMDT	Compagnie malienne pour le développement des fibres textile (Malian Company for Textile Development)
DEA	Data envelopment analysis
FE	Fixed effect estimator
GPCs	Groupement des producteurs de coton (Cotton Producer Groups)
GSCVM	Groupement des syndicats cotonniers et vivriers du Mali (Group of Cotton and Food Producers' Unions of Mali)
GVs	Groupement villageois (Village Groups)
GVPCs	Groupement villageois des producteurs de coton (Village Cotton Producer Groups)
IMF	International Monetary Fund
IPC	Inter-profession coton (Inter Professional Cotton Association)
LDCs	Least developed countries
MLE	Maximum likelihood estimator

NIE	New institutional economics
NGOs	Non-governmental organizations
OIE	Old institutional economics
OLS	Ordinary least squares
POs	Producers' organizations
SAPs	Structural adjustment programs
SCPCs	Sociétés coopératives des producteurs de coton (Cotton Producer Cooperative Societies)
SFA	Stochastic frontier analysis
SODECO	Société pour le développement du coton (Cotton Development Company)
SOFITEX	Société burkinabè des fibres textiles (Burkina Faso Textile Fibre Company)
SONAPRA	Société nationale pour la promotion agricole (National Company for Agricultural Promotion)
SYCOV	Syndicat des producteurs de coton et vivriers du Mali (National Union of Cotton and Food Crop Producers)
TCE	Transaction cost economics
TE	Technical efficiency
UNPCB	Union nationale des producteurs de cotton Burkina Faso (National Union of Cotton Producers of Burkina Faso)
UN-SCPC	Union des sociétés coopératives de producteurs de coton (National Union of Cotton Producer Cooperative Societies)
WB	World Bank

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ECONOMICS, INSTITUTIONS, DEVELOPMENT, AND TRADE:
ANALYSIS OF THE MALIAN COTTON SECTOR

By

Veronique Theriault

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Cotton is the source of livelihood for millions of rural households and an important source of export revenue for many West African countries. Correspondingly, cotton is vital to efforts related to economic and social development in the region. In the late 1990's, Mali and other West African countries initiated reform measures to privatize and liberalize segments of their cotton sectors, with the goal of rendering them more efficient. Previous research examined relationships between changes in market structure (i.e., monopoly versus competitive market) and cotton sector performance (i.e., prices and production). Comparatively little research has analyzed the interaction between institutional arrangements (i.e., formal and informal rules affecting date of payment and access to fertilizers and pesticides) and economic performance of cotton sectors.

Using the Malian cotton sector as a case study, this research contributes to the existing literature by 1) exploring how the evolution of institutional arrangements has influenced economic performance and 2) estimating their effects. First, a cotton producers' supply response to price and non-pecuniary factors is assessed using a fixed effect estimator. Results suggest that institutional constraints, such as low credit

recovery rates and delays in payment to farmers, have significantly impacted cotton acreage and production in Mali over the last decade. Second, technical efficiency scores of cotton producers in Benin, Burkina Faso, and Mali are estimated using a stochastic frontier production model. Results provide insights regarding the performance of West African cotton producers relative to differences in local market structures and institutional realities. Finally, the evolution of institutions and their (un)intended consequences on economic performance in the Malian cotton sector is examined using John R. Commons' framework. From the analysis, low cotton prices, delays in payment, indebtedness, inadequate access to cereal inputs and extension services, and lack of adequate communication between farmers and their union' leaders appear to be key limiting factors to further economic benefits.

Throughout this study, it is demonstrated qualitatively and quantitatively that institutions do matter. This finding provides empirical support for the following conclusion: policy reforms that ignore institutions and institutional reforms may result in limited levels of success in terms of economic development.

CHAPTER 1
INTRODUCTION

From Neoclassical to Institutional Economics

Neoclassical economics is characterized by perfect markets, where prices, outputs, and flows of factors of production adjust automatically to shifts in supply and demand, where rational individuals seek to maximize their utility or welfare, where firms seek to maximize their profit function, and where equilibriums are reached in all markets. Neoclassical theory is based on the assumptions of rationality and self-interest of individuals, on the efficiency of free markets, on perfect knowledge, and costless and complete information. Though these concepts allow for the analysis of price determination and marginal effects of shifts in market conditions, the underlying assumptions of neoclassical economics are a poor fit for the reality that many developing countries, especially African ones, have to deal with, such as large rural populations with livelihoods depending heavily on agriculture, imperfect markets, incomplete information and lack of transparency. For instance, access to formal credit systems and infrastructure, such as roads and utilities, are not well-developed, and are not easily accessible by a large segment of the population in poor countries. Moreover, information on prices, quantities, and qualities of goods and services is often scarce and inaccurate.

As a result, policy recommendations based solely on the neoclassical approach have failed to fulfill their promises of poverty alleviation by inducing economic development. By dismissing institutions, they have proved to be ineffective and inappropriate (Saleth and Dinar, 2004 and North, 1994). For instance, the Washington Consensus , which describes a set of ten market-based developmental policies, failed

to stimulate economic growth in Africa, since it assumed that economic reforms alone would lead to market efficiency, and hence ignored completely the need for and effect of political institution reforms (Haber, North, and Weingast, 2003). Solid political foundations, which keep the government strong enough to implement and enforce contracts while restraining any rent-seeking actions from occurring, are required for market-economies to foster development. In the presence of market failures, externalities, and imperfect information, policy prescriptions based essentially on price mechanisms and clearly defined and secure property rights did not lead to the anticipated outcomes. This is not surprising, given that legal and institutional foundations are generally absent or extremely weak in developing countries and, as a result, there is not a legal system to ensure that property protection or even contract rights are enforced. By focusing mainly on market operations and disregarding how the incentive structure embodied in institutions influence economic performance, neoclassical theory alone is not well-suited to understand the realities of developing countries. Therefore, the future success of agricultural developmental policy in Africa lies in a better understanding and application of both neoclassical and institutional theories.

Institutional economics complements mainstream economic concepts by including social, political, and economic institutions in the analysis of economic phenomena. In general, institutional economists assert that economic choices are embedded in social, cultural and political systems, and markets are the results of the various and complex interactions between individuals and institutions, such as firms, governments, and norms. Hence, a broader set of factors is considered to be important for analysis.

Institutional economics can be seen as an approach for overcoming limitations in neoclassical economic theory, which have contributed to failure in development policies. By ignoring that the economy is both a part of and a product of an interdependent social system, where economic and non-economic forces continually interact to reinforce or attenuate each other's effects, development policy seeking to increase agricultural output and rural employment in order to eradicate poverty often failed (Todaro and Smith, 2009; p.26). Indeed, whether or not farmers have had the ability to seize opportunities, brought by institutions and institutional changes, has determined successes and failures in African agricultural reforms (Dorward et al., 2009). Unfortunately, successes have been more limited than failures.

Many institutional economists have been awarded the prestigious Noble prize in economics: Gunnar Myrdal, Hebert Simon, Maurice Allais, Kenneth J. Arrow, Ronald Coase, Amartya Sen, Joseph Stiglitz, Douglass North (Schmid, 1995), and more recently, Oliver Williamson, and Elinor Ostrom. However, the complexity of quantitatively measuring institutions and, therefore, conducting rigorous empirical analysis remains an important challenge. First, the selection of a subset of the most relevant institutions to include in the regression can be difficult. Second, finding a method to measure the selected institutions in order to quantitatively examine their effect is even more complicated. By applying both institutional and neoclassical economic theories to the same research topic, a dialectic synthesis of findings is possible, hence the two bodies of theory become complementary to each other, and a more rigorous analysis is achieved.

Analysis of the Malian Cotton Sector

Throughout this work, the roles of institutions and how they are interconnected with trade[1] and development are examined. Using the Malian cotton sector as a case study, this research contributes to the literature by 1) using empirical evidence to demonstrate how the evolution of institutional arrangements has influenced economic performance and 2) by quantitatively estimating the pecuniary effects of this evolution. This analysis could easily be extended to other West African cotton producing countries and even to other agricultural sectors in the economic development literature.

Mali is relevant for analysis of development through agriculture because it is one of the world's poorest countries and cotton is a major source of export revenue. By providing employment to more than three million smallholder farmers, the Malian cotton sector has the potential to assist economic growth and help alleviate poverty. Over 95% of Malian cotton production is exported and sold on the international market. Any comparative advantage that can be obtained by Malian cotton producers is dependent on institutions and infrastructure that both support and are supported by cotton revenue. The efficiency of transactions taking place among the various cotton stakeholders is central to the capacity to further develop cotton production. Reforms are currently being undertaken that would eventually lead to the privatization and liberalization of the cotton sector. The ultimate goals of these reforms are both to improve cotton farmers' livelihoods and to enhance Malian cotton competitiveness on the world market.

[1] For the purpose of this study, trade is defined as the exchange of products and services and therefore, encompasses both domestic and international transactions.

Aim and Scope

The aim of this study is to analyze both qualitatively and quantitatively how the institutional environment in the Malian cotton sector has influenced the reform process and economic performance. Although many studies have previously examined the relationship between market structure (i.e., monopoly versus competitive market) and cotton performance (i.e., prices and production), little research has analyzed the interaction between other relevant institutional arrangements (i.e., formal and informal rules affecting date of payment and access to fertilizers and pesticides) and economic performance in the cotton sector. In order to fulfill this objective, the study is organized as follows:

Chapter 2 discusses the main literature related to the analysis of institutions, and connects this literature to development and trade concepts. Examples from the Malian cotton sector are given to strengthen the arguments presented. Chapter 3 empirically analyzes how key institutional factors have influenced the Malian cotton supply over the last decade using a fixed effect estimator and aggregate regional data. Chapter 4 compares and estimates the role of institutional environments on farmers' technical efficiency scores in Benin, Burkina Faso, and Mali using farm-level data. Chapter 5 applies the general concepts of John R. Commons to the evolution of institutions to analyze key changes in the institutional environment of the Malian cotton sector, starting with the country's Independence in 1960 to the current reforms in the 2000s. Finally, Chapter 6 summarizes key findings, makes policy recommendations, and discusses potential future work.

The novelty of this research is in its integrated approach to study three core components of economics (development, trade, and institutions) through the analysis of

a specific sector—Malian cotton. Each chapter also sheds new light on important agricultural economic questions. For instance, Chapters 3 and 4 provide new insights on how institutions influence agricultural productivity over time and across countries, respectively; Chapter 5 improves our understanding on how institutions have evolved in the Malian cotton sector as a way to account for limiting factors, their (un)intended consequences, and their impacts on economic performance.

CHAPTER 2
LITERATURE REVIEW

Understanding Institutions

A commonly accepted definition of institutions is: the rules of society that structure incentives shaping economic, social, and political behaviors and organizations (North, 1990). Political groups (e.g. political parties, regulatory agencies, governmental bodies), economic groups (e.g. firms, farms, unions, cooperatives), and social groups (e.g. religious associations, kinship) are all examples of organizations. In a world of imperfect knowledge and asymmetric information, institutions reduce uncertainty by providing additional information. But even in a world of perfect knowledge and full information, where uncertainty does not exist, institutions remain useful by mediating agents' interactions and interdependencies.

In addition to making a distinction between institutions and organizations, a line can be drawn between institutional environments and institutional arrangements. Davis and North (1970: p.133) defined an institutional environment as: "a set of fundamental political, social, and legal ground rules that govern economic and political activity" and thus, establish the basis for production, and trade in market-economies. As defined, institutional environment encompasses property rights, enforcement and sanction mechanisms, religious beliefs, norms, and laws. Institutional arrangements provide an incentive framework under which individuals and organizations would decide whether to cooperate or compete (Davis and North, 1970). Institutional environments are the rules of the game, whereas institutional arrangements are the governance structures/modes of managing transactions (trade) inside the institutional environment. The distinction between institutional environments and arrangements is not always clear-cut. The

following example, drawn from West African cotton sectors, is provided to clarify these two concepts. Although both cotton growers from Mali and Burkina Faso are participating in contract farming schemes[1] (similar institutional arrangements), they are ruled by different constitutions (different institutional environments). For instance, presidents are constitutionally limited to serve a maximum of two five-year terms in Mali; whereas the constitution does not limit the numbers of terms that presidents can serve in Burkina Faso (e.g. Blaise Compaore has been president since 1987).

Dorward et al. (2009) classified institutional arrangements into three broad categories: gift exchange, hierarchies, and markets. Fafchamps (2004) used the terminology “allocation mechanisms” rather than “institutional arrangements” to describe these three categories. Gift exchanges are allocation mechanisms that take place among households, familial, and kinship circles without explicit obligation for immediate or future rewards. However, gift exchanges implicitly rely on reciprocity. This can be summarized by: “I am here for you, since you are there for me”. Market allocations are voluntary and are based upon explicit reciprocity between sellers and buyers. Trade occurs when perceived gains explicitly exist for both sellers and buyers. If some individuals do not seek the potential benefit of trading, they can voluntarily disengage themselves from being a part of the exchange. Market transactions also differ from gift exchanges since the terms of the agreement, such as prices, quantities, qualities, and transaction dates, are implicitly or explicitly defined.

Unlike gift exchanges and markets, hierarchies rely on command and control to allocate resources, rather than on reciprocity. Resource allocations within governmental

[1] Contract farming refers to a system where cotton growers agree to sell their harvest to gin facilities in exchange of getting inputs on credit at the beginning of the season

agencies, parastatals, banks, and firms are all examples of hierarchies. Elements from these three categories—gift exchanges, hierarchies, and markets—can be combined to form hybrid arrangements. The effectiveness of these three allocation mechanisms vary widely across the institutional environments. Their relative importance also changes according to the level of socio-economic development and market penetration. For instance, gift exchanges are generally a more important allocation mechanism in Africa, compared to capitalist countries, where hierarchies through corporations are generally more developed.

Interestingly, institutions are both a function and a source of power that come with rights and duties. For example, who has which resources ex ante to the act of gift exchange, or who owns what is an ex ante determinant of market exchange, so the initial distribution of endowments can profoundly affect economic performance. In addition to conferring different levels of power (i.e., bargaining power), institutions empower actors with rights while imposing duties on them differently. In gift exchange, property rights give power to owners on how to allocate their resources while constraining them to give. Conversely, the actors with no initial endowment have the rights to receive but the duty to repay gifts in the future. In the next sections incentive and distributional power issues associated with institutions and their effects on economic performance will be further discussed.

Levels of Institutions

Williamson (2000) developed a framework that puts the different levels of institutions into perspective (Table 2-1). The first level is called embeddedness, which means that economic structures are integrated in social environments that impact their functioning. For instance, informal rules, tradition, culture, religion, and norms influence

the economic functioning of institutions. The second level is called institutional environments, and encompasses the formal rules, such as laws, constitutions and property rights. The institutional environments are constrained by their social environments (level 1). The majority of the literature on property rights is part of level 2, and it is often based on the premise that legal systems will allow private markets to prosper by clearly defining and enforcing property rights. One drawback of this premise is that definition and enforcement of property rights are assumed to be costless. A second drawback is the absence of power and its distributional implications. The assumption of costless enforcement is relaxed in the third level: institutional arrangements. In addition to being constrained by the social and institutional environments, the third level incorporates the play of the game and focuses on governance, mainly through the analysis of transaction costs.

Formal and informal institutional constraints shaping more than two individuals' behaviors in a specific institutional environment have been the object of research for new institutional economics of history (NIEH) developed initially by North. In contrast, transaction cost economics (TCE), largely known through Williamson's work, has the type of arrangement between two players as the primary object of research (Richter, 2005). Thus, public goods and collective actions have been further analyzed through NIEH, whereas private goods and individual actions have received more attention from TCE.

In the fourth level of institutions, marginal decisions are made in accordance with neoclassical theory, and they are constrained by the social and institutional environments, as well as by the governance structures. New institutional economics

(NIE) focuses primarily on the second and third levels, whereas the fourth level is the focal point of neoclassical economics. Another interesting feature of NIE is that the institutional environments and arrangements are not assumed to be given, as done in mainstream economics, but rather they are “the object of research” and researchers “seek to consider implications for economic behavior of any given institutional arrangements” (Richter, 2005; p.163).

The old institutional economics (OIE) school of thought is more closely related to the first and second levels—social and institutional environments—than the two other levels. OIE views institutions as “settled habits of thought common to the generality of man” (Veblen, 1919; p.239, cited by Lawson, 2005; p.16), and rejects the idea of rational maximizing and self-seeking behavior of individuals and hierarchies as institutional arrangement (Stein, 1994). Indeed, trust and loyalty are considered to be key elements of successful firms, rather than hierarchy and supervision. Furthermore, property rights are not seen as a way to reduce transaction costs, but rather as a mode of thinking. In his paper, Stein (1994) examined the three institutional theories—OIE, NIE and Neoclassical—on five institutions related to economic development in Africa. He concluded that structural adjustment programs, which are derived from neoclassical theory, are ill equipped to promote development since institutions are dismissed. He also argued that OIE is better suited to promote successful economic reforms in Africa, since this approach does not rely on any neoclassical foundations, compared to NIE.

By setting the rules of the game, institutions define what individuals can or cannot do in a particular context and thus, delineate the action sets for individuals and for the collectivity (Saleth and Dinar, 2004). For instance, in advanced capitalist countries, firms

are more willing to deliver goods and services on credit to individuals outside their social capital network, because they anticipated being paid. Contract and property rights are strongly supported by the legal system. Typically, credit sales with outsiders are less common in developing countries, since weaknesses in property rights and lack of legal contract enforcement reduce the expectation of payment. Transaction on credit occurs mainly between people that mutually trust each other (e.g. Fafchamps, 2004). Hence, institutions can have contradictory effects: by increasing opportunities in some contexts and by being restrictive in others, as well as being distributive. In a given context, institutions can increase the opportunities for some while restricting the opportunities of others.

Types of Institutions

Institutions can be classified under different categories: formal/informal and economic/political/social. It is important to note that both formal and informal rules are embedded in institutional environments and arrangements. If the rules of the game are written and enforced by a third party, such as the state, the institutions are considered formal (Kirsten et al., 2009; Helmke and Levitsky, 2003). Formal institutions encompass constitutions, laws, and regulations, among others. Examples of formal political institutions are constitutional designs and electoral systems. Specific to the Malian cotton sector, the law[2] under which cotton cooperatives have been created is an example of a formal political institution. In Mali, among the criteria for formal recognition as a cooperative, cotton farmer organizations must be composed of at least five members and democratic elections have to be held to select the cooperative president.

[2] Loi No.01-076- Régissant les Sociétés Coopératives en République du Mali

Written contracts between buyers and sellers, and marriage certificates are examples of formal economic and social institutions, respectively. Under a formal contract, terms and conditions binding both parties are written and can be enforced by a third party.

Generally, unwritten rules that are informally sanctioned are regarded as informal institutions (Kirsten et al., 2009; Helmke and Levitsky, 2003). Norms, kinship, religious beliefs, and socially shared values are all examples of informal institutions. In addition to being a social institution, social hierarchy (caste) prevailing in many developing countries can be seen as a form of informal political institution, since a caste system might forbid those at the bottom to access higher positions. For instance, cotton farmers who are also blacksmiths cannot aspire to become president of cotton cooperatives in some regions in Mali. Their social status would prevent them from applying for the position and/or being elected. In contrast, the sons of village chiefs occupied, more often than not, important positions in Malian cotton cooperatives.

Another notable aspect of West Africa's cotton sector is that cotton is a crop mainly produced by adult male farmers. Indeed, women and children can provide their labor during peak demand but, otherwise, men are in charge of cotton fields and all the decisions related to cotton production. Traditionally, women grow garden products whereas men cultivate main staples and cash crops (e.g. cotton, maize, and millet). Even though the distinction between gender activities is an informal social institution, it has important implications in terms of developmental policy success. Black markets are certainly the most obvious example of informal economic institutions.

When formulating policy recommendations (e.g. structural adjustment policies), it is important to not confound weak formal institutions with informal institutions (Helmke

and Levitsky, 2003). Formal institutions can well exist on paper but might be completely ignored in reality. Weak formal governance (lawlessness[3]) is generally associated with less-developed countries and transition economies, where states are more limited and less reliable in protecting property rights and enforcing contracts (Dixit, 2009; Williamson, 2005). Ineffective formal institutions do not necessarily imply the presence of informal institutions. Informal institutions can be seen as the actual sets of rules being followed by individuals and collectively. Typically, informal rules change gradually over time, whereas formal rules may be changed overnight (North, 1990). For instance, village associations have been formally transformed into cotton cooperatives in Mali, but these new organizations still work similarly to the former. It takes longer for individuals and collective groups to adjust to the new rules of the game than to write them down.

Roles of Institutions

By being the foundations for market economies, institutions have an important role in comparative development (Todaro and Smith, 2009). The rules of property rights and contract enforcement affect economic performance through investment, as well as transaction and information costs, among others. By influencing the distribution of political and socio-economic power, institutions also have an impact on political outcomes. Institutions are double-edged swords, since they can enhance economic development or limit it. According to Acemoglu (2003), “good” institutions have three characteristics in common. First, the enforcement of property rights for a broader segment of the society, which creates incentives for many individuals to invest. Second, the limitation of the economic and political power of the elites minimizes their capability

[3] Lawlessness does not mean lack of order, as strong informal governance can provide economic order even in an environment of lawlessness.

to expropriate the income and investment of other people. Third, better institutions offer more equal opportunities for a larger portion of the population, which enhance investment, especially in human capital and thus, lead to higher participation in the market economy.

For Dorward et al. (2009), effective institutions play three different roles. First, they facilitate coordination[4] of exchange and resource management. For instance, a high level of coordination is required to ensure that transactions are reliable, in terms of prices, quantities, and qualities of services and goods traded, and timing in payment. As it will be demonstrated in Chapter 3, timely payment is a key issue in the Malian cotton sector, with important consequence on cotton production. Second, effective institutions promote low-cost exchange and resource management while encouraging trust. Therefore, low transaction costs should lead to increases in investment, such as human capital. Third, effective institutions provide incentives for exchange and resource management by creating exchange and investment opportunities. Throughout this study, it will be shown how trust and incentives have been affected by the management of credit, through the joint liability program, inside cotton cooperatives.

The effectiveness of institutional arrangements, such as gift exchange, hierarchy and market, are influenced by the interaction between the specificities of the transaction and the institutional environment (Dorward et al. 2009). Economic development is generally associated with changes in institutional arrangements, for example, less reliance on gift exchanges and more on hierarchies. It is also important to keep in mind that formal institutions that perform well in one setting might perform poorly in another

[4] Coordination is defined as the efforts deployed by different actors to manage interdependencies between their activities in order to achieve a common goal.

setting because of differences in informal norms and enforcement (Rodrik et al. 2004; North, 1994). The cross-country analysis in Chapter 4 will provide further insights about the set of institutions shaping the Benin, Burkina Faso and Mali cotton sectors, and on their impacts on economic performance in each.

Furthermore, institutions that are judged as dysfunctional and detrimental to the population as a whole can be good for a small, powerful interest group. Establishment of better institutions may be blocked by elites if their losses cannot be credibly compensated (Acemoglu, 2003). Effective institutions may not arise naturally. Hence, qualitative analysis in Chapter 5 presents the evolution of institutions and discusses the positions of some of the key stakeholders toward the cotton reforms.

Governance as Institution

As seen in Table 2-1, the concept of governance emerges from both the institutional environment and arrangement levels. From the economist's lens, governance can be regarded as "the structure and functioning of the legal and social institutions that support economic activity and economic transactions by protecting property rights, enforcing contracts, and taking collective action to provide physical and organizational infrastructures" (Dixit, 2009; p.5). This definition of economic governance does not narrow directly to the modes of governance (gifts, markets, hierarchies, and hybrid), as Williamson does (2005), but regards it more broadly as traditions and institutions by which authority is exercised (Lio and Liu, 2008). Good governance is needed to protect, under the same umbrella, security of property rights, enforcement of contracts, and collective actions, which are core components of successful market economies (Dixit, 2009). It is expected that adequate provisions of public goods and

services[5] and low transaction costs would emerge with good governance, which would positively impact economic performance.

Table 2-2 summarizes, on one hand, the main positive outcomes associated with the three prerequisites of market economics (as defined by Dixit, 2009) secured through good governance and on the other hand, their main market failures associated with poor governance and the distributional issues. Although government is often seen as the guardian of good governance (Binswanger-Mkhize and McCalla, 2010), other organizational entities— such as firms, civil societies and community-based organizations—can also play this role. Shared values, social norms, trust, and reputation are examples of institutions that can be used to improve governance.

The first element to secure with good governance is property rights. Insecurity associated with property rights discourages individuals from saving and investing, since they fear losing everything in the near future. As a result, money, time, and labor are spent to secure property rights, instead of being used on economically fruitful activities. As an extreme case, Lio and Liu (2008) mentioned Somalia in the early 1990s, where violence and theft (absence and lack of enforcement of property rights) prevailed on the "rule of law "[6] and led to mass starvation, due to farmer decisions to not produce. Secure property rights empower the owners while imposing duties on others.

Moreover, lack of contract enforcement opens the door to two major cheating and opportunistic behaviors: adverse selection and moral hazard. Adverse selection issues

[5] "Public goods are defined as those goods (including services) that tend to be under-supplied when their provision relies on the incentives available to private actors because their benefits 'spill over' to other members of the community" (Booth, 2009; p.5).

[6] The rule of the law is defined as: "a legal system in which rules are clear, well-understood, and fairly enforced, including property rights and enforcement of contracts. (Deardorff, 2010)

occur when characteristics of one party (agent) cannot be observed by the other party (principal). For instance, debtors engaging in contracts knowing that they are unlikely to fulfill the terms and conditions, but wanting to take advantage of the absence or weaknesses in contract enforcement (Fafchamps, 2004). Adverse selection discourages creditors from engaging in transactions. Transactions are more likely to be restricted, and the few occurring have higher transaction costs, due to screening costs. Although collecting information is costly, it allows learning more about the specific characteristics of the other party and, therefore, ensures mutual gains from trading. Social networks can play an important role in collecting information more efficiently. Enforcement is not costless, and therefore, the money spent helping the empowered to be protected is money not spent on helping the “non-elite”.

The second issue arising from lack of contract enforcement is moral hazard. This occurs when one party (principal) cannot observe the action of the other party (agent) under contract. Therefore, the latter has an incentive to cheat. Monitoring and promise of repeated transactions in the future are mechanisms that could be used to prevent the other party from defaulting. Note that these mechanisms can lead to better governance (i.e., less opportunistic behavior) without direct involvement of the government. Yet, monitoring is costly and, therefore, leads to higher transaction costs.

Sequencing in the trade process also creates new challenges in contract enforcement. Issues arise when one player has to deliver the goods, at time t, in anticipation that the second player will fulfill the engagement at time t+1. However, at time t+1, the second player might decide to default on his/her commitment. For instance, producers receive cotton inputs on credit at the beginning of the sowing

season with the promise of paying back at the harvest. However, some farmers might decide to divert their cotton inputs to cereal production, which might reduce their cotton yields and, hence, their ability to repay and to fulfill their promise. Repeated transactions, monitoring, trust, and reputation are mechanism that can be used to ensure that both players are fully committed to the contract. Problems can even arise when trade occurs at the same period. For example, quality of cotton inputs purchased is unknown by the farmers' organizations, but known by the suppliers at the moment of the transaction. Therefore, the latter might be tempted to cheat by selling low quality inputs at high prices. In addition to the mechanisms enumerated previously, farmers' organizations with stronger voice, could help to reduce opportunistic behaviors of suppliers by ensuring that inputs received are of good quality.

The third important prerequisite that good governance has to secure is collective action. In many developing countries, the state, which is generally regarded as the main provider of public goods[7] , poorly performs, in part, due to its limited financial capacity. Although public good investment is important to the private sector, the latter is rarely willing to take the lead, due to high risk of free-riding (Valentinov, 2009). Therefore, collective actions become important in the provision of public goods, such as physical, institutional and organizational infrastructures, and the management of common pool resources (Dixit, 2009). For the collective action to emerge, the less-endowed people have to collectively accept their situation and status, and use this to motivate action.

Free-riding behavior is the main problem associated with collective action and occurs when one party consumes more than his/her fair share of the common resource

[7] Security, water sanitation, and road infrastructure are examples of public goods.

and/or contributes less than his/her fair share to the provision of the public good. The joint liability program prevailing in the Malian cotton cooperative is a good example of both collective action and free-riding. Given that financial institutions were unwilling to provide individual credit to cotton farmers, due to their lack of collateral, they regrouped into cooperatives to collectively access credit (collective action). Through joint liability, each member of the cooperative is responsible for the loans of other borrowers. In absence of good governance (effective monitoring and enforcement), some farmers have the incentive to free ride and to let other members pay their loans.

Research questions regarding whether individuals will free ride in collective action using the prisoner's dilemma schematic have been extensively studied theoretically, and through case studies in the field of natural resource management (e.g. Schlager and Ostrom, 1992; Ostrom, 1990). Researchers have also devoted attention to repayment rate decisions in group lending, notably, through the work done by Besley and Coate (1995). A limitation of past studies is that players are assumed to be homogeneous, which is far from being the case in reality. As emphasized by Dixit (2009), heterogeneity is a critical feature to introduce. Furthermore, the joint liability program prevailing in cotton farmers' organizations has received, until now, little attention from researchers. Indeed, theoretical studies on cotton sectors have mainly focused on the rent sharing process between parastatals and farmers, using the principal-agent framework (e.g., Delpeuch et al. 2010; Kaminski, 2010). This research, gives special consideration to the joint liability program prevailing inside the producers' organizations in order to get a better understanding of producers' incentives to free ride, and discusses how their internal functioning could be improved.

Institutional Changes

Institutional change is shaped by the interaction between the agents of change, the governance structure (institutional arrangement), and the institutional environment. Economic outcomes, politics, population growth, and technological innovations are examples of agents of change. “Exogenous changes such as technology, trade, and investment affect institutional changes through their effects on economic outcomes which, in turn, prompt economic organizations to induce political organizations to make necessary changes in the institutional arrangements” (Saleth and Dinar, 2004; p.34). Being part of the institutional environment, organizations may evolve with institutional changes. Thus, institutions and individuals (as well as organizations) are encompassed in a feedback loop, since they are part of the dynamic process and they are also emerging outcomes of the process (Schmid, 2005). For instance, the National Union of Cotton and Food Crop Producers in Mali, which in theory should represent cotton farmers’ interests, should adjust to any changes in its member’s behaviors and preferences. Also, the National Union can influence its member’s behaviors and preferences.

Using microeconomic foundations, Dorward et al. (2009) developed an analytical framework to show how institutional changes affect economic development through supply and demand (Figures 2-1 and 2-2). They used economic growth as an indicator for economic development. In addition to being a good measure of economic development, economic growth has been widely studied, and thus provides an excellent template to demonstrate how economic theory has gradually evolved to take into account institutions. Even though their analytical framework is based on economic

growth, it can also well-explain the impact of institutional changes on the Malian cotton sector.

The central idea of early development literature is that economic development was restrained due to insufficiencies in technology and factor endowments, such as human and physical capital. Therefore, any increase in technology and/or factor endowments would shift supply outward and, thus, supply would become more elastic[8] (from S1 to S2). Development in the economy would lead to higher income for both producers and consumers, and would raise demand. With an outward shift in demand (from D1 to D2), a new equilibrium would be reached at higher levels of outputs and at lower prices, leading to increase in both consumer and producer surpluses.

In their analysis of the extension reforms in the Malian cotton sector, Bingen and Dembele (2002) concluded that long-term investment in human capital (i.e., an increase in a factor endowment) is the key factor to respond successfully to agro-environmental concerns and to maintain earnings from cotton exports. For instance, training should help farmers to better understand the importance of crop rotation, which should result in more fertile soil and better yields. Although human capital is considered to positively affect economic performance, it cannot alone ensure the long-term profitability of the cotton sector. As it will be demonstrated in Chapters 3, 4, and 5, institutions shaping the Malian cotton sector significantly influence cotton sector economic performance through supply.

[8] Price elasticity of supply is defined as the percentage change in the quantity supplied divided by the percentage change in price. With technological progress and/or more factor endowments, a small increase in price, would lead to a large increase in supply.

Being aware of the limitations of technology and factor endowments to explain economic performance, development research has been refined to take into account other explanatory factors. From the literature, three schools of thought stand out: geography, trade, and institutions.

First, some believe that geography is the key factor to economic development. Through climate, diseases, natural resource endowments and distance to road networks, geography is considered to impact significantly agricultural productivity and labor. However, Rodrik, et al., (2004) found that geographical variables lose much of their explanatory power once institutions are taken into account. In the analysis of the determinant of Malian cotton supply (Chapter 3), regional dummies are included in the regressions in order to control for difference in geographical features.

A second strand of thought focuses on international trade. It is believed that removing trade barriers, dismantling agricultural marketing parastatals—often involved in export commodities, such as cotton and cacao—and eliminating input and output subsidies would lead to higher productivity and, thus, to economic development. The structural adjustment program (SAP), which consists of policies implemented by the Bretton Woods Institutions[9] that developing countries have to meet to ensure better loan conditions and to preserve future loan access, is heavily trade and market-oriented. The main objective of SAP could be summarized as reducing a country's fiscal deficit in order to bring not only economic stability, but sustained economic growth, through less governmental intervention and more free market policies. It is worth noting that the World Bank and the International Monetary Fund continue to strongly recommend trade

[9] The Bretton Woods Institutions include both the World Bank and the International Monetary Fund.

liberalization, albeit its uncertain outcome on economic growth in developing countries. On one hand, Rodrik et al. (2004) showed that trade variables are more likely to be statistically insignificant in explaining economic development once institutions are controlled for. On the other hand, Dollar and Kraay's (2004) results suggested that trade is statistically significant and has a larger impact on growth than institutions.

From comparing the explicative power of both trade and institution factors on economic development, research questions have gradually moved toward the analysis of the types of relationship between these two. Extensive literature exists on the impact of trade liberalization on institutions (Bhattacharyya, 2008; Acemoglu et al. 2005; and Krueger 1974), but little research has been done on how institutions affect trade. An emerging idea in trade theory is that institutions, through their effects on transaction costs and productivity, can impact a country's comparative advantage (Bardhan, 2006). A paper by Nunn (2007) evaluated the relationship between a country's ability to enforce contracts and its comparative advantage. His results indicated that economic institutions, through enforcement of contracts, explain more of the pattern of trade than physical assets, capital and skilled labor combined.

Cotton trade and production activities have been highly subsidized in some parts of the world. Over one-fifth of the world's cotton farmer earnings came from government support in 2001/02 (Gillson et al., 2004). In the United States (US), China, and the European Union (EU), cotton sectors are, by far, the most subsidized compared to other countries. Cotton subsidies have been criticized as unfair by African cotton producing countries, especially by Benin, Burkina Faso, Chad, and Mali (also known as the Cotton-4 (C4)). The C4 countries have complained that EU and US practices are

distorting trade by creating incentives for overproduction, in which the products are then sold at depressed prices on the world market. Trade-distorting subsidies negatively affect developing cotton producing countries, as the C4, whose economy largely depends on cotton revenues. Reduction in international prices are passed on to poor smallholder farmers who receive lower farm gate prices for their cotton production and decrease government earnings from cotton exports.

Although the removal of US and EU cotton subsidies should lead to a reduction in their levels of production, which should result in increased international market prices in the short-run (Bassett, 2008; Sumner, 2007; Gillson et al. 2004), the impact on poor cotton growers from developing countries remains ambiguous. If cotton producers from developing countries have a clear voice, through their producer associations, then they would be able to capture a fair share of the increase in world prices and their livelihood would be enhanced (Bassett, 2008). However, if the institutional context does not promote transparency in the price determination mechanism, stakeholders other than cotton producers would benefit from the world price increase. In fact, the world market price was augmented by 463 CFA/kg after the CFA devaluation in 1994, but Malian cotton farmers only got a 30 CFA/kg increase (Tefft, 2003)[10]. One possibility is that the state-owned enterprise, which is in charge of buying and marketing all cotton, has captured the largest share of the increase.

Increased world prices from the elimination of trade-distorting subsidies would not last long, since cotton farmers around the world would respond to this increase by producing more. It is important to note that only farmers with supporting institutions

[10] It was not detailed who got the rest of the increase.

would be able to seize this opportunity. In addition to affecting a country's comparative advantage, institutions, through their effects on transaction costs and productivity, influence its capability to seize opportunity. Indeed, the institutional environment and governance structure have to be effective to ensure that enough good quality inputs would be provided to farmers on time, and that increased levels of output would not lead to bottlenecks in transport and marketing.

The third school of thought emphasizes the role of institutions[11], especially security of property rights and enforcement of contracts. Although the relevance of institutional variables in economic growth models appears to be now beyond dispute, the inclusion of high quality measures is still challenging, particularly in cross-country analysis. Not only are institutional environments not always easily quantified, they also vary widely over time and from one country to another. For example, protection of property and contractual rights can be measured through expropriation and contract defaulting. However, these two outcome measures might have been achieved with different institutional arrangements (Keefer and Knack, 1997). Furthermore, social norms, culture and local realities are examples of unobservable characteristics that are unique to each nation and affect the institutional environment. Keefer and Knack (1997) found that deficiencies in the institutional environment underlie economic divergence across countries, and went further by concluding that human and physical capital—as well as foreign investment and trade—serve only as vehicles to transfer technology advancement and accumulation of capital. Insufficiencies in any of these factors are more likely to occur in the presence of poor institutions.

[11] Unlike the second school of thought, the analysis of institutions is not limited to international trade only.

Similarly, Easterly et al. (2006) empirically analyzed the relationship between social cohesion, political institutions, and economic growth. Income inequality and ethnic fractionalization serve as proxies for social cohesion. Voice and accountability, civil liberties, government effectiveness and freedom are proxies used to measure the quality of political institutions. Their results suggest that, on average, stronger social cohesion leads to better institutions, and that better institutions lead to higher economic growth.

One common point shared by all three schools of thought is that institutions matter. Their views divert in terms of the key determinant factor (geography/trade/institutions) of economic development. Coming back to the analytical framework developed by Dorward et al. (2009), Figure 2-2 shows how technical and institutional developments affect supply. The main difference between Figure 2-1 and 2-2 is the decomposition of supply into two sets of curves: producer supply (S1 and S2) and consumer supply (S1' and S2'). Producer supply represents the costs of production up to the farm gate, whereas consumer supply represents both the costs of production and the risk associated with selling the product. Thus, the difference between (S1 and S1') and (S2 and S2') indicates the costs and risk of doing business. Development induced by effective technical and institutional changes would have two main impacts on supply. First, the producer supply curve would be shifted outward, and its elasticity would be increased (Figure 2-1). Second, costs of transaction, transport, communication and risk per unit of output sold to consumer would be reduced. As a result, the gap between producer and consumer supply curves is smaller, since doing business is cheaper and safer. Examples of institutional changes are the enforcement

of contracts and property rights through legal systems and subsequent reduction in the level of uncertainty and riskiness associated with a transaction.

Institutional changes can be beneficial to economic development as well as detrimental. Indeed, dysfunctional institutions would lead to an inward shift of supply curve and to increased business costs and risk. As it will be demonstrated in Chapter 3, increase in delays of payment, which is the product of a specific institutional change, has contributed to the decline in Malian cotton supply over the last decade. Chapter 4 will explain the difference in cotton supply across Benin, Burkina Faso, and Mali as a function of their institutional settings, once basic production factors are controlled for.

Motivation for Research on Cotton in Mali

In this section, the key issues associated with cotton sectors in Africa, and especially with privatization/liberalization reforms, are examined. In addition to improving our understanding of the institutional constraints facing African cotton sectors (and particularly, Mali), this section discusses previous research while highlighting questions that remain to be addressed. Correspondingly, it sheds light on the contribution of this study to the literature.

Cotton exhibits special characteristics that require a good system of governance to ensure that a high degree of coordination among the various stakeholders is achieved. Otherwise, cotton performance (such as quality, production, yields, and profits) is severely affected. Effective coordination is required to ensure timely collection of seed cotton and prompt payment to producers, for example. In this study, market coordination is defined as the effort deployed by the various cotton stakeholders to manage interdependencies between their activities in order to achieve a common goal, which is the efficient and timely provision of private and public goods necessary for high

economic performance in the cotton sector. Although stakeholders are performing interdependent activities, they might have conflicting interests (Malone and Crowston, 1994) and therefore, the design of specific measures might be required in order to prevent them from pursuing contrary goals (Poulton et al. 2004).

To achieve a high level of coordination, stakeholders must first agree on what should be done and how. Then, they must implement and enforce agreements in a manner that will discourage opportunistic behavior such as free riding and rent-seeking. The absence of competition in domestic markets (i.e., where there are national or local monopolies) is regarded as creating incentives for rent-seeking behaviors that are detrimental to both farmers and national welfare (Baffes, 2004; Badiane, 2002). Asset specificity is also closely related to contract hazards such as opportunistic behavior (Williamson, 1991). As illustrated by Poulton et al. (2004), the provision of inputs on credit (seen as asset specificity) by ginning firms at the beginning of the cotton campaign increases their risk of being exposed to free-riding behaviors from competitors at the harvest. To access inputs, essential to cotton production, farmers engage in contracts with gins at the start of the sowing season, on the promise of selling them, and only them, their crop at the harvest. In cotton sectors characterized by the presence of many small gin facilities, such as in Uganda and Tanzania, farmers are encouraged through higher prices to side-sell to competitors. However, side-selling is not an issue where local monopolies prevail, such as in Zambia.

In addition to being an asset specificity[12] issue, the provision of inputs on credit can be seen as an adverse selection problem, where ginning firms cannot observe the

[12] Williamson (1991; p.281) defined asset specificity "as the degree to which an asset can be redeployed to alternative uses and by alternative users without sacrifice of productive value". Asset specificity is only

characteristics of farmers (whether they would side-sell or not) and, therefore, can decide to ration credit to minimize losses due to low recovery. For reform measures to be successful, it is essential to design and implement incentives that discourage free-riding and rent-seeking behaviors. One example is to let farmers become shareholders in gin facilities (i.e., vertical integration).

The biggest challenge of any cotton reform in Africa is to ensure that both public and private goods (e.g. high cotton lint quality, timely inputs delivery, research on improved seed varieties) essential to the vitality of the cotton sector will continue to be provided in an effective manner. The success of the Malian cotton reforms heavily depends on the level of market coordination achieved among the various actors (e.g. the parastatal—soon regional monopolistic firms—government, private sector market agents, farmers' organizations, producers, banks) involved in the cotton sector.

In a perfectly competitive market, only one form of vertical coordination is required between actors, and this is achieved through the market price mechanism defined by supply and demand (Poulton and Tschirley, 2009). From a neoclassical perspective, effective institutions are considered as given and thus, full information is available throughout the market. Therefore, it is assumed that perfect competition would lead to perfect coordination. However, given that perfect competition never fully holds empirically, Poulton et al. (2004) argued that a trade-off exists between coordination and competition in African cotton sectors, where a sufficient degree of coordination is required to ensure that the numerous essential public goods (e.g. timely input delivery and sufficient input supply) are adequately provided. They concluded that high levels of

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one element that might affect transactions, and institutional and design performances. For instance, frequency of transactions also matters.

coordination imply less competition. To strengthen their arguments, examples drawn from the recent liberalization reforms in Eastern African countries are presented. On one hand, Tanzania and Uganda cotton sectors are facing major credit problems, due to lack of coordination among stakeholders (side-selling), but farmers' prices have increased, due to high competition among the numerous small firms. In contrast, Zambia and Zimbabwe have better debt recovery rates, due to higher levels of coordination, but their farmers receive lower prices, due to the absence of competition in the cotton market.

When government does not have the ability to support the provision of public goods, it might rely on the private sector. When this is the case, the private sector has the choice between three different coordination options (Poulton et al., 2004). First, the private sector market actors could fail to coordinate and, therefore, fail to provide public goods. The private sector market agents might fail to coordinate when they do not care enough about the future, when retaliatory actions are (or are not) credible, and when benefits from coordinating are not sufficiently probable. Second, private sector market agents can establish a collective organization to set and enforce formal rules in order to provide public goods. This collective organization is more likely to have a biased representation toward more powerful actors, but it still gives a stronger voice to small actors than the previous option. The recent establishment of interprofessions[13] in many African cotton sectors is an example of the second coordination option. The interprofession will be further discussed in Chapters 4 and 5. Finally, interpersonal and

[13] The interprofession is a formally recognized organization that groups key stakeholders involved in a same sector, and which has as objectives, to elaborate sector performance enhancing-policies and to defend sector's interests.

relational mechanisms can be used to provide essential public goods. In a very informal way, major actors discuss and make decisions among themselves, which leave smallholder farmers without a voice. Empowered organizations or individuals can collude to provide goods they want, as they want.

Table 2-3, drawn from Serra (2008), provides a summary of the different types of risks associated with the provision of public and private goods essential to the cotton sector and how ineffective coordination of them leads to costly market failures and, therefore, to higher transaction costs. Types of risks can also be described as institutional constraints (e.g. Fok, 2008; Fok and Tazi, 2004). Benefits associated with effective market coordination and main stakeholders performing this activity are indicated in columns three and four, respectively. If cotton growers, for instance, perceive a high risk of delay in collection of seed cotton and/or payment, they will respond by devoting fewer acres to cotton, and will use cotton inputs on other crops, or will sell them. Delays in payment increase the liquidity constraint that smallholder farmers face.

Correspondingly, coordination is essential in order for the transport and ginning companies to provide timely and quality services which, in turn, will provide incentives for farmers to plant optimal acreage of cotton. Otherwise, insufficient coordination leads to market imperfections and sends distorting incentive signals to actors. Increasing the number of collection sites[14], to almost one per village, for example, encourages farmers to produce cotton while reducing their transaction costs (Fok and Tazi, 2004). Given that farmers are responsible for transporting cotton from their fields to the collection

[14] Collection sites are the locations from which cotton is graded, sold, and transported to gin facilities.

sites, more of the latter means lower distances to cover, lower risk of damaging cotton and, therefore, lower costs. Multiple sites create a positive incentive for farmers to grow cotton by reducing an institutional constraint.

Past success stories in West Africa cotton sectors have been explained by the gradual changes in institutional arrangements that led to the creation of vertically integrated systems (Fok, 2008). Fully integrated structures were gradually implemented to deal with smallholder concerns and constraints, such as price fairness, risk aversion, lack of financial resources, lack of competence, and high transaction costs. On the downside, vertically integrated structures were costly and created extra burdens on cotton gin companies and State budgets.

With the privatization and liberalization reform process, roles and responsibilities of shareholders have evolved, as well as the institutional arrangements. The implementation of more market-oriented policies has led to the establishment of new institutional arrangements, though these have been highly criticized for being externally imposed. Fok and Tazi (2004) argued that the new institutional arrangements are inefficient since they have been pushed by donors who wanted a quick turnover of the past system, and who have ignored not only strategic alliances between stakeholders, but the gradual pace at which institutional changes typically take place.

Benefits and detriments to African rural development related to cotton production have received much attention. In some studies, cotton is considered as “the mother of poverty” (e.g. Isaacman et al., 1980), while in others, cotton has been described as “the white gold” (e.g.Tefft, 2010; Tefft, 2004; Moseley, 2001). A collection of case studies from Sub-Saharan Africa on the interconnection between cotton production, rural

development, and global economy has been assembled in the book, *Hanging by a Thread* (2008). However, fewer studies have specifically looked at how institutional arrangements (other than market structure) affect the ways producers' constraints and concerns are solved and on their impact to cotton sector performance.

Gray (2008) referred to local realties to describe institutional constraints facing Burkinabe cotton producers, such as access to fertile land, indebtedness, corruption, transportation, and late payment. However, there is not an attempt to estimate their effects on cotton performance. In their case study, Gouse et al. (2008) discussed institutions, but with regard to the adoption of new technology, GM cotton varieties, whereas Tschirley et al. (2008) analyzed them with regard to cotton market reforms. Particularly, they looked at how the pre-reform institutional arrangements in five East and Southern African countries have influenced current challenges facing their respective cotton sectors and their performance.

In addition to Tschirley et al. (2008), many works have been done recently on market structures and cotton performance (e.g. Tschirley et al., 2010; Tschirley et al. 2009; Poulton et al. 2004). Main conclusions are that pre-reform institutional arrangements influence the reform path chosen by each country (path dependency) and that sector typologies (national monopoly, regional monopolies, concentrated, competitive, and hybrid market structures) influence cotton performance differently. For instance, competitive cotton sectors offer higher prices to farmers, but struggle to provide adequate inputs on credit and, therefore, yields are low. Concentrated cotton sectors are more effective in the provision of inputs on credit, but they charge farmers more and pay them less. To illustrate the path dependency concept, cotton sectors

historically managed by parastatals are more likely to choose regional monopolies as post-reform institutions. Similarly, Delpeuch et al. (2010) used a stylized contracting model to analyze the relationship between market structures, equity, and efficiency in Sub-Saharan cotton sectors. They argued that world prices, government intervention, post-reform competition, and the degree of inefficiency in parastatals currently make the reform process less attractive for West and Central African countries than it was for the East and Southern African countries a decade ago. These studies demonstrate that market structures matter to performance, but say little on how institutional arrangements, such as farmers' organizations, have influenced cotton reforms and performance.

The relationship between institutional arrangements (other than market structure) and cotton performance in post reforms has recently received some attention. In his work, Baffes (2009) looked at the history of the Uganda cotton sector and at its current institutional set-up as explanations to its post-reform performance. Although the lack of cooperative structures, high cost of credit, and low quality of seed cotton are all limiting institutional factors, he argued that low on-farm profitability associated with growing cotton is the key reason to poor performance.

Benefits and limits of farmers' organizations that characterize the Malian cotton sector at the village level have been depicted by Koenig (2008) and Lacy (2008). However, neither the village associations nor the cooperatives have been explicitly seen as institutional arrangements that shape reforms and performance in the Malian cotton sector. Conversely, Goreux (2003) considered explicitly the empowerment of the CFA cotton farmers as an important institutional change. Note, however, the role of social

and political institutions, such as the caste system, on the internal functioning of Malian farmers' organizations has been excluded from these descriptive studies.

Although institutions matter to cotton sector performance, they have received little attention from researchers. As Fok and Tazi (2004; p.1) pointed out:

"[…] few people are aware of the crucial role of successful institutional arrangements that induced the actual adhesion of farmers to cotton production. Furthermore, most external analysts still hold the image of rigid institutional arrangements inherited from the colonial times while these arrangements evolved a lot during the last five decades".

Although many works have been done on the impacts of institutions on economic growth, fewer studies have looked at their effects on specific agricultural sector performance. For instance, the vast majority of research done on cotton performance has focused on supply responsiveness, supply elasticity, and farmers' efficiency while ignoring institutional constraints in their framework (e.g. Vitale et al. 2009; Douya, 2008; Shepherd, 2006). The exceptions are Kaminski and Thomas (2010) and Brambilla and Porto (2007) studies, where institutions have been incorporated through the use of binary variables in their regressions. Thus, research on the specific effects of disaggregated institutional factors on cotton performance is limited.

Moreover, the majority of the (already) limited quantitative studies on institutions have focused on a single country case. The little empirical cross-country research that has been done on cotton in Africa has focused mainly on the adoption of new technology, such as BT cotton (Cabanilla, 2005; Elbehri and Macdonald, 2004). Of these, few have controlled for institutional arrangements (Falck-Zepeda et al., 2008).

Table 2-4 lists the relevant research related to African cotton sectors and performance. The aim of this table is to put in perspective the work that has been done so far, and the gaps in the literature, in order to better understand the contribution of this research. Studies have been categorized as either qualitative or quantitative, and as single country case or cross-country analysis. Furthermore, a distinction has been made on whether the effects of institutions on cotton sector performance have explicitly been the main focus of the analysis (where yes = main focus).

Given that reforms are still ongoing in the Malian cotton sector, Chapter 5 will contribute to the literature by providing a detailed update on the new institutional changes and on their effects on performance. Chapter 3 will bridge a gap in the literature by empirically assessing the individual impact of institutional factors on cotton supply. To the best of my knowledge, Chapter 4 will be the first empirical quantitative cross-country study on institutions and cotton sector performance.

Concluding Statements

In Chapter 2, the relevant literature on institutions has been reviewed and linked to development and trade concepts through examples from the Malian cotton sector. The general conclusions that can be drawn from this review are:

- Institutions do matter and policy reforms that ignore them often fail to achieve the desired results.
- Absent or weak institutions have been shown to lead to opportunistic behaviors that impede economic performance by increasing costs.
- Despite general acceptance that institutions can affect economic development, effects of institutions are not easily quantified, and empirical studies on their impacts on agricultural sector performance are limited.

One objective of this study is to address this shortcoming in the literature by qualitatively and quantitatively analyzing the impact of institutions on the performance of

the cotton sector in Mali. Specifically, the role of institutions on cotton performance will be empirically estimated in two ways. First, using secondary data collected during my visit in May/June 2009, Chapter 3 will empirically examine the supply response of Malian cotton producers to both price and institutional arrangement factors. The empirical framework will involve a balanced panel dataset for the six Malian cotton regions over the period 1998-2008. Second, Chapter 4 will quantitatively analyze local realities of cotton producers in Benin, Burkina Faso, and Mali in order to better understand internal constraints and how they impact cotton farmers' technical efficiency in each country. This analysis will be using a unique dataset based on individual farmer surveys conducted in each country during summer 2009 by the "Africa Power and Politics" research team[15]. Then, using a John R. Commons framework, the evolution of institutions in the Malian cotton sector and the (un)intended consequences on economic performance will be discussed in Chapter 5, starting with the country' Independence in 1960 to the current reforms in 2010.

[15] The "Africa, Power and Politics (APP)" is a research program funded by the Department for International Development (DFID) and Irish Aid. The Center for African Studies at the University of Florida is one of their partners. For more information, see www.institutions-africa.org

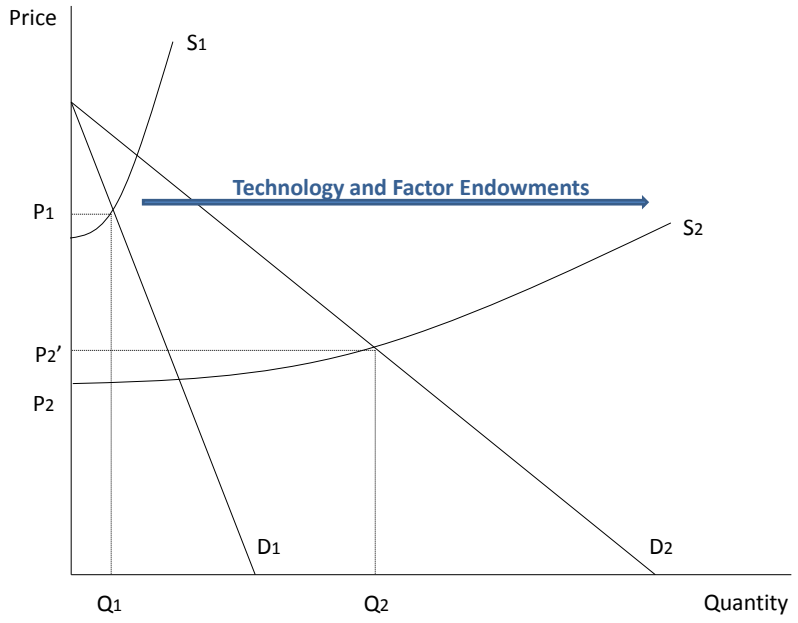

Figure 2-1. Impacts of Technology and Factor Endowments on Supply and Demand (Source : Adapted from Dorward et al., 2009)

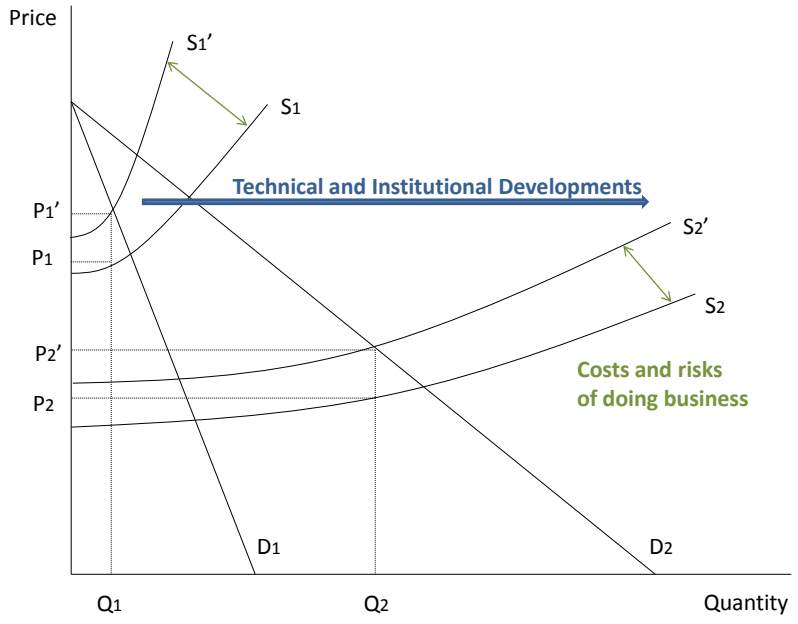

Figure 2-2. Impacts of Technical and Institutional Developments on Supply and Demand (Source : Adapted from Dorward et al., 2009)

Table 2-1. Levels of Institutions

Levels	Purpose	Theory	Economic Streams
1) Embeddedness: Social environments (e.g. informal institutions, traditions, norms, religious beliefs)	Protect, preserve and empower	Social theory (e.g. anthropology, sociology)	OIE (e.g. Veblen)
2) Institutional Environments: Set of fundamental political, social, and legal rules (e.g. property rights, laws, and constitutions) that govern economic and political activity	Create the right institutional environment	New institutional economics of history (NIEH) – public goods	OIE (e.g. Commons) NIE (e.g. North)
3) Institutional Arrangements: Governance, play of the game (e.g. gift exchanges, hierarchies, and markets)	Create the right governance structure	Transaction cost economics (TCE)-private goods	NIE (e.g. Williamson)
4) Neoclassical analysis: Performance (e.g. prices, quantities, and incentives)	Create the right marginal conditions	Neoclassical economics (e.g. structural adjustment programs)	Neoclassical

Source: Adapted from Kirsten et al. (2009) and Williamson (2000)

Table 2-2. Positive Outcomes and Incentive Issues Associated with Governance

Prerequisites of market economies	Positive Outcomes	Incentive Issues	Distributional Issues
1) Security of property rights	Saving, investment, higher productivity	Capital, labor and time are used unproductively on protecting property	Property rights are manifestations of "public" choice to empower some while imposing duties on others
2) Enforcement of contracts	Reduce incentives to cheating and opportunistic behaviors Lower transaction costs	Adverse selection, moral hazard Fewer transactions Higher transaction costs	Enforcement is not costless. Resources spent on enforcement have opportunity costs that compound their impact.
3) Collective action	Provision of public goods and management of common pool resources	Free riding behaviors	Require the "non-elites" to collectively accept their situation and status as "non-elites"

Source: Based on Dixit, 2009

Table 2-3. Market Failures and Associated Coordination Principles

Types of Risk	Market Failures	Market Coordination	Stakeholders
Late purchase of fertilizers and inadequate access to inputs on credit	Inability to purchase fertilizers in desired quantity and timeframe leads farmers to plant less than optimum acreage and to divert inputs, leading to low yields	Improve procurement processes; enhance village-level storage facilities	Ginning firms, farmers' organizations, banks
Delay in seed delivery and seed cotton collection & payment	Farmers plant smaller area than optimum, liquidity constraints	Promptly provide inputs and payments	Ginning firms, farmers' organizations
Inappropriate technical package to farmers	Package purchased/used below optimum	Realign technical optimum with economic optimum	Ginning firms, government, farmers
Lack of timely and quality transport services	Seed and cotton quality is impaired: farmers less willing to plant cotton	Eliminate free rider problems in transport services (e.g. vertical integration)	Ginning firms, transporters, farmers
Improper cotton grading	Ginning firms' contract with traders is in peril	Eliminate free rider problems in grading (e.g. vertical integration)	Farmers' organizations, ginning firms
One-tier pricing schemes paying at the end of the season	Risk-averse farmers plant less than optimal amount	Reduce price risks to farmers (e.g. move to two-tier pricing schemes)	Ginning firms, farmers
One-tier pricing schemes paying only at the start of the season	Low incentives to perform well for ginning firms facing high market risks	Reduce price risks to ginners (e.g. move to two-tier pricing schemes)	Ginning firms, farmers
No requirement for ginners to reveal their financial accounts	Ginning firms overestimate costs so to get government support	Increase public information and transparency of companies accounts	Ginning firms, farmers' organizations, government

Source: Modified from Serra (2008)

Table 2-4. Literature on Institutions and Performance in African Cotton Sectors

	Institutions	Single Case Country	Cross-Countries
Qualitative	No	Koning (2008) Lacy (2008)	Tschirley et al. (2009) Poulton et al. (2004)
	Yes	Tefft (2010) Baffes (2009) Gray (2008) Fok (2007) Fok and Tazi (2004)	Tschirley et al. (2010) Delpeuch et al. (2010) Tschirley et al. (2008) Fok (2008) Goreux (2003)
	Yes	Chapter 3	
Quantitative	No	Vitale et al. (2009) Douya (2008) Audibert et al. (2003) Chakraborty et al. (2002)	Shepherd (2006) Cabanilla (2005) Elbehri and Macdonald (2004)
	Yes (aggregated and/or dummies)	Kaminski and Thomas (2010) Brambilla and Porto (2007)	Falck-Zepeda et al. (2008). Chapter 5
	Yes (individual)	Chapter 4	

Source: Author

CHAPTER 3
INSTITUTIONS IN THE MALIAN COTTON SECTOR: DETERMINANTS OF SUPPLY

Introductory Statements

Cotton is considered the most important cash crop commodity in Mali, significantly contributing to the national economy by providing income and employment to over three million smallholder farmers. Moreover, cotton has positive residual crop rotation effects on cereal production, gives rise to jobs in the manufacturing and transport industries, and is a major source of foreign exchange and revenue for the Malian government. Despite historic successes, the Malian cotton sector is now facing external (e.g., low international prices) and internal (e.g., high credit default rates) challenges that are threatening to offset or slow down the economic growth derived from cotton exports. The decline in world prices, combined with increases in input costs, mismanagement, and ill-performing credit schemes over the last several years have undermined profitability of the entire Malian cotton sector.

The resulting cotton crisis put sector reforms, proposed in the 1990s under structural adjustment programs, back on the national policy agenda, and accelerated pressure for their execution. The principal objective of these reforms, recommended by the World Bank and the International Monetary Fund, is to liberalize and privatize the cotton sector, under the assumption this will lead to greater market efficiency and competitiveness. While the reform process is still ongoing, Malian cotton production continues to face huge institutional challenges. At the start of the 2000/2001 growing season, farmers' unions organized to protest against low farm-gate prices and the mismanagement of the parastatal ginning company, CMDT (Compagnie Malienne de Développement des Textiles). As a result of their call for a boycott on cotton cultivation

during that campaign, production decreased by about 53% compared to the previous year, and resulted in a significant loss in potential revenue of about 20 billion CFA francs ($29 million) (Tefft, 2010; CMDT, 2009). From the crop years 1997/1998 to 2007/2008, production sharply declined by more than 50%. This recent downward trend in production negatively affects the entire economy through the decrease in export revenue, and the worsening in producers' and the ginning parastatal company's debts.

This study aims to quantitatively assess cotton growers' supply responses to institutional factors that have shaped the sector over the last decade. Specifically, the objective is to analyze the determinants of the recent drop in production in terms of both price and non-price variables. The latter include the date by which farmers receive payment for the cotton they have sold to the gin, the credit recovery rate for farmers' loans, and extension services. This analysis uses a balanced aggregated dataset for the six Malian cotton regions over the period 1998-2008. A fixed effect estimator is used to determine the principal factors responsible for the changes in cotton supply as well as their relative importance. Results provide valuable insights for policymakers seeking ways to boost production and exports of cotton, and consequently reduce poverty.

Existing research on the effect of institutional arrangements on African cotton sectors has been primarily qualitative (e.g. Tefft, 2010 and Fok, 2007) and only a limited number of quantitative studies have been conducted in this area. These empirical studies either disregard the impact of internal institutional changes in their econometric analysis (e.g. Douya 2008; Bond 1983) or incorporate them by means of one dummy variable on the presence or not of marketing reforms (e.g. Brambilla and Porto, 2007; Dercon, 1993). The main contribution of this research is to shed new light on the effects

of institutional factors on cotton supply, by using several important measures of institutional effectiveness, such as farmers' credit recovery rates, date of payment, and extension services, thanks to the dataset's richness and unique nature. Therefore, this study not only provides additional evidence about the effects of pricing policy on cotton supply, but also presents information on the effect of disaggregated internal institutions on cotton supply responsiveness.

Chapter 3 is divided as follow. Section 2 provides an historical background. Section 3 discusses the main institutional factors shaping the Malian cotton sector over the last decade. Section 4 explains the theoretical supply model and Section 5 summarizes the data. Section 6 presents the empirical results. Section 7 concludes.

Overview of the Malian Cotton Sector

The first impetus for cotton sector reforms within the ongoing structural adjustment programs in Mali appeared during the late 1980s and early 1990s. As was the case in other West African countries, the Malian cotton sector was severely affected by a sharp decline in world cotton prices during this time. Poor management and lack of transparency, combined with operating cost inflation due to low international prices, led the CMDT into financial deficit in 1998. To cover these losses, financial resources from the Malian governmental budget were transferred to the CMDT. These transfers then threatened improvements in Mali's fiscal and economic performance brought about by economic reforms of the 1990s (Aksoy and Beghin, 2001). In response to the CMDT financial crisis, the World Bank and the International Monetary Fund (IMF) made their loans conditional on liberalization and privatization in the Malian cotton sector. The proposed liberalization and privatization were intended to foster higher farm-gate cotton prices and rural household incomes through a more competitive market structure. A

transfer of some CMDT activities to the private sector and to farmers' organizations was also proposed to improve the management of CMDT and lighten its debt burden, thus reducing the need for fiscal outlays from the government.

The privatization of the CMDT was initially planned to occur in 2005. Following an unsuccessful public offer of sale, the government decided to split the CMDT into a main holding and four regional monopolistic firms, whose majority share (61%) was to be transferred to private operators. The completion date was postponed to 2006, then to 2008, and it is now expected to occur in 2011 (Sako, 2009). Indeed, the Malian government is now analyzing the purchasing offers made by one national and four international investors to ensure that their interests go along with the long-term success of the Malian cotton sector. Each monopoly ginning company will be in charge of providing essential inputs on credit, purchasing, and marketing cotton produced in their assigned geographical zone.

The recent downward trend in cotton supply has had negative repercussions on the economy by shrinking producers' income, enlarging ginning company debts, deepening the country's balance of payment deficits due to lower export revenues, and leading to a reduction in government expenditures on education and health care. As reported by Fok (2007), the crisis facing the cotton sector has considerably slowed down money flows, since villagers are spending less on cement, sheet metal for roofs, motorcycles, loincloths, and even on sugar, which is seen as a luxury good.

Institutional Effectiveness

This section presents the key variables used to proxy institutional effectiveness in the Malian cotton sector over the last decade and discusses their current and eventual impacts. Specifically, date of payment, the farmers' loans credit recovery rate

associated with the inter-linked input-credit-cotton markets, and the provision of extension services are explained in detail. As mentioned by Dorward et al. (2009), effective institutions play three different roles. First, they facilitate coordination of exchange. For instance, a high level of coordination is required to ensure that transactions are reliable, in terms of prices, quantities, and qualities of services and goods traded, and timing in payment. As it will be seen, timely payment is a key issue in the Malian cotton sector, with important consequence on cotton farmer production decisions. Second, effective institutions promote good resource management while encouraging trust. For instance, a good extension service system leads farmers to make better decisions that will enhance their long-run productivity. However, this can only work well if the relationship between producers and extension agents is based on trust. Third, effective institutions provide incentives for complying with given norms, and thus solve collective action problems. The discussion on the joint liability program prevailing in the cotton cooperatives will show how the inability to exclude non-performing farmers may discourage well-performing farmers to grow cotton.

Date of Payment

Farmers typically complain about delays in receiving their payments from cotton sales and also about the fact that the length of the delay has increased over time (CTA, 2009). Although producers should technically be paid soon after the harvest, it is not uncommon for many of them to receive their payment after the next year's planting season. The peak in cotton harvest occurs during the months of December and January. Planting season starts with the first rains, which occur in late May and early June. Some producers received their payment for the crop year 2007/2008 in November 2008, which almost coincides with on time payment for the next crop year (2008/2009).

This situation is not unique to Mali. According to Dercon (1993), Tanzanian farmers have experienced delays in their payments, creating a disincentive to produce cotton. Delays in payment reduce farmers' capability to access inputs necessary for the upcoming crop year and to repay their previous loans on time. They can be regarded as a form of market failure, leading farmers to plant smaller acreage of cotton than the optimum and to divert cotton inputs to other crops (Serra, 2009).

Market Inter-Linkages

Provision of inputs, mainly seeds and fertilizers, is provided by the CMDT, which does not require any payment until the harvest. After the harvest, input costs are directly deducted from CMDT's payments to farmers for their harvested cotton. The inter-linkage between the input, credit, and cotton markets aims to ensure higher loan repayment rates. The next year's provision of inputs is also conditional on previous payment. Nevertheless, some inputs are diverted by farmers to other crops or sold on the market for immediate liquidity. Inputs are generally sold on the market at a price below their purchase price on credit. Otherwise, it would be more profitable for buyers to acquire them on credit with the CMDT. For instance, households that struggle to be food self-sufficient at the beginning of the cotton season, which coincides with the end of the dry period, are more likely to purchase chemical products on credit and to sell them at lower prices on the market in order to access liquidity to buy food. With a sub-optimal use of fertilizers, insecticides and herbicides, cotton yields are low and thus, farmers often fail to fully repay their loans. This credit default reduces their ability to access inputs for the next crop year and so on.

Cotton growers from the same village can form cooperative societies, under which they collect, grade and weight unginned cotton as well as manage credit and

cooperative revenues, and distribute equipment and inputs among themselves. A system of joint liability (also known in French as *caution solidaire*) prevails in the cotton producer cooperative societies (known as SCPCs). If one or more producers are unable to repay their input loans to the CMDT, all the other members have the obligation to step in. In the instance in which the cooperative revenues are not enough to cover the unpaid portion, a deduction from each producer's CMDT cotton payment will be made until everything is paid back. The most productive and financially sound cotton growers will be in the very uncomfortable position of repaying other farmers' debts. Joint liability is causing several disagreements in mismanaged SCPCs where good producers face diminishing profit margins due to other members' insolvency.

Although the exclusion of insolvent cotton growers from the cooperative seems a priori a solution, tightly networked social relations prevailing in villages prevent it from happening. Peer monitoring, to ensure that borrowers do not exceed their credit limit capability and use fertilizers as expected, is not a common practice inside cooperatives. Peer pressure, exclusionary pressure and forced acquisition of defaulters' assets are not mechanisms reported as being used by cooperatives to sanction defaulting members. As Paxton et al. (2000) also found, harmony inside villages is often considered more important than high repayment rates.

Extension Services

The CMDT, through producer associations, have offered reading and writing lessons to the rural population. With the ongoing reforms, the CMDT has gradually withdrawn from rural and social development activities and consequently, literacy is not a priority anymore. As discussed by Rivoli (2006), literate producers have an advantage over illiterate farmers since they are able to read and understand dosage instruction for

chemical products and to analyze the potential impact of new policies. Moreover, under the liberalization and privatization process, the CMDT has refocused its activities mainly toward transformation and marketing of cotton. As a result, the CMDT has provided fewer technical training sessions on soil erosion, organic manure and animal nutrition to farmers. This degradation in extension services might be costly in terms of production and export revenue. For example, the CMDT agents previously provided guidance to farmers on how to adequately feed their draft animals during the dry season, when grazing is scarce. With this training, farmers were able to use their cattle to plough the land earlier in the season, without compromising their animals' health. In the absence of this technical support, some farmers now wait for pastures to grow green with the rains before utilizing their cattle for ploughing. This however delays the sowing and compromises production.

Model Specification

The choice of explanatory variables to evaluate the impact of institutional factors on cotton production over the last decade is based on previous qualitative (Tefft, 2010; CMDT, 2009; Fok, 2007) and quantitative (Dercon, 1993; Askary and Cummings 1977) studies as well as on fieldwork conducted during the months of May and June 2009 in Mali. During this trip, structured interviews with different stakeholders (e.g., farmers, producers' union leaders, as well as representatives of the CMDT, banks and NGOs) were conducted in order to get a better understanding of local realities and economic institutions governing the cotton industry. Information collected through interviews provided deep insights into which institutions have shaped the cotton industry and how they might have possibly affected production.

The estimation of price and non-price relevant variables on cotton sector responsiveness is built on a supply model (e.g., Elobeid and Beghin, 2006; Fadiga et al., 2005; Dercon, 1993). The traditional framework consists of modeling supply, in terms of production, yield or acreage, as a function of current/lagged output and input prices. Following Walsh (1944) and Askary and Cummings' (1977) reasoning, acreage is chosen as the dependent variable since it is less susceptible to exogenous shocks, such as weather conditions, pests and diseases and cultural practices, than production and yield. A production function is also estimated using the same set of explanatory variables and compared to the acreage regression as a robustness check. This model extends prior research by taking into account regional disparities and institutional factors.

Under this framework, harvested cotton acreage ($A_{r,t}$) and cotton production ($Prod_{r,t}$) are a function of farm-gate cotton prices (P_t), input costs per hectare (including fertilizer, insecticide, herbicide and seed) (C_t), and non-price variables that would capture the effect of institutional factors. Specifically, these include delays in farmers' payment the previous year (D_{t-1}), loan repayment rates in the previous year ($RR_{r,t-1}$), number of agents trained to provide technical assistance and literacy lessons to farmers last year as a proxy for extension services ($ES_{r,t-1}$), a time dummy to capture the effect of the 2000/2001 boycott movement (B_t), and a time trend to account for any changes in supply over time. The variable $DEP_{r,t}$ denotes the dependant variable, acreage ($A_{r,t}$) or production ($Prod_{r,t}$) and the subscripts r and t represent regions and crop years, respectively.

$$DEP_{r,t} = f\,(P_t, C_t, D_{t-1}, RR_{r,t-1}, ES_{r,t-1}, B_t, \text{Trend}) \qquad (3\text{-}1)$$

The Nerlovian model, which takes into account price expectation in the estimation of a supply response, is not suitable for this analysis (Nerlove, 1956). Unlike other agricultural markets, where price is determined by the supply and demand equations, farm-gate cotton price is set by the CMDT at the beginning of the planting season. Therefore, farmers make their decision allocation based on a set price and not on their expectation of the anticipated price. Unlike past empirical studies (Baffes, 2009; Baquedano and Sanders, 2008) that evaluated changes in cotton quantity with respect to lagged price, this regression uses the current panterritorial price announced by the CMDT early in the planting season as done by Vitale et al. (2009). Given that the actual price is exogenously fixed by the CMDT, its inclusion in the right-hand-side of the supply equation does not lead to endogeneity.

The constant increase in petroleum price and its derivative products, such as fertilizers used to grow cotton, is considered as a main factor that has contributed to undermining the cotton sector through lower production and productivity (CMDT, 2009). Even though different exogenous factors could influence fertilizer costs and farm-gate cotton prices, they appear to be highly correlated with each other in the context of a small dataset (correlation=76%). As seen in Figure 3-1, farm-gate cotton prices and input costs per hectare, which are mainly composed of fertilizer costs, have followed a similar trajectory over the last decade.

This highlights the specificity of the institutional pricing arrangement in the Malian cotton sector until recently. Although the price mechanism and call to tender to purchase inputs are being reformed in order to better link the former to the international market and transfer the latter activity to a committee composed of representatives from

the ginning companies and the farmers' organizations, these functions have been traditionally under the parastatal control. Indeed, the CMDT has been prominent in buying and distributing inputs to farmers as well as setting the pan-territorial farm-gate cotton price each year.

The inclusion of both variables in the regression, as suggested by Askary and Cummings (1977), might lead to a collinearity problem. Although no irrefutable test exists to detect the presence of multicollinearity, some elements might serve as warnings. On one hand, the relatively high correlation between the pairs of estimated coefficients for farm-gate cotton prices and input costs per hectare [1] and the large condition number[2] (K=52) suggest that multicollinearity should be a concern (Williams, 2010, Greene 2003). On the other hand, Cameron and Trivedi (2005) consider that multicollinearity becomes problematic only with a condition number exceeding 100. The point at which collinearity is considered a critical issue is not clear-cut but rather arbitrary.

In the presence of multicollinearity, the inclusion of both variables would generate higher standard errors and lower significance levels which might lead to finding one or more explanatory variable coefficients not statistically significant from zero. Dropping the input costs or farm-gate cotton prices from the regression would allow one to estimate the parameters of the model more precisely, but these parameters are more

[1] The correlations between pairs of estimated coefficients (farm-gate cotton prices and input costs per hectare) are -58% and -63% for the acreage and production regressions respectively.

[2] If two variables are perfectly correlated, then the variance is infinite and the inverse matrix $(X'X)^{-1}$ cannot be computed. The full rank condition is needed to inverse a matrix. In case of high but not perfect correlation, the condition number of the matrix (X'X), which is the square root of the ratio of the largest to smallest eigenvalue of X'X can be computed. If the matrix (X'X) has a large condition number (value greater than 20), then it is difficult to invert it and thus, multicollinearity is considered problematic. (Greene, 2003)

likely to be biased. Indeed, if the dropped variable truly belongs to the model, then a specification problem arises and all the other estimated coefficients would be biased. In this specific case, the trade-off of some bias for smaller variance is worthwhile since I am more interested in the significance of the estimated institutional parameters than their magnitude per se. Nevertheless, results from all regressions, obtained from including both farm-gate cotton prices and input costs and excluding one or the other, will be reported. Using a consumer price index, nominal farm-gate cotton prices and input costs have been converted into real values using the base year 2000 (IMF, 2007).

Given that cotton growers complain about increasing delays in payment over the years, a duration variable has been constructed to capture this effect on cotton supply. Although Dercon (1993) noticed the importance of timely payment, he did not include this non-price variable in his regression, since he assumed that delays of payments to farmers were time-invariant. The number of days passed (D) since the beginning of the planting season, set to May 31, up until the date by which all producers have been paid, is calculated in order to create a numerical value that captures delays in payment. Since I am interested in analyzing how delays in cash receipts for cotton from the previous crop year affects producers' motivation to grow cotton in the current year, a lagged variable is used.

The rates of past credit repayment (RR) by farmers' cooperatives are likely to influence their production decisions in two ways. First, cooperatives that struggle to repay their last year loans would have more difficulty in obtaining new ones this year than those with good credit records. As a result, they might incur more difficulty in accessing the inputs necessary to grow cotton. Second, cooperatives with bad credit

recovery are more likely to discourage performing farmers from planting since they would have to use their own profit to cover the losses of others because of joint liability. A lagged loan repayment rate variable has been created by taking the ratio of the total amount reimbursed over the total amount payable from the previous year in order to capture cotton growers' responses to overindebtedness. A value closer to 100 means that credit has been repaid in a timely manner while a value near 0 represents incapacity to pay back loans. Given that the data on hand are disaggregated at the regional level, it is impossible to isolate the impact of credit recovery by cooperatives on their own cotton supply response. Nevertheless, this variable can provide insight about the effect of credit on cotton production and might clarify the effects of joint liability to some extent.

The number of agents trained by the CMDT to teach literacy in cotton producing regions has been added to the number of agents trained to provide technical assistance in order to create a proxy for extension services (ES). Following the CMDT withdrawal from financing and supervising literacy training sessions, the rates of literate people have considerably declined since neither the government nor the NGOs fully stepped up to take care of it. Our proxy variable for extension services is lagged by one period in order to take into account the lapse of time before return to extension services become tangible (Poulton and Tschirley, 2009).

The dataset regroups information per region allowing for more control over geographical features. Unobservable factors that might vary per regions such as soil quality, topography, proximity to the capital, Bamako, would be controlled for by regional dummies. Given the importance of the farmer boycott, a time dummy variable for the

crop year 2000/2001 is included in the regression in order to capture its effect on cotton supply. Even though this time dummy might capture other specificities to the 2000/01 crop year, no other major event was reported. Therefore, this time dummy variable is considered to mainly represent the farmer strike movement. A time trend is also included in all regressions[3].

Data

Nearly all data related directly to the Malian cotton industry come from CMDT electronic and paper files. This is a rich and unique dataset that contains information on prices, non-price variables at the regional and national level for the period 1998-2008[4]. Table 3-1 provides a statistic summary of the variables used in the analysis.

Data are disaggregated by the six cotton regions of Mali: Fana, Bougouni, Koutiala, Sikasso, San, and Kita. Cotton historically has been produced in the southern region near the Niger River, also known as the Old Cotton Basin. Each year, 50% to 70% of the nation's cotton is still grown in the Old Cotton Basin, which includes the whole region of Koutiala, and the northern parts of Fana and Sikasso. Spreading out from the Old Cotton Basin are the regions of Bougouni and San as well as the southern parts of Fana and Sikasso. The region of Kita, on the west side of Mali, which started growing cotton in 1995, is considered to be the New Cotton Basin.

[3] Acreage and production models using only time dummies were run and only the time dummy for the crop year 2000/01 showed up statistically significant. Then, a joint test was run to see if all the time dummies were all equal to zero. In both cases, the null hypothesis that all time dummy coefficients are jointly equal to zero was not rejected at the 10% level of significance. Therefore, no time fixed effect is needed. However, a time dummy variable to take into account the farmer boycott movement in 2000/01 and a time trend are included in both regressions. In comparison, the null hypothesis that region dummy coefficients were all equal to zero was strongly rejected at the 1% level of significance in both models. Therefore, region fixed effects are needed.

[4] I am very grateful to the CMDT for giving me the permission to access such a rich and unique dataset.

Empirical Results

Using a balanced panel dataset, this study estimates cotton grower supply responsiveness to prices and institutional arrangements. The advantage of panel data is that two different kinds of additional information are captured. First, cross-sectional information reflects differences across regions and second, time-series information reveals variations within regions over time. Even though past studies (Elobeid and Beghin, 2006; Dercon, 1993) used an ordinary least square estimator to evaluate their supply function, this regression technique might not be optimal while using panel data, since the estimated coefficient might be subjected to unobservable effects (Cameron and Trivedi, 2005). The fixed effect estimator, which exploits special features of the panel data, is therefore used to estimate the relative effects of price and non-price variables on cotton supply. The specific linear panel regressions for the model are written as,

$$DEP_{r,t} = \alpha_r + P'_t\beta_0 + C'_t\beta_1 + D'_{t-1}\beta_2 + RR'_{r,t-1}\beta_3 + ES'_{r,t-1}\beta_4 + B'_t\beta_5 + Trend\beta_6 + \varepsilon_{r,t} \quad (3\text{-}2)$$

$$r = 1, \ldots, 6; \quad t = 1, \ldots, 11$$

The subscript r indexes the six cotton regions, t indexes the crop years from 1998 to 2008 and α_r represents the unobservable regional effects. Under the fixed effect (FE) estimator, the random variable (α_r) is assumed to be correlated with the observable explanatory variables. Given that the dataset contains a short time-series (1998-2008), a linear functional form is more suitable in order to save degrees of freedom (Elobeid and Beghin, 2006). Both simple linear and double-log functional forms have been used in previous studies on supply responsiveness. In this study, a simple linear specification

is chosen since the results from the Box-Cox test show that it has a better goodness-of-fit than the double-log[5].

Acreage Model

Table 3-2 shows results for the FE one-way acreage model corrected for first-order autocorrelation[6]. The first column reports the estimated coefficients from the equation including all explanatory variables, whereas columns 2 and 3 excludes input costs and farm-gate cotton prices, respectively, as a way to solve for potential multicollinearity. The estimated parameters for input costs and farm-gate cotton prices are statistically insignificant across all specifications, whereas the magnitude and level of significance of the other parameters remain relatively similar.

The estimated coefficient of farm-gate cotton prices is not statistically significant from zero. This insignificance might suggest that farm-gate cotton prices are not one of the main factors influencing farmers' cotton acreage decisions. In addition to providing a guaranteed income, farmers might continue to devote land to cotton independently of small changes in farm-gate cotton prices in order to keep access to inputs on credit. As mentioned earlier, the input-credit-cotton markets are strongly inter-linked. On one hand, it is very difficult for non-cotton growers to access fertilizers. Given that cereal

[5] To compare whether the double-log or linear functional form is the most appropriate, we cannot only compare the two R-squared results, since the total sum of squares (TSS) in a linear dependent variable is different from a logarithmic one. Therefore, the data has to be transformed in order to make the residual sum of squared (RSS) comparable. Then, both models can be compared using the BoxCox test {BC=n/2*log(RSSlargest/RSSsmallest) ~ χ^2_1}. If the null hypothesis that both models are similar is rejected, then the model with the lowest RSS is considered to have the best goodness-of-fit. In this case, the linear model is statistically different from the double-log and has the smallest RSS.

[6] The Wooldridge test for autocorrelation in panel data rejects the null hypothesis that there is no first-order autocorrelation at the 5% level of significance for all three specifications. The null hypothesis of homoskedasticity fails to be rejected at the 10% level of significance for all three specifications. Therefore, our FE estimates for the acreage equations have been corrected for first-order autocorrelation only.

farmers cannot provide guarantees that they will pay back their loans, financial institutions are more reluctant to lend them money. On the other hand, extending loans to cotton producers is safer since the CMDT commits to buy the entire cotton production at a set price and the credit is directly deducted from the cotton payments made to farmers. Therefore, growing cotton can be seen as an incentive to gain access to inputs on credit. Even though the results suggest that farm-gate cotton prices do not significantly influence the number of hectares devoted to cotton, they do not indicate, at this stage, whether production is impacted by prices. Facing low farm-gate cotton prices, farmers might decide to use their fertilizers, obtained on credit through the CMDT, on their cereal crops. In this case, decline in cotton prices would lead to a reduction in cotton production but not necessarily to less acreage.

The imperfection in the input-credit markets is also more likely to explain the statistical insignificance of the input cost parameter. Indeed, this insignificance should not be directly interpreted as a total farmers' unresponsiveness to costs but should be put in perspective with their local realities. The input cost per hectare variable can be decomposed into two elements: input costs, mainly fertilizers, and quantity of inputs.

As seen in Figure 3-2, while input costs have followed an upward trend due mainly to increases in fertilizer costs, the quantity of inputs has been declining. Given the incompleteness of input and credit markets and their links to cotton, farmers appear to be less responsive to changes in input costs than otherwise. However, there is no indication at this stage of whether inputs purchased on credit are truly applied to cotton fields or diverted to cereals. Regressions with production as the dependent variable instead of acreage will provide further insight on this.

The number of days after the start of the new cropping season (i.e., the number of days after May 31) during which producers have to wait to be paid influences negatively the acreage of cotton, as expected. The estimated coefficient of delays of payment is statistically significant at the 1% level. One more day of delay in farmers' payment reduces the regional average land devoted to cotton by about 300 hectares. To put this result into perspective, a month late in payment would contribute, on average, to a 13% drop in the number of cotton hectares. The finding suggests that date of payment is time-variant and that failure to make timely payment is costly, since it discourages producers from growing cotton.

The estimated repayment rate parameter is positive and significant at the 1% level. Therefore, acreage declines with deterioration in the credit repayment rates of the previous year (worsening of credit record). Indeed, the result suggests that a 10% drop in the credit repayment rate would reduce, on average, the number of cotton hectares by 8%. Higher credit default rates make it harder for farmers to access inputs necessary to start the new cropping season. Moreover, overindebtedness is more likely to create a disincentive for profitable farmers to keep producing cotton, since their profits would be used to cover other farmers' losses. Those outcomes are consistent with Brambilla and Porto's (2007) conclusions and strengthen the argument that input and credit institutions are important determinants of cotton supply.

The insignificance of the estimated parameter measuring technical assistance and literacy does not necessarily mean that extension services are irrelevant to explain cotton supply, but rather suggests that our proxy possibly suffers from a major lack of precision. The time dummy parameter capturing the effect of the farmers protest is

statistically significant at the 1% level and is negative, as expected. From the crop year 1999/00 to 2000/01, national cotton acreage went down from 442,496 hectares to 211,724 hectares. From this important decline, about 32,000 hectares, on average, were lost in each of the six regions (~50%) and these loses are estimated to be due to the cotton grower boycott movement.

Production Model

Results from equation (2) using production rather than acreage as the dependent variable are also reported in Table 3-2[7]. The third column reports the estimated coefficients from the equations including both input costs and farm-gate cotton prices whereas they have been dropped from the fourth and fifth columns, respectively. Unlike the acreage regression, the estimated parameter for input costs is statistically significant with production as dependant variable whereas cotton prices remain insignificant, when both are included in the regression. This might be due to the relatively high correlation between input costs and farm-gate cotton prices. After dropping input costs, as a way to solve for the potential multicollinearity problem, cotton prices turn significant at the 5% level.

The magnitude of the other estimated parameters is very similar across both regressions but they differ in terms of significance level. For instance, both delays in payment and repayment rates have larger standard errors and therefore, they are now statistically significant at the 5% level. Results from the production model suggest that delaying farmers' payment by a month would reduce, on average, the regional cotton

[7] The Wooldridge test for autocorrelation in panel data rejects the null hypothesis that there is no first-order autocorrelation at the 10% level of significance for all three specifications. The null hypothesis of homoskedasticity is rejected at the 10% level of significance for two of the specifications. Therefore, our FE estimates for the production equations have all been corrected for first-order autocorrelation. Specifications 4 and 6 have also been corrected for heterokedasticity.

production by 11%, whereas a 10% decline in credit repayment rates would induce, on average, a 7% drop in regional production. Almost 50% of the decline in the average quantity of cotton production by region during the crop year 2000/01 is due to the farmers' boycott movement.

One of the two main differences between the acreage and production regressions regards the farm-gate cotton price estimate. Indeed, the estimated parameter for cotton prices is statistically significant at the 5% level under the production function after dropping input costs. As expected by production theory, a reduction in farm-gate cotton prices would lead to a drop in cotton supply. For instance, decreasing the average farm-gate cotton prices to 145 CFA/kg from 160 CFA/kg, would contribute, on average, to an 8% reduction in cotton production. This finding also supports our assumption that farmers might not react as strongly to a decline in cotton prices, in terms of acreage, in order to keep access to inputs on credit. One has to keep in mind that access to credit is a major constraint in many developing countries such as Mali. Given that no efficient monitoring is done to ensure that inputs (such as fertilizers, insecticides and herbicides) bought on credit are only used on cotton and not on cereal crops, diversion is more likely to occur in years of low farm-gate cotton prices.

Secondly, the estimated parameter for input costs per hectare is statistically significant under all production regression specifications. However, the magnitude of the coefficient is attenuated and the p-value is larger when the explanatory variable, farm-gate cotton prices, is also included in the model. A priori, the positive sign of the input costs coefficient might seem counterintuitive. Indeed, the finding suggests that a 10% increase in input costs per hectare would lead to a 21% increase, on average, in cotton

production. However, this positive relationship between input costs and production provides interesting insights on cotton farmers' realities. Under imperfect markets, it is very difficult for farmers to access inputs on credit for their cereal crops. As a result, some of the inputs obtained through the cotton sector are diverted toward cereal fields. Given that all cotton production is guaranteed to be purchased at a set price after the harvest, cotton is seen as a safer income option than cereals. Indeed, for the quantity of cereals that is not used to ensure food security for the household but can be sold, there are no guaranteed outlets and prices are highly volatile[8]. One hypothesis is: As input costs go up, farmers might be more likely to divert less (apply more to their cotton fields) in order to strengthen their capability to repay their loans. In case of defaulting, future access to inputs on credit is more likely to be denied. With more inputs applied on cotton and less on cereals, cotton production increases. A future research objective will be to further investigate the decision process of diverting cotton inputs toward other crops, due to institutional constraints in the credit system, and to measure their effects on farmer cotton revenues and household livelihood.

Results for the institutional variables are very similar in terms of size of the estimated coefficients and significance level across all six specifications. Date of payment, credit default rates and boycott movement explain a large part of the variation in cotton acreage and production that occurred over the last decade.

[8] Models including rainfall and lagged cereal prices as explanatory variables were also run. Given the small dataset and that those variables were insignificant; they have been excluded from the final models in order to save some degrees of freedom. This does not mean that climatic conditions and alternative crop prices are irrelevant but rather the data used do poorly to capture their effects on cotton supply. However, our main findings do not change by including or excluding those variables.

Concluding Statements

This research contributes to the literature by providing new evidence that not only prices, but also institutions, impact farmers' production decisions. Indeed, statistically significant relationships between key factors measuring institutional effectiveness and cotton farmers supply responses were established. Therefore, failure to take them into account would lead to misspecification of the supply regression, and more importantly to misguided policies.

Results suggest that date of payment is time-variant and that timely payment positively influences farmers' decisions to grow cotton. Moreover, credit default rates significantly impact cotton supply. Good farmer repayment rates from the previous year leads to higher cotton acreage and production the following year. As expected, a large part of the decline in cotton acreage during the crop year 2000/01 is due to the farmers boycott movement, which led to a significant drop in output. Being an imprecise measure, the number of agents trained to teach literacy and to provide technical assistance to farmers, which represent a proxy for extension services, does not significantly impact acreage and production in the tested models.

Given the incompleteness of the inputs-credit markets and their close relationship with the cotton sector, input costs and farm-gate cotton prices do not appear to significantly impact farmers' acreage decisions. However, cotton production is influenced by input costs and by farm-gate cotton prices. A rise in cotton prices would positively influence production. Results also suggest an increase in input costs would lead to an increase in cotton production. This might be explained by less inputs diversion (from cotton to cereals) occurring when inputs are more expensive in order to ensure better loan repayment and to preserve future access to inputs on credit.

In sum, cotton exhibits special characteristics that require a good institutional system to ensure that a high degree of coordination among the various stakeholders is achieved. Otherwise, cotton performance is severely affected. Effective coordination is required to ensure prompt payment to producers, good extension services, and high credit recovery rates, among others. To be successful, any policies driven changes in institutional arrangements would have to be gradually implemented and to take into account these local realities. Under specifically targeted institutional changes, the Malian cotton sector would be able to resume its promise of contributing to poverty eradication in Mali's rural sector.

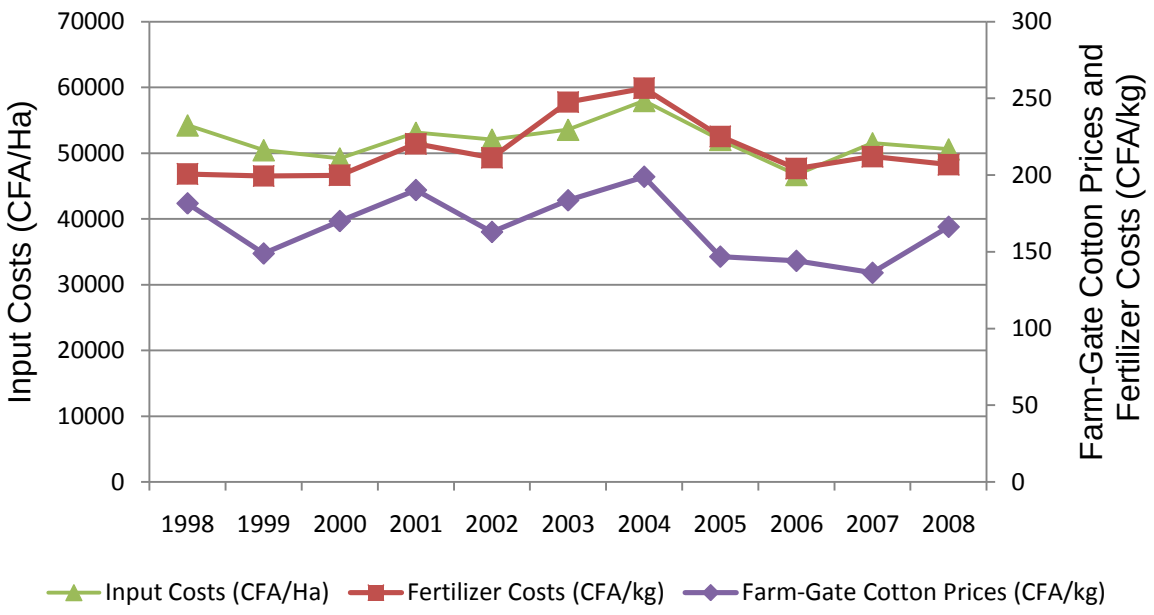

Figure 3-1. Relationships between Input Costs per Hectare, Fertilizer Costs, and Farm-Gate Cotton Prices, 1998/99-2008/09 (Source: Author, based on CMDT archives)

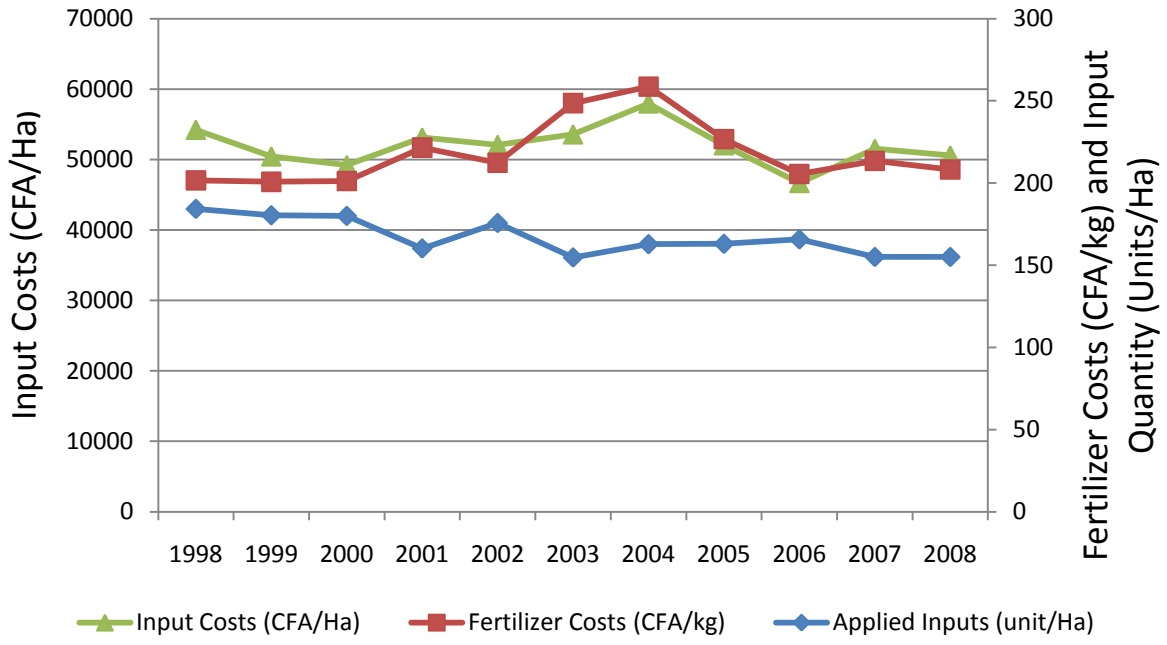

Figure 3-2. Relationships between Input Costs per Hectare, Fertilizer Costs, and Input Quantity, 1998/99-2008/09 (Source: Author, based on CMDT archives)

Table 3-1. Summary Statistics, N=66

Variables	Measurement	Units	Mean	Standard Deviation	Min	Max
$A_{r,t}$	Regional	Ha	68516	35594	10922	139417
$Prod_{r,t}$	Regional	Tons	69436	38689	9006	169973
P_t	National	CFA/kg	160	21	136	199
C_t	National	CFA/ha	51955	2797	46697	57962
D_{t-1}	National	Days	43	48	0	178
$RR_{r,t-1}$	Regional	%	74	23	5	100
$ES_{r,t-1}$	Regional	persons	24	36	0	147
B_t	Dummy	Crop years 2000-2001	----	----	0	1

Source: Author

Table 3-2. Fixed Effect Results for Cotton Acreage and Production, 1998/99-2008/09

Variables	Acreage Estimates (1)	Acreage Estimates (2)	Acreage Estimates (3)	Production Estimates (4)	Production Estimates (5)	Production Estimates (6)
Cotton Prices	156.16	208.42		272.02	379.62**	
	[0.434]	[0.196]		[0.289]	[0.050]	
Input Costs	0.6496		1.29	1.55**		2.87**
	[0.588]		[0.186]	[0.048]		[0.024]
Delays in Payment	-301.91***	-296.82***	-280.95***	-265.75***	-259.44**	-241.98***
	[0.001]	[0.001]	[0.000]	[0.001]	[0.011]	[0.003]
Repayment Rates	529.62***	499.70***	552.99***	488.31***	479.33**	548.41***
	[0.003]	[0.004]	[0.002]	[0.001]	[0.016]	[0.002]
Extension Services	0.1228	-8.50	-1.68	-18.11	27.26	-43.02
	[0.999]	[0.924]	[0.985]	[0.884]	[0.796]	[0.709]
Boycott	-30937.41***	-32542.98***	-31996.92***	-33588**	-34363.73***	-30491.12*
	[0.008]	[0.004]	[0.007]	[0.042]	[0.009]	[0.069]
Time Trend	2029.67	1699.75	1372.36	775.62	327.45	424.98
	[0.450]	[0.527]	[0.556]	[0.414]	[0.917]	[0.674]
Constant	-26111.79	3250.83	-32434.98	-81624.49*	-16216.42	-108836
	[0.614]	[0.921]	[0.541]	[0.075]	[0.680]	[0.110]
R-sq:						
within	0.6067	0.6004	0.6061	0.6039	0.5668	0.5896
Between	0.8421	0.8432	0.8434	0.7685	0.8528	0.7269
Overall	0.4246	0.4120	0.4278	0.3759	0.4082	0.3734
Prob > F	0.0000	0.0000	0.0000	0.0030	0.0000	0.0006

Note: The p-values are in brackets. *** significant at the 1% level, **significant at the 5% level and * significant at the 10% level. All regressions have been corrected for first-order autocorrelation AR(1). Regressions (4) and (6) have also been corrected for heteroskedasticity

CHAPTER 4
INSTITUTIONAL CHANGES AND MARKET REFORMS IN WEST AFRICAN COTTON SECTORS: A CASE STUDY OF FARMER PERFORMANCE

Introductory Statements

Cotton is a key cash crop commodity with important implications for agricultural development and poverty alleviation in West Africa[1]. The importance of the cotton sectors can be gauged by considering that they provide employment and income to millions of smallholder farmers and cotton exports represent about 20%, 60%, and 80% of total agricultural export values in Benin, Mali, and Burkina Faso, respectively (FAO, 2011) In addition to being a major source of foreign exchange for the government and a main source of revenues for poor rural households, West African cotton sectors have multiplier effects on the rural economy and even on the economy as a whole (e.g. Baden and Alpert, 2007; Nubukpo and Keita, 2005). Therefore, improving productivity in cotton sectors has the potential to induce economic growth and poverty reduction.

Traditionally, West African cotton sectors have been vertically integrated, with state-owned enterprises acting with near monopsony power in seed cotton markets and near monopoly power in credit markets for the distribution of agricultural inputs necessary for cotton production, such as seeds, fertilizers, and pesticides. In addition to purchasing all cotton from farmers at fixed and guaranteed pan-territorial prices, state-run companies oversaw agricultural advice, input supply, transport, and ginning and marketing services. Under this system, the viability of West African cotton sectors depended on the ability of the state-owned enterprises to produce surplus in times of high world prices and to rely on financial support from national governments in times of

[1] In this present work, West Africa refers to Benin, Burkina Faso, and Mali cotton sectors

low international prices (Badiane et al., 2002). A combination of low world prices, lack of transparency, and general mismanagement in ginning operations led to significant deficits in West African cotton sectors in the 1990s. Given the importance of cotton in West Africa economies, governments and international institutions stepped in to cover their financial losses during this time period.

In response to the financial problems posed by poor performance of West African cotton sectors, reforms within the framework of structural adjustment programs (SAPs) have been recommended. Major goals of the SAPs have been to resolve the financial crisis faced by governments and to revitalize the production structures by removing structural rigidities and inefficiencies in the economy (Baffes and Gautam, 1996; p.765). For instance these policies have encouraged the progressive withdrawal of state-run enterprises in the agricultural sector. It is assumed that successful reforms would stimulate cotton production by allowing farmers to allocate more efficiently their resources.

Concretely, West African countries started to reorganize their cotton sector by privatizing certain market operations (e.g., transport, ginning, and marketing), liberalizing other segments of the market (e.g., input procurement), and by strengthening their farmer organizations to involve them more actively in critical decisions. The dismantlement of state-owned enterprises also led to the curtailment of technical assistance and extension services. However, the withdrawal of the government in the provision of these services has not been accompanied by the entrance of new actors. There have been discussions on “getting the prices right” by aligning seed cotton prices (a.k.a., farm-gate prices) with world prices, but this

liberalization policy has not been implemented[2]. To enhance West African cotton sector competitiveness and ensure its long-run viability, efforts to promote efficiency are crucial, especially at the gin and farm levels.

With millions of smallholder farmers depending partially or totally on cotton for their livelihood, it is important to better understand which factors influence farm efficiency to ensure that implemented reforms can lead to the desired outcomes. The objective of this research is, therefore, to expand the existing literatures on cotton reforms and efficiency by briefly discussing the institutional environments in which farmers have been producing cotton first, and, then, quantitatively estimate the technical efficiency scores of producers in Benin, Burkina Faso, and Mali using a stochastic frontier production model. Specifically, a one-stage estimation procedure is used to examine the effects of institutional environments on the technical efficiency scores at the farm-level in all three countries[3]. Cotton producers' technical efficiency is defined as their ability to produce the maximum amount of output from a given set of inputs and technology. Using a unique dataset derived from surveys of cotton producers (conducted under the Cotton Reform Project teams of the Africa, Power and Politics Programme in summer 2009), this work shows how farmers' performance and their determinants vary from one country to another, and provides guidance on the fundamental environmental factors that should be taken into account for the cotton sector to be successful and sustainably revitalized in each country.

[2] The Malian cotton sector experienced price liberalization policy during 2004-07 but has since reverted (Nubukpo and Keita, 2005).

[3] Regressions are at the country level, since statistical evidences are found against pooling the datasets (Section 5.4 for a detailed description of the statistical test).

Chapter 4 is organized as follows. The institutional environments, including market structures of the cotton sectors in Benin, Burkina Faso and Mali are briefly described in section 2. The measurement of technical efficiency is addressed in section 3. A description of the data, variables, and model used is provided in section 4. Empirical results are presented and discussed in section 5. Section 6 concludes.

Institutional Environments

This section briefly discusses changes that have occurred in the market structures, ginning company ownership and activities, input procurement functions, and producer organizations since the implementation of cotton reforms in Benin, Burkina Faso, and Mali (Table 4-1).

Pre-Reform Institutional Settings

Historically, West African cotton sectors shared a similar institutional setting that was laid out during the colonial period. In all three countries, the French company, CFDT[4], played an important role in the development of their cotton sectors by providing technical advice and inputs to farmers and by transporting, ginning, and marketing cotton (Baffes, 2001). Following the country's independence, cotton sectors got nationalized and state-owned enterprises were created: the CMDT[5] in Mali, the SOFITEX in Burkina Faso, and the SONAPRA in Benin. Unlike in Benin, where the SONAPRA was fully owned by the state, the CMDT and the SOFITEX were initially a joint venture between the CFDT[6] and the Malian and Burkinabe government,

[4] CFDT is the acronyme for «Compagnie française pour le développement des fibres textiles»

[5] CMDT is the acronyme for "Compagnie Malienne de développement des textiles"; SOFITEX is the acronyme for "Société Burkinabé des fibres et textiles "; SONAPRA is the acronyme for "Société Nationales de Promotion Agricole".

[6] The CFDT became Dagris in 2001 and then Geocoton in 2008.

respectively. Following the vertical structure already established by the CFDT, these state-run companies were responsible for input procurement, technical assistance and extension, transport, ginning and marketing services.

The first producer organizations (POs) to be established were village-wide and they grouped both cotton and non-cotton farmers. They were known as village associations (AVs[7]) in Mali and as village groups (GVs[8]) in Benin and Burkina Faso. Through their POs, farmers were able to get inputs on credit provided by the state-owned enterprises at the beginning of the season. After the harvest, state-owned enterprises recouped their costs by deducting what farmers owed them from their cotton payment. Although their establishment contributed positively to empower cotton farmers by transferring them responsibilities in the collection, grading and weighting of seed cotton, the absence of exclusive membership in the AVs and GVs made input distribution and credit management more difficult to manage. Indeed, non-cotton farmers were allowed to get inputs on credit, even though cotton remained the principal means of revenues to pay back loans and some farmers decided to free-ride by selling on the black market inputs obtained on credit, assuming that other farmers would cover their loans (Gray, 2008). As a result of input diversion, bad governance, and mismanagement, there was accrued indebtedness at both individual and PO levels.

Although cotton producer organizations from the three West African cotton sectors under study have suffered from indebtedness, only the Burkina Faso government made the decision of canceling their debts accumulated over the past campaigns. On the

[7] AVs is the acronyme for “Associations villageoises”

[8] GVs is the acronyme for “Groupement villageois

other side of the border, the Malian government is examining whether solvable farmers should be rewarded for their good credit rather than eliminating insolvable farmer's debts. The argument is that eliminating debts sends the wrong incentives to farmers and forgiveness of agricultural debt reduces the costs of credit default for farmers, making such outcomes more likely to occur again (Govereh, 1999; Dorward et al. 1998).

Post-Reform Institutional Settings

Even though the pre-reform institutional setting was similar, the pace and path of the market-oriented reforms have considerably differed across the three countries. Contrary to Mali, where cotton reforms have been mainly undertaken to satisfy international institutions and donors, restructuring of the Benin cotton sector was from the beginning wanted by the State (Yerima and Affo, 2009; p.59). Therefore, Benin has been a first mover by privatizing the input procurement activities and by establishing privately owned ginning companies by the mid-1990s. However, it is only in 2008, after several postponements, that the partial privatization of the Beninese state-owned enterprise, SONAPRA became finalized through the creation of SODECO.

A private partner holds 33.5% of SODECO`s share whereas the government holds 66.5%, from which 33% will eventually be transferred to producers, local authorities, citizens and gin workers (EU-ACP, 2009) Interestingly, the private shareholder in SODECO also owns other gins in Benin. In fact, with his involvement in SODECO, this private actor has secured its dominant position in the Benin cotton sector by owning 16 gins out of 18 nationwide (Saizonou, 2008). Given that almost all ginning and marketing activities within the Benin cotton sector are managed by the same private operator, the transition toward a more competitive structure seems compromised. Indeed, a

monopolistic structure better characterizes the Beninese cotton market, but private rather than public this time.

In 1999, the partial privatization of the Burkinabe state-owned enterprise, SOFITEX, followed an unconventional market reforms path by transferring 30% of the governmental shares to farmers rather than to private investors (Kaminski and Serra, 2011). This initiative aimed at empowering farmers by involving them more actively in critical decisions such as input and producer price determination. The government retained 35% of the capital in SOFITEX and private operators owned the remaining 35%. Particularly, the French company, Dagris, held a 34% ownership and the local banks the remaining 1% (Sofitex, 2005).

The cotton reforms also led to the establishment of two new ginning companies, FASO COTON and SOCOMA, in 2004. A particularity of the Burkinabe cotton sector is the presence of zoning, which consists of demarcating the cotton producing area into exclusive zones for specific companies. Farmers producing within a zone have to deal exclusively with the gin company assigned to operate there. The principle of zoning is to limit problems of malpractices in the cotton sector, such as poaching[9] and unsatisfactory technical and extension services (ICAC, 2010).

Even though the reforms undertaken by Burkina Faso to revitalize its cotton sector was considered a success story in the early 2000s (World Bank, 2004; Goreux and Macrae, 2003), they did not lead to better financial performances in the long-run. Indeed, in 2007 SOFITEX was first recapitalized entirely by the government after the

[9] Poaching occurs when farmers receive input on credit by one ginning company at the beginning of the cotton season on promise of selling them their production but at the moment of the harvest, they sell it to a competitor that offered them higher prices. As a result, the gin that initially offered inputs on credit cannot recoup totally its costs and, thus, will eventually limit its services of inputs on credit to farmers

major private investor decided to not contribute, and, then, FASO COTON and SOCOMA had to be recapitalized the following years to avoid bankruptcy. It has been suggested that the inflexibility in the price mechanism and, hence, the inability to pass world price fluctuations to farmers contributed to the financial losses incurred by the gin companies during 2004-06 (Yartey, 2008). With approximately 85% of the national cotton production managed by SOFITEX, which is now largely owned by the government, the Burkinabe cotton sector is again characterized by the presence of a large public monopoly. Since the recapitalization, the government has adopted a multifaceted strategy to reduce SOFITEX costs, which should ultimately lead to the sale of 30% shares to a private investor.

In comparison with Benin and Burkina Faso, Mali has been a latecomer to undertake the privatization reform process recommended by international institutions and donors. Indeed, the privatization of the state-owned enterprise, CMDT, has not been completed yet. Proposed dates of privatization have been several times postponed. At the latest, national and foreign investors made purchasing offers to the Malian government to acquire one or more of the four regional monopolies that will be created with the dismantlement of the CMDT and the establishment of cotton production zoning. Once the privatization is completed, the four regional gin monopolies- Northeastern, Southern, Central, and Western- will be owned at 61% by private operators, 20% by producers, 17% by the State, and 2% by the workers (ICAC, 2008a).

Refocusing the ginning company activities on the cotton system is one of the key strategies proposed by the reforms to improve the efficiency and performance of the West African cotton sectors. As a result, gins have gradually withdrawn from rural

development activities. For instance, the CMDT progressively disengaged from the provision of public services outside the cotton sectors (such as maintaining roads and ensuring access to drinkable water to rural population) and from the active promotion of integrated farming systems based on livestock production and cereals. Furthermore, there has been a decline in the technical and extension services offered to producers, since neither the government nor private investors stepped in to offer services no longer considered to be the gin's responsibilities. To deal with the lack of technical support, the Beninese "Interprofession[10]" decided to hire more technicians to ensure a better service to its producers (Yerima, 2010, p:31). To my knowledge, this initiative has not been followed in Mali and Burkina Faso, yet.

With the cotton reforms, the POs have been reorganized with the aims of becoming solvable and better positioned to defend their member interests within the cotton sector. The Malian village associations were transformed into cotton producer cooperative societies (SCPCs[11]), the village groups in Benin and Burkina Faso into village cotton producer groups (GVPCs[12]) and cotton producer groups (GPCs[13]), respectively. Under these new structures, membership is restricted to cotton farmers only. Cotton producers can freely create their own organizations based on other member affinities, such as levels of indebtedness or field proximity. However, the presence of strong kinship makes exclusion of members less likely. A joint liability

[10] An "interprofession" is a formally organized association that groups key stakeholders involved in the cotton sector. Their objectives are to enhance market performance, through more efficient coordination and to defend the sector's interests.

[11] SCPCs is the acronyme for "Societes cooperatives des producteurs de coton"

[12] GVPCs is the acronyme for "Groupements villageois des producteurs de cotton"

[13] GPCs is the acronyme for "Groupement des producteurs de coton"

program, known as "*caution solidaire*" prevails in the SCPCs, GPCs, and GVPCs. Therefore, members of a same PO are jointly liable for each other's loans. Given that the higher performing farmers have to use their own profits to cover the financial losses of the lower performing ones, tensions among members exist. In some cases, the best performing farmers even stopped cultivating cotton (Gray, 2008). Indeed, the joint liability program has been the source of conflict among POs in each country, since indebtedness remains highly problematic (Yerima 2010; Kaminski et al., 2009, and Fok, 2007, for a description of the problems faced in Benin, Burkina Faso, and Mali, respectively).

With the reforms, Beninese cotton farmers became able to order inputs on credit for both their cereal and cotton production. Opening the input access to both types of crops was seen as a solution to reduce input diversion from cotton to cereal fields. Input diversion has always existed and has even been tolerated to some extent. However, difficulties emerge when input diversion becomes greater than a minimum acceptable amount and when monitoring of repayment is slack. With less inputs used on cotton fields, cotton production declines, and farmers are more likely to default on their credit repayment. Therefore, input diversion was and remains a potential cause of high level of indebtedness faced by the majority of POs. With the privatization process, import and distribution of inputs became two separate activities in Benin and led to the introduction of a new intermediary, the Cotton Inputs Commission (CIC), formerly the Provisioning and Management Agricultural Inputs cooperative (CAGIA) (Saizonou, 2008). Political interests greatly interfered in the selection process of private firms to provide essential inputs to farmers. As a result, firms were more likely to be selected based on their social

networks rather than on the quality of their services and their expertise (Yerima, 2009; p.55). Therefore, farmers have often complained about the poor quality of inputs purchased.

Interestingly, by refocusing the ginning activities toward cotton only, the CMDT progressively disengaged from rural developmental services, such as access to inputs and advice for cereals crops in cotton areas. Indeed, all activities related to inputs meant for CMDT cereal crops were transferred to the cotton and cereal producer union group, GSCVM[14]. However, due to the lack of experience in handling logistical operations and lack of collateral to ensure loan repayment to input suppliers, GSCVM has had important difficulties in providing cereal inputs on credit to farmers (IFDC, 2004). Being used to cultivate in integrated systems, it is not uncommon for Malian producers to divert some of their cotton inputs toward their cereal fields. On one hand, diversion may be a means to cope with the lack of access to cereal inputs on credit. On the other hand, diversion may be more a sign that cotton prospects are bleak rather than due to lack of access to inputs. With the privatization of the CMDT, activities related to cotton input procurement has been progressively transferred to the national union of the cotton producer cooperatives, UN-SCPC[15].

In Burkina Faso, input supply functions have also been transferred to the national union of Burkinabe cotton producers, UNPCB, following the privatization of SOFITEX. However, unlike in Mali, inputs meant for both cereal and cotton crops are managed by the UNPCB. After the harvest, credit for both cotton and cereal inputs are directly

[14] GSCVM is the acronyme for “Goupement des syndicats cotonniers et vivriers du Mali”

[15] UN-SCPC is the acronym for “Union nationale des sociétés coopératives des producteurs de coton

deducted from farmer cotton payment. Linking cereal inputs on credit to cotton payment have contributed to increases in their availability.

For the reforms to be successful in sustainably revitalizing West African cotton sectors, it is essential to get a better understanding on how the institutional environments, in which farmers are growing cotton, influence their performance. A wide array of applied work has looked at the sources of inefficiency in agriculture of developing countries, including the cotton sector. However, previous studies on farm-level efficiency of cotton producers have focused on a single-country case and have not specifically assessed the roles of institutional environments (e.g., Audibert et al., 2003; Shafiq and Rehman, 2000; Bravo-Ureta and Evenson, 1993). At present, there is no known cross-country empirical analysis that explicitly examines the roles of institutional environments on West African cotton sectors efficiency at the farm-level. This research contributes to the literature by measuring and comparing the technical efficiency scores of cotton producers in three West African countries and by analyzing the role of institutional environments, such as joint liability credit programs and extension services, on farmer performance. Results should provide useful insight to policy-makers regarding how cotton producer performances are influenced by local market and institutional realities.

Measurement of Technical Efficiency

Literature on efficiency of productive units, which has been shaped by the seminal work of Farrell (1957), can be classified according to whether the measurement technique used is non-parametric or parametric. The development envelopment analysis (DEA) and the stochastic frontier analysis (SFA) are the most commonly non-parametric and parametric methods, respectively, used to measure the relative

efficiency on farm-level data at one point in time[16]. Both the DEA and the SFA approaches recognize the possibility of inefficiency in production. They do not assume that all farmers are technically efficient. Being both extensively used in measuring production efficiency in agricultural sector of developing countries, the advantages and limits associated with these two competing methods, DEA and SFA, are briefly discussed[17].

Developed in 1978 by Charnes et al., the DEA method consists of mathematical programming formulations, where inefficient producing units are compared with the most efficient (best) units within the sample. The initial assumption of constant returns to scale was relaxed by Banker et al. (1984) to allow for variable returns to scale. The advantage of non-parametric techniques, such as the DEA, is that they do not rely on assumptions about the functional form or about the distribution of the error terms. The main limitation of the DEA method comes from its deterministic nature, which assumes that any deviation from the production frontier is due to inefficiency. Therefore, any measurement error and/or random stochastic error in the data are confounded with farmer inefficiency. As a result, the DEA estimates are very sensitive to the sample data, and especially to outliers (Greene, 1993).

The SFA approach, which estimates the parametric form of a production function and recognizes the presence of random errors terms in the data, was first introduced by Aigner et al. (1977) and by Meeusen and van den Broeck (1977). This regression-based method incorporates a composed error term. One component of the error term reflects

[16] In addition to cross-sectional data, both the DEA and SFA methods can also be used to measure efficiency on panel data.

[17] Coelli et al. (2005) provided a more comprehensive discussion on both methods.

the inefficiency in production while the other component represents the random effects outside producer control, including luck, (un) favorable climate conditions, measurement error and other statistical noise from the data. The production frontier itself is stochastic since it varies randomly across farms due to the presence of the random error component (Coelli et al. 1999). Unlike the DEA method that estimates the best observed practice, the SFA approach econometrically estimates the best theoretical practice. The main criticism of this econometric technique is that strong assumptions have to be made concerning the selection of a particular functional form and the distribution of the inefficiency component in the composed error term. Nevertheless, the SFA model has the advantages of being able to measure the individual inefficiency in the presence of statistical noise in the dataset and to estimate standard errors.

Given that both have virtues and shortcomings, the choice of an approach to measure efficiency becomes almost philosophical. Empirical studies on technical efficiency for cotton farmers have used either the DEA (e.g.,Gul et al., 2009; Helfand and Levine, 2004; Audibert et al. 2003; Shafiq and Rehman, 2000) or the SFA (e.g., Thirtle et al., 2003; Bravo-Ureta and Evenson, 1994) or both (e.g., Chakraborty et al., 2002). In the context of agriculture in developing countries, where imperfections in credit and chemical input markets exist, the assumption that random shocks, such as weather and unpredictable variation in labor performance, do not influence productivity becomes questionable. In addition to being influenced by the main underlying assumptions, the decision to use one approach over the other depends upon the data available and the types of analysis. For instance, the DEA technique has the ability to easily handle multiples outputs and inputs. Alternatively, the stochastic frontier is better suited to

analyze the determinants of inefficiency since the inclusion of environmental variables can be done in one-stage rather than two-stages to avoid implicit bias. Given that the objective is to examine how different environmental contexts, market structures and institutional arrangements in the cotton sector influence cotton productivity at the farm-level, and given that random effects non controllable by farmers are considered to impact productivity, the SFA method is considered more appropriate.

Comparing 32 frontier studies using farm-level data from developing countries, Thiam et al. (2001) did not find TE estimates from SFA to be statistically different from those using the DEA deterministic approach. Obviously, the smaller the components of the error term due to random shocks and statistical noise, the closer the estimates from both methods are. The use of panel data rather than cross-sectional also improves the accuracy of the measured efficiency (Greene, 1993). Using panel data, Ruggiero (2007) also concluded that DEA and SFA methods generated similar results. Therefore, the decision of measuring cotton farmer efficiency through econometric techniques rather than linear programming should not be seen as a limitation, since it has been shown to lead to similar results.

Stochastic Frontier Analysis

Following the model proposed by Aigner et al. (1977), the general stochastic frontier production function can be expressed as,

$$Y_i = f(x_i;\beta) + \varepsilon_i \quad = \quad \exp\,(x_i\beta + \varepsilon_i), \qquad (4\text{-}1)$$

$$i=1, \ldots, N$$

where, Y_i denotes the output of the i-th farmer, x_i represents a (Kx1) vector of input quantities of the i-th farmer, β is a (Kx1) vector of unknown production elasticity parameters to be estimated, and ε_i is the double component error term. It is postulated

that $\varepsilon_i = v_i - u_i$, where v_i represents the classical symmetric disturbance term and u_i is the technical inefficiency component to be estimated. The symmetric error component, v_i, is assumed to be independently and identically distributed as $N(0, \sigma_v^2)$. The one-side error component, u_i , is assumed to be distributed independently of v_i , to satisfy $u_i \geq 0$, and is derived from a $N(0, \sigma_u^2)$half-normal distribution. A higher value of the one-side component, u_i , implies an increase in the farmer technical inefficiency. A value of u_i equals to zero means that there is perfect technical efficiency. Borrowing from Battese and Coelli (1988), the technical efficient of the i-th farm can be represented as,

$$\mathrm{TE_i} = \frac{\mathrm{Y_i}}{\mathrm{Y_i^*}} = \frac{\mathrm{Y_i}}{\exp\,(\mathrm{x'_i\beta + v_i})} = \frac{\exp(\mathrm{x'_i\beta + v_i - u_i})}{\exp\,(\mathrm{x'_i\beta + v_i})} = \exp\,(-u_i) \qquad (4\text{-}2)$$

A basic stochastic production frontier is depicted in Figure 4-1. The vertical axis represents the level of cotton output whereas the horizontal axis represents the inputs used to produce cotton output. In absence of noise effects (v_i), the production frontier is considered to be deterministic rather than stochastic. The deterministic production frontier is represented by the curve. The observed cotton production levels of two farmers, 1 and 2, are represented by squares. The first farmer uses inputs defined by X1 and obtains a level of cotton production equals to Y1. In the presence of favorable conditions, the noise effects are positive, and the frontier output (Y1*) is above the deterministic production frontier. The second farmer uses inputs defined by X2 and produces Y2. The frontier output Y2* is below the deterministic frontier production due to the presence of unfavorable conditions (negative noise effects). Interestingly, the second farmer is judged technically more efficient relative to the unfavorable conditions associated with the production cotton activities than if judged relative to the maximum output possible given the deterministic production frontier. The inefficiency effect (u_i)

can be seen as the difference between what farmers are producing (observed cotton output Y) and what they are capable of producing given the conditions (frontier output Y*).

Note that the production frontier above does not take into account the possibility that cotton farmers may be facing different institutional arrangements that may influence their technical efficiency. Later research has extended this basic model in order to take into account the environment in which farmers are producing. Two major alternative extensions have been developed (Coelli et al., 1999). The first one assumes that the environment directly affects the production function and the shape of the technology available. Consequently, each farmer is assumed to face a different production frontier. The environmental condition variables are added to the original model as follows,

$$Y_i = f(x_i, z_i; \beta, \theta) + \varepsilon_i = \exp(x_i\beta + z_i\theta + \varepsilon_i), \quad (4\text{-}3)$$

$$i=1, \ldots, N$$

where, z_i represents a (Mx1) vector of environmental factors in which the i-th farmer produces and θ is a (Mx1) vector of unknown parameters to be estimated. The technical efficiency becomes net of environmental influences.

In the second approach, the environment directly affects the technical efficiency score rather than the production frontier and technology. This model extension relies on the assumption that all farmers share the same technology and, therefore, face the same production frontier. The distance between farmer's efficiency score and the best practice function varies with the environment conditions. The impact of environment on technical efficiency can be measured using either a two-stage or a one-stage procedure. In the two-stage method, the stochastic production frontier and the technical

efficiency (TE) scores, as stated by equations 1 and 2 respectively, are first estimated. Then, the TE scores are regressed upon a set of environmental explanatory variables, including farmer demographic characteristics and institutional arrangements.

The two-stage estimation in the second approach has been criticized for being contradictory (Kumbhakar and Lovell, 2000, p.262-264; Coelli, 1998, p.207-209). In the first stage, both components of the error term are assumed to be identically and independent distributed, however, the regression of different factors on the inefficiency score in the second stage suggests that these latter are not identically distributed (e.g., Coelli et al., 1999; Battese and Coelli, 1995). The omission of environmental variables in the first-stage is also criticized for leading to biased estimated coefficients in both the production frontier and technical efficiency scores (Coelli, 2005; Wang and Schmidt, 2002).

The one-stage estimation of the second approach satisfies the assumptions while estimating the effect of environment directly through the technical efficient score. This approach, which allows the environmental factors to directly affect the stochastic component error term of the production frontier, has been developed for cross-sectional data by Kumbhakar et al. (1991), and extended to panel data by Battese and Coelli (1993). Under this approach, the inefficiency score of the i-th farm has a distribution that varies with the farm-specific characteristics, z_i , and, therefore, the one-sided error terms are no longer identically distributed. The new technical inefficiency term is described as;

$$\mu_i = \delta' z_i + w_i \qquad (4\text{-}4)$$

where, z_i is a (Mx1) vector of environmental factors in which the i-th farmer produce and δ is a (Mx1) vector of unknown parameters to be estimated. The asymmetric error

component,u_i , is assumed to be distributed independently and to follow a $N(\delta' z_i, \sigma_u^2)$ distribution truncated at zero. Equation (4) is then added to equation (1) in order to estimate simultaneously all the unknown parameters (βs, δs, σ_u^2, and σ_v^2) of the production frontier and inefficiency using the maximum likelihood method. Following Battese and Coelli (1992), the variances are parameterized as;

$$\sigma_s^2 = \sigma_v^2 + \sigma_u^2 \tag{4-5}$$

$$\gamma = \sigma_u^2 / \sigma_s^2 \tag{4-6}$$

where, γ must lie between 0 and 1 in order to start the iterative maximization process. If γ is statistically different from zero using a one-sided likelihood test, then there is presence of inefficiency in the model. With inefficiency, the production frontier method is more appropriate than ordinary least squares.

Whether to choose the first (environment affects directly production frontier) or the second (environment influences directly technical efficiency) approach is a matter of philosophical perspective as mentioned by Coelli et al. (1999, p.252). Although both approaches have been used, the one-step estimation in the second approach has received further attention in the recent literature (e.g., Bhandari and Maiti, 2007) and seems more appropriate for the analysis of institutional arrangements in the context of West African cotton sector. It is assumed that each farmer faces a similar production frontier, but the environment in which they are producing influences their efficiency.

Data

The data used for this analysis comes from the Africa, Power, and Politics (APP) surveys conducted by the cotton sector reform research teams in Benin, Burkina Faso,

and Mali during summer 2009[18]. The survey instrument consisted of an individual 13-page questionnaire, divided into two sections. Although a similar version of the questionnaire was used across the three West African countries under study, some personalized questions were added to account for the local realities of each country. Both qualitative and quantitative information were collected through the survey. The quantitative data is processed with statistical tools in order to compare determinants and contexts for differing productivity across the three countries. The qualitative information collected during the interview process serves as a validation tool for the empirical results and is used to enrich the discussion.

The first section of the survey encompassed all questions related to demographic (e.g., education and experience), household (e.g., number of people and food self-sufficiency), and farm characteristics (e.g., equipment, and crop production) of the respondent. The second section of the survey included all questions related to determinants of cotton supply. For instance, reasons that would incite (discourage) farmers to grow more (less) cotton, types of intervention that would improve the cotton sector overall, issues related with the input provision, technical assistance received, difficulty with the joint liability program, and quality of the relationship with union representatives, among others. The second part provided information regarding the level of coordination achieved among stakeholders and, therefore, revealed the

[18] The cotton sector reform project, which is coordinated by Dr. Renata Serra from the Center for African Studies (CAS) at the University of Florida, is part of a broader programme on Africa, Power, and Politics (APP). The APP program is funded by the United Kingdom's Department for International Development (DFID) and Irish Aid, as a consortium of which CAS is a member. The main researchers in charge in each country are: Borgui Yerima from the "Laboratoire d'Analyse Regionale et d'Expertise Sociale (LARES)" in Benin- Jonathan Kaminski from the Department of Agricultural Economics and Management at the Hebrew University of Jerusalem in Burkina Faso- Bourema Kone from the "Institut d'Economie Rurale (IER)" in Mali.

elements of the institutional arrangements that work well and the ones that need to be improved to ensure the viability of West African cotton sectors.

In each country, 5 to 10 cotton producer organizations (GVPCs in Benin, GPCs in Burkina Faso, and SCPCs in Mali) were initially selected from different cotton regions. The main objective of this survey was to gather information at the farm level from a fairly diverse population in order to get deeper insights about their realities as cotton farmers (Serra, 2008). Therefore, producer organizations (POs) presenting different characteristics were picked for interviews across the different cotton regions. In each PO, 10 to 12 cotton growers were randomly selected using the member list. The farmer sample was not stratified per farm size- small, medium, or large- as it has been done in other studies (e.g., Carter, 1984), since the definition of farm size is not consistent across the three countries. For instance, the number of equipment (e.g., ploughs and carts) and plough animals (e.g., oxen) are at the base of the definition in Mali, whereas the number of hectares is the criteria used in Benin.

In Benin, surveys were conducted in 4 GVPCs located in the North and in 1 GVPC from both the Central and South regions of the country. More GVPCs were selected in the North to account for the fact that cotton is mainly produced there. In total, 90 cotton producers, 15 in each GVPC, were interviewed across the three main cotton regions. In Burkina Faso, 12 cotton growers per GPC were interviewed across two main cotton regions. In Houndé, 2 GPCs were chosen whereas interviews were conducted in 3 GPC in the Bobo region. The sample of Burkinabe cotton producers totaled 60. In Mali, surveys were conducted in 12 SCPCs located across 5 cotton regions (3 SCPCs in

Koutiala, 2 SCPCs in Sikasso, Fana, Ouélésséboougou, and Kita, and 1 SCPC in Bougouni). The number of farmer interviews totaled 114[19].

Production economic theory is based on several assumptions concerning both the output and input sets (Coelli, 2005). Two assumptions are of particular interest for this study. First, zero production is impossible from a given sets of inputs. Second, zero level of inputs cannot produce positive level of output. Therefore, all interviewed farmers that did not produce cotton and/or did not use a positive quantity of each traditional input (labor, land, chemical inputs on credit, and equipment) during the crop campaign 2008/2009 are excluded from the datasets. Other efficiency studies at the farm level also had to deal with restrained dataset due to the deletion of non-producing farmers and incomplete records (e.g., Bravo-Ureta and Evenson, 1994). In the end, the sample used for estimating the technical efficiency at the farm level includes 81 observation from Benin, 56 from Burkina Faso, and 82 from Mali.

Model

A Cobb-Douglas functional form for the stochastic frontier is chosen for the analysis of technical efficiency in the three cotton sectors. The Cobb-Douglas has been widely used in efficiency studies on agricultural sector of developed and developing countries, and especially on cotton (e.g., Gebremedhin et al. 2009; Chakraboborty et al., 2002; Shafiq and Rehman, 2000; Bravo-Ureta and Evenson 1994). Despite being less flexible than other functional forms, the Cobb-Douglas provides a nice economic interpretation (coefficients measure elasticity) and allows saving some degrees of

[19] In each SCPC, 10 cotton growers were interviewed with the exception of one SCPC in the Kita region, where only 6 surveys were conducted due to an external event. A tornado hit the village few days earlier and, therefore, many farmers were too busy repairing the damage to answer the questionnaire (10*12 + 6= 114).

freedom (which is important given the relatively small number of observations in each country). Results from previous studies suggest that technical efficiency measures are not significantly affected by the choice of the functional form (Ahmad and Bravo-Ureta, 1996; Koop and Smith, 1980).

The Cobb Douglas stochastic frontier model used for the econometric analysis is written as;

$$lnY_{ic} = \beta_0 + \sum_{j=1}^{m} \beta_j lnx_{jic} + v_{ic} - u_{ic} \quad (4\text{-}7)$$

where the subscripts i and c represent the i-th farmer growing cotton in the c-th country, respectively. The traditional explanatory variables included in the stochastic frontier production model are similar to those used in previous cotton efficiency studies (Helfand and Levine, 2004;Audibert et al., 2003; Chakraborty et al., 2002; Battese and Broca, 1997; Bravo-Ureta and Evenson, 1994). These variables can be classified into four general categories: labor, inputs, equipment, and land. Given that cotton production is mainly rain-fed in West Africa, there was no need to make a distinction between irrigated and non-irrigated fields. Following is a description of the traditional variables used in the regression;

- Y represents the logarithmic quantity of cotton harvested (in kgs)
- x_1 represents the logarithm of total amount of active family labor (in persons)[20]
- x_2 is a dummy variable having a value of one if the farm hires non-family labor to work on the cotton fields; zero otherwise
- x_3 represents the logarithm of total purchased inputs- seeds, fertilizers, pesticides, and insecticides (in CFAs). This includes both direct and credit purchases.

[20] A better measure would have been the total number of man days of work spent on cotton fields, but this information was not collected by the surveys used in this study. Male and female workers are not weighted equally. Given that females also have to take care of the children, and domestic chores, they generally have less time to spend on the cotton fields. Therefore, they receive a lower weight (0.8).

- x_4 represents the logarithm of total value of equipment- owned ploughs, carts, sprayers, and tractors (in CFA)
- x_5 represents the logarithm of the ratio of cotton acreage over total cultivated land (%)[21]
- x_6^m represents the regional dummy variables to taken into account soil and climatic condition differences.
- v_{ic} represents the stochastic component error
- u_{ic} represents the technical inefficiency

Table 4-2 provides a statistic summary of the production factors for each country sample. The mean is reported as a measure of central tendency. The standard deviation as well as the minimum and maximum are included to show the dispersion of the observations within each sample. The average production per farm is higher in Benin (6250 kg) than in Burkina Faso (3055 kg) and in Mali (3571 kg). This can be explained by the fact that interviewed Beninese farmers cultivate more hectares of cotton, purchased more cotton inputs such as pesticides, and have higher cotton yields. Moreover, the majority of the Beninese farms hired non-family labor whereas the work on Malian cotton fields is mainly done by family labor. No interviewed producers reported owing a tractor in Benin and Burkina Faso, compared with 2 farmers in Mali. Note that these tractors can be seen as a gift from the government to encourage cotton production, since their purchases have been highly subsidized. Owning a tractor does not necessarily reflect the purchasing power of the farmer. In our sample, the Burkinabe farmers are the most specialized in cotton production across the three countries.

[21] Note that cotton acreage and purchased cotton inputs are strongly correlated in Burkina Faso (corr=94%) and in Mali (corr=88%). The correlation between cotton land and inputs is weaker, but still strong, in Benin (corr=74%). To avoid correlation between these two explanatory variables, land has been included in the regression through the use of a ratio rather than acreage. A very weak correlation exists between cotton land ratio and value of inputs in all three countries.

Indeed, half of their cultivated land is planted with cotton. The lower number of active family members working on cotton fields in Burkina Faso can be explained by the smaller size of their farms compared to those in Benin and Mali.

Following production theory, it is expected that a greater endowment of labor, inputs, equipment, and land devoted to cotton contribute positively to higher level of cotton production. However, it is still unclear how the institutional context affects farmer's ability to be technically efficient. This cross-country study contributes to the literature by empirically assessing how the use of traditional production factors is impacted by the environment in which farmers are working. Given that the APP dataset used in this study is based on information collected through similar survey questionnaire and methodology across the three West African countries, comparative analysis is possible.

Environment is a broad term that encompasses four different categories as defined by Audibert et al. (2003). The first category includes structural factors such as food self-sufficiency and cereal acreage. The second category deals with human capital, including education and farm experience. Social factors, such as satisfaction with the management of producer organizations and local culture, compose the third category. The last category consists of institutional factors, such as technical assistance and extension services. Unlike the human capital category, social and institutional factors as well as structural (with the exception of farm size), have received less attention in studies of efficiency in agriculture. Therefore, structural, social and institutional variables shaping the cotton sector in West Africa are included in the inefficiency score regression in order to examine their roles on performance.

The model of technical inefficiency effects on the stochastic frontier equation (7), including environmental factors, is determined by

$$u_{ic} = \delta_0 + \sum_{j=1}^{8} \delta_j z_{jic} + w_{ic} \quad (4\text{-}8)$$

where, z_{jic} represents the j-th environmental characteristics of the i-th farmer producing in the c-th country.

- z_1 is a dummy variable having a value of one if the farm is food self-sufficient; zero otherwise
- z_2 represents the number of hectares cultivated with cereals-sorghum, millet and maize (ha)
- z_3 represents farmer experience in growing cotton (in years)
- z_4 is a dummy variable having a value of one if the farmer is literate; zero otherwise
- z_5 is a dummy variable having a value of one if the farmer considers the norms prevailing in the cooperative to be restrictive to the achievement of high performance; zero otherwise
- z_6 is a dummy variable having a value of one if the farmer has experienced difficulty with the joint liability program; zero otherwise
- z_7 is a dummy variable having a value of one if the farmer has received technical assistance and extension services over the last five years; zero otherwise
- z_8 is a dummy variable having a value of one if the farmer is optimistic about the future of the cotton sector; zero otherwise.

Table 4-3 reports the summary statistics for the institutional environment variables included in this analysis. On average, 2.82 hectares of land are allocated to cereals per cotton farm in Burkina Faso. This number is larger in Benin and Mali with 5.17 and 7.46 hectares, respectively. However, levels of self-sufficiency among Malian and Burkinabe farmers are comparable. The percentage of literate farmers is very similar in Burkina Faso and Mali, but higher in Benin. A majority of the Burkinabe farmers are dissatisfied with how their GPC is managed, whereas the Malian producers seem overall satisfied.

The joint liability program appears to be a more important issue in Benin than in Mali and Burkina Faso, with 87% of farmers who have experienced problems with it. Also, more Beninese farmers have received technical assistance over the past years and they are more confident that the cotton situation will improve.

The hypotheses regarding the influence of the non-traditional factors on cotton farmer technical inefficiency are presented below.

Structural Factors[22]

To my knowledge, no study on technical efficiency has examined the role of food self-sufficiency on cash crop outputs. Looking at the interrelation between food self-sufficiency and cotton production in the 18th century in the South of the United States when food markets were not well-developed, Gallman (1970) found that plantations with high levels of maize output also have higher levels of cotton output. Given the presence of imperfect food markets (e.g., inadequate roads and transport systems) in our three countries, it is expected that farmers that are food self-sufficient are more efficient in producing cotton.

The expected sign of the coefficient of cereal hectares is ambiguous. On one hand, cereal and cotton crops are directly competing for certain resources such as land allocation and chemical inputs. In the absence of an efficient cereal input distribution channel, there is a high incentive for Malian farmers to divert some of their cotton inputs toward their cereal fields. Therefore, cereal hectares may negatively impact cotton production. On the other hand, complementary dimensions of cotton and cereal crops

[22] No direct measure of farm size is included in the regression, since there is no consensus over a definition across the three countries. As previously mentioned, farm size is defined in terms of acreage in Benin, whereas owned equipment is the measure used to differentiate small, medium, and large farms in Mali. Nevertheless, this structural factor is indirectly taken into account through the use of inputs, cotton land ratio, and equipment variables in the production model.

may be more important than the competing ones. Given that both crops require use of labor and equipment at different periods, growing cereals should not reduce cotton capacity (Jayne, 1994; Gallman, 1970). In comparison with farms practicing cotton monoculture, farmers who practice crop rotations are more likely to get higher yields due to a better conservation of soil resources (Hulugalle and Scott, 2008; Naudin and Balarabe, 2005). Indeed, sustainable cereal-cotton rotations may maintain or may even improve soil structure and fertility by increasing soil organic matter content and decreasing soil erosion, and minimize disease and pest incidence. Therefore, cotton farmer inefficiency may decline with increases in cereal acreage.

Human Capital Factors

Unlike previous studies that include farmer age, we prefer to use years of farming experience since its effect on efficiency can be more directly measured. Indeed, it is expected that more cotton farming experience leads to higher cotton productivity (Thirtle et al., 2003). The influence of age on efficiency is not as straightforward. On one hand, older farmers may have more years of farming experience, and, therefore, efficiency may be higher. On the other hand, older farmers may be more reluctant to changes in cotton farming practices, and, therefore, productivity may be lower.

Literate farmers are generally assumed to have better farming capacity and access to information, and, therefore, to be more efficient (Gebremedhin et al., 2009). However, the lack of statistically significant relationship between basic level of education and efficiency in previous works has been explained by the potential presence of a stage of development threshold below which the expected positive relation is not found (Bravo-Ureta and Evenson, 1994).

Social Factors

Governance problems and internal conflicts inside collective action organizations may restrain production to reach its full potential and may lead to the withdrawal of some producers, as was the case for rice farmers in Benin (Kinkinggninhoun-Medagbe et al., 2010; p59). In our case, it is assumed that farmers, who subjectively believe that the norms prevailing in their cotton producer organizations are restrictive, are technically more efficient. Indeed, producers who are dissatisfied with management of their cooperatives are more likely to be entrepreneurial and, thus, to understand the discrepancy between status-quo and what would be possible under efficient management (Mude, 2006).

Institutional Factors

Although group lending programs are very common among cotton farmer organizations in Africa, their influences on productivity is still debatable. The principle of joint liability in loan programs is not problematic, per se, but its application may lead to undesirable outcomes. If every producer decided to participate actively, they would all be better-off under this cooperative arrangement (Lawrence, 2003). However, cooperation requires a high level of commitment from everyone. Lack of commitment may lead to opportunistic behaviors that are detrimental for the group lending initiative. Local realities, such as conflicts between age, ethnicity, and class groups, have been found to affect cooperative efficiency (Woods, 1999). The expected sign for the joint liability dummy is ambiguous.

A positive relationship between technical inefficiency and farmers that reported having issues with the joint liability would suggest that these farmers are struggling to produce enough to cover their loans. Indeed, lower performing farmers may have to sell

assets or ask for outside help in order to be able to repay their loans. In contrast, a negative sign would suggest that the higher performing farmers are the ones experiencing problems with the joint liability program, since a part of their profits go to cover the financial losses of other members.

In the developing world, technical support and extension services offered to producers have been widely recognized as a key factor contributing positively to production by providing advice and information on how to improve technical skills in farming operations (e.g. Keil et al., 2007; Haji, 2006). However, expectations regarding the performance of agricultural extension services remain low since their delivery faces many limitations (Poulton et al., 2010). For instance, technical assistance received by farmers may be of poor quality or the method used to transmit the information may be inadequate.

A very limited number of studies have examined how farmer attitude toward market reforms influences their productivity. Among those, Mude (2006) found that pessimistic farmers, those lacking confidence in policymakers to improve their situation, are more likely to be less technically efficient.

Empirical Results

Ordinary least squares (OLS) estimates of average production function as well as the maximum likelihood parameters (MLE) of the stochastic production frontier for different distributional forms are first estimated using the software Stata version 11.1. A one-sided likelihood ratio[23] is used to test whether technical inefficiency is present in the

[23] Likelihood ratio (LR)= 2(Log-likelihood of the unrestricted model- log-likelihood of the restricted) ~ χ_1^2 (2α). Ho: ϒ=0, where ϒ=σ_u^2/σ^2. This implies that $\sigma_u^2 = 0$, and therefore, there is no technical inefficiency.

dataset. If technical inefficiency is detected, the stochastic production frontier is more appropriate. Otherwise, the OLS estimator is better-suited for the data. Then, the stochastic production frontier model providing the best goodness of fit is analyzed using the computer program, Frontier 4.1 (Coelli, 2005 for a description of the program). The advantage of the software Frontier 4.1 is that it allows analyzing the impact of environment on individual technical efficiency scores using a one-stage estimation procedure.

Benin

As seen in Table 4-4, the average production (OLS) function better fits the Beninese dataset. Indeed, the likelihood ratio test for the presence of inefficiency fails to be rejected. Therefore, the stochastic production frontier model reduces to a simple OLS model with a normal disturbance term, i.e. that the Beninese cotton producers in the sample appear to be fully technically efficient. A first hypothesis would be that unfavorable conditions during the 2008/2009 crop campaign (large noise effects) reduced the gap between the observed and frontier outputs to non-statistically significant levels (Figure 4-2). A second hypothesis would be that the market-oriented reforms in the cotton sector led to the withdrawal of underperforming farmers and, therefore, cotton is, now, mainly produced by the most efficient ones. From 1999 to 2003, approximately forty percent of Beninese households, who were once producing cotton, stopped production due principally to debt issues related to policy implemented over the years (Siaens and Wodon, 2003). A third possible hypothesis is that the actual production frontier is so low that farmers can easily produce on its frontier. If this is the case, new technologies, such as BT cotton, should be introduced to move the production frontier outward (Figure 4-2). Otherwise, failure to push the production

frontier outward could jeopardize the ability of Beninese cotton farmers to be competitive on the international market (Kelly and al., 2011).

As expected, all input factors-labor, inputs, equipment, and land- have a significant positive effect on cotton production. The estimated elasticity coefficients for value of inputs (seeds, pesticides, insecticides, and fertilizers) purchased[24] and for value of equipment are significant at the 99% and 95% confidence intervals, respectively. Farms that are better equipped and that have better access to inputs on credit are more likely to get higher levels of cotton production. Indeed, a 1% increase in purchased inputs and in equipment value would augment production by 0.570% and 0.087%, respectively.

A negative relationship exists between cotton output and farms located in the southern region of Benin. This result is pertinent since the agro-climatic conditions in the South are less appropriate to cotton crops than those in the Northern part of the country. The central region appears to be the best location to grow cotton in Benin. One possible explanation is that farms located in the central region benefit from both appropriate agro-climatic conditions and good access to services due to their proximity to the port and the largest city, Cotonou.

It is important to keep in mind that, in our sample, Beninese farmers are technically efficient, which does not necessary imply that they are also allocatively efficient. Indeed, they are producing the optimal level of outputs given the productive factors they use and the technology available, but they might not allocate them the most efficiently. Increased production would lead to a decline in farmer income if this increase was associated with additional costs that exceed the additional revenues from the

[24] Over 95% of the inputs are obtained through credit. Pesticides account for over 78% of the purchased inputs in Benin.

marginal gain in outputs. Therefore, being technically efficient does not imply that Beninese farmers are less poor. Unfortunately, it is not possible to measure the allocative efficiency, since some costs of productive factors were not collected.

Burkina Faso

The estimated elasticity coefficients for non-family labor and cotton land ratio are not statistically different from zero in the Burkina Faso dataset (Table 4-5). Given that these two input factors are statistically insignificant; they have been disregarded in the model specification[25]. The magnitude and level of significance of the other input variable coefficient estimates remain relatively unchanged across the different OLS models. The high adjusted R^2 value (0.83) suggests that the predictive ability of the model is high.

Results from OLS and MLE are reported in Table 4-6. With the exception of the regional dummy, all coefficient parameters estimated by maximum likelihood are smaller in magnitude than those obtained through OLS. The likelihood ratio test rejects the null hypothesis of absence of technical inefficiency. Therefore, the stochastic production frontier is better suited for the analysis of the Burkinabe sample. Among the different distributional forms, the half-normal specification is the one chosen to estimate the stochastic production function and the technical efficiency scores[26]. As expected, a greater endowment of family labor, purchased inputs and equipment contribute positively to higher levels of production. The purchased input elasticity coefficient is the largest and is significant at the 99% confidence level. Increasing the average purchased

[25] An F-test is used to compare whether model 1 (including hired labor dummy and cotton land ratio) gives a significantly better fit to the data than model 2 (excluding hired labor dummy and cotton land ratio). The null hypothesis that model 1 does not provide a better fit than model 2 fails to be rejected: F(2,49)= 3.187> 1.029. F-test= $\frac{(RSS_2 - RSS_1)/(P_1 - P_2)}{RSS_1/(N-P_1)}$

[26] As seen in Table 4-5, results obtained from the half-normal and exponential distributional forms are very similar.

inputs by 1% (an expenditure of 2,356 CFA) would raise cotton production by 0.78% (22kg). The regional dummy is also statistically significant from zero. Farms located in the Bobo region are more likely to have lower levels of cotton production than those in Hounde.

In Burkina Faso, over 99% of the cotton inputs are obtained through credit allocated by the ginning companies at the beginning of the crop season. An important aspect of the Burkinabe cotton market is that farmers have access to inputs on credit for both cotton and cereals through their national union, UNPCB. Interestingly, the quantity of cotton inputs purchased by farmers is highly correlated with total cotton acreage (correlation= 94%). In comparison, 85% of the cereal inputs are obtained through credit and the correlation with acreage is relatively low (correlation=52%).

When asked what the main constraint to diversify away from cotton was, Burkinabe farmers almost unanimously answered the lack of market access for other crops (51 farmers out of 56). Given that inadequate access to credit and insufficient access to inputs were among the possible answer choices, this suggests that the highest correlation between cotton acreage and inputs is not a manifestation of issues within the input market for cereals. It might imply that farmers are getting a quantity of inputs that is close to the optimal recommendation per hectare made by the ginning companies. No information on the level of indebtedness of farmers and on their previous credit reimbursement rates were collected. Otherwise, it would have been interesting to investigate whether inputs on credit are mainly allocated as a function of the cotton acreage planted or as a function of the farmers' past solvency rates. Given that previous debts incurred by Burkinabe cotton producers were forgiven, they might

have an incentive to get the maximum amount of inputs per hectare possible, no matter their capability to repay.

Table 4-10 reports the frequency distribution of TE estimates for the Burkina Faso sample. The mean technical efficiency (TE) is estimated to be 69% among the interviewed Burkinabe cotton producers. Although the TE showed great variability (TE ranging from 26% to 96%), only 16% of producers are below 0.50. Variations in the technical efficiency of cotton farmers have been analyzed through the use of environmental factors.

The coefficient estimates of the inefficiency model in the Burkinabe cotton sector are reported in Table 4-7. It is important to keep in mind that a negative sign of a coefficient stands for a negative impact on inefficiency- an efficiency enhancing factor-, whereas a positive coefficient sign implies an efficiency reducing effect. Among all environmental variables, the human social capital factors- years of cotton farming experience and literacy- and the number of cereal hectares have the largest standard errors relative to their coefficient estimates[27]. Based on the results from a generalized likelihood ratio test, these three variables have been excluded from the final model specification in order to save some degrees of freedom.

The institutional factors- whether farmers have received technical assistance and extension services over the past five years and whether they have struggled with the joint liability program- are not statistically different from zero. The social factor- cooperative norms- is negative and statistically significant at the 10% level. Producers, who believe that social norms are restraining their GPC to be better managed, are

[27] Other studies, such as Mude (2006), found that socio-demographic variables were not statistically related with degree of efficiency.

technically more efficient. How producer organizations, GPCs in Burkina Faso, deal with farmer payment, indebtedness, and their internal funds, are considered by these farmers to be efficiency reducing. Norms prevailing inside the cooperative structure do not effectively encourage timely payment to farmers, good management of indebted farmer cases, and a productive and transparent use of the internal GPC funds. This situation is not unique to cotton growers. Govereh et al. (1999) report that coffee farmers in Kenya started to side-sell in order to avoid working with poorly functioning coffee cooperative societies. Mude (2006)'s results also suggest that the higher performing Kenyan coffee producers are dissatisfied with the poor management of their cooperatives. Similarly, Audibert et al. (2003) find a negative relationship between social cohesiveness and efficiency for Ivorian cotton producers. Their results show that cotton farms located in villages where social cohesiveness is lower, are more efficient. A new question arising from this finding is whether farmers that consider social norms prevailing in the cooperatives as being efficiency reducing are more individualistic-driven and/or business-oriented.

Mali

As seen in Table 4-8, all elasticity coefficients are statistically significant, with the exception of family labor. Using the likelihood ratio test, the null hypothesis stipulating the absence of inefficiency is rejected. Therefore, it is more appropriate to analyze the Malian dataset with a stochastic production frontier than an OLS model. The largest estimated elasticity parameter is cotton land ratio. Farms with a higher proportion of their cultivated land planted with cotton are more likely to produce more. The result suggests that a 1% increase in the cotton land ratio would lead to a 0.70% increase in cotton production. Interestingly, the Malian farmers are the less specialized in cotton

across the three countries, by growing cotton on less than 1/3 of their cultivable land. This percentage is consistent with Fok (2008)'s result that cotton share in the Malian cropping system does not exceed 30% of the cultivated land. The elasticity coefficient for equipment is also relatively large in Mali.

A statistically significant difference was found across farms located within the Old Cotton Basin. Cotton production in the Northeastern and Central regions is lower than in the Southern region. As expected, level of cotton output from the New Cotton Basin (Western region) is significantly lower than in the Southeast region.

The frequency distribution of TE estimates for the Malian sample is reported in Table 4-10. The mean technical efficiency (TE) among the Malian cotton producers is 46% and over 60% of the farmers are below a TE score of 0.50. The TE ranges from 15% to 95%. Differences in farmer technical inefficiency are examined through the use of environmental factors.

Table 4-9 reports the coefficient estimates for the one-stage technical inefficiency model. Given that cooperative norm and technical assistance variables were highly insignificant- their standard errors largely exceeded the estimated parameter values- they have been dropped from the final model. Farmers that are food self-sufficient are more technically efficient in producing cotton as expected. First, farmers that produce enough food to meet their family needs are more likely to spend more time on their fields and less on off-farm activities. Indeed, the availability of off-farm income is found to be efficiency reducing (Keil et al., 2007). Secondly, they might also have better farm managerial and technical skills, which are also beneficial to cotton production.

Interestingly, the cereal hectare coefficient estimates is negative and highly significant. Cultivating more hectares of cereals- maize, millet, and sorghum- reduces cotton grower technical inefficiency. The Malian cotton sector is characterized by the absence of an efficient distribution channel for cereal inputs. Given that cotton farmers have been farming in an integrated system that involves livestock production and cereal-cotton crop rotation, they have coped with the limited access to cereal inputs on credit by diverting some of their cotton inputs, such as fertilizers and pesticides, to their cereal fields. Although, input diverting might reduce cotton production if a sub-optimal dosage is applied, it might bring some benefits too. First, soil fertility is generally better preserved on farms practicing rotation between cotton and cereals compared to those practicing only cotton monoculture (Hulugalle and Scott, 2008). Second, farmers with greater cereal area might be in a better position to feed their animals during the dry season, which also coincides with the plowing season. Indeed, the use of cereal straw improves the feed situation of animal in the dry season (Bakker et al., 1997).

Literacy and farming experience are both statistically insignificant. A previous study shows that illiteracy does not restrain Malian farmers to cope with scouting cotton pests and to properly use the right chemical (Michel, 2000; cited by Fok, 2008; p.200). The coefficient for the joint liability variable is positive but not statistically different from zero. The estimated parameter for whether farmers are confident that the cotton situation will improve in the future is positive and statistically significant. This suggests that optimistic farmers are more technically inefficient. This finding contrasts with Mude (2006)'s result that Kenyan coffee producers lacking confidence in the future are less efficient. Qualitative information gathered during interviews reveals that optimistic

farmers believe that inputs will become cheaper and that better support to purchase equipment will be provided with the reform process. The higher level of inefficiency among optimistic farmers may suggest that they have access to fewer resources and, thus, hope that their farming situation will improve with the reforms.

Comparisons

Overall, the production factors are all positive and mostly statistically significant in the three countries. The family labor elasticity coefficient is 0.252 in Benin and 0.172 in Burkina Faso. In the stochastic production frontier model including inefficiencies, the family labor is statistically insignificant in the Malian sample. Hiring labor positively influences the level of cotton production in Benin (β_{hired}=0.399) and Mali (β_{hired}=0.226). The value of owned equipment is highly significant in all countries, but the magnitude of the coefficient is larger in Mali. This is explained by the fact that Malian producers are better-equipped than their West African fellows[28]. This finding is consistent with Fok (2008; p.199), who mentioned that “Mali distinguishes itself by the popularization of animal-drawn so that only a small share of the peasants is strictly conducting manual farming”.

In Benin and Burkina Faso, where farmers can more easily access inputs on credit for both cereal and cotton crops, the largest elasticity coefficient is value of inputs (fertilizers, pesticides, insecticides, and seeds). Unlike these two countries, cotton land over total cultivated land has the largest elasticity coefficient in the Malian dataset. Interestingly, access to inputs on credit is mainly available for cotton growers and the

[28] Dropping the two observations with a tractor does not change the finding. Indeed, the minimum and maximum values remain unchanged and the mean value goes from just above one million CFA (1 111 370 CFA) to just below one million CFA (995 770 CFA) .

quantity on inputs available is proportional to the number of cotton hectares. Therefore, a strong incentive to plant cotton exists for Malian farmers.

Among the three countries, inefficiency fails to be found in the Beninese dataset. Producers obtain the maximal (frontier) level of cotton outputs from a given set of inputs. However, before concluding that all Beninese farmers are fully technically efficient, it would be preferable to collect more data and over more than one year, to ensure that efficient level of outputs are not the result of an aggregate negative shock, such as bad luck or unfavorable climatic conditions. Data collected from developing countries are also more susceptible to be contaminated by statistical noise due to measurement errors and variability in climatic conditions, resulting in underestimated TE scores (Coelli et al., 1998; p.219). In our case, random disturbances or random events might have lead to overestimate the TE of Beninese farmers. However, if Beninese farmers are truly technically efficient, there is an important need to find productive technologies that would shift outward the production frontier in order to improve their ability to compete on the international market.

Technical inefficiency is present in both the Burkinabe and Malian datasets. An examination of the sources of inefficiency reveals that human capital factors have a positive sign but they are not statistically significant. Findings from previous studies on the influence of human capital on farmer technical efficiency in developing countries are mixed. Some studies find literacy to be efficiency reducing (Audibert et al., 2003), others to be efficiency enhancing (Gebremedhin et al. 2009; Keil et al., 2007), and others do not find any statistically significant relationship (Gul et al. (2009); Haji, 2006; Battese and Coelli, 1995). As in previous studies such as Idiong (2007), a lack of association

between farming experience and efficiency is obtained. This is in contrast with Gul et al. (2009)'s finding that farmer experience with cotton farming positively influences efficiency. Technical assistance and extension services offered to cotton farmers do not statistically impact their productivity[29]. This finding is consistent with other research focusing on African cotton sectors (Ngassam et al., 2010). The coefficient for the joint liability variable is positive in both countries. However, we cannot conclude that farmers having issue with the joint liability program prevailing inside the cotton cooperatives are less efficient in producing cotton, since the coefficient is not statistically significant at the 10% level.

The estimated coefficients that are statistically significant in the Malian inefficiency model appear insignificant in the Burkinabe model and vice-versa. For instance, being food self-sufficient and having a larger number of cereal hectares do not significantly influence farmer performance in Burkina, whereas they are highly efficiency enhancing factors in Mali. These findings suggest that cereal and cotton crops can be complementary to each other. Even though cereal crops and cotton may compete in terms of land allocation, their relationship with other production factors such as labor, working capital, and crop management has complementary dimensions (Govereh et al., 1999; p.3)

Social norms prevailing in Burkinabe cotton producer organizations, GPCs, are reducing farmer efficiency. These social norms are considered inadequate to manage farmer payment, indebtedness, and cooperative funds. The accrued internal debts from

[29] A dummy variable accounting for technical assistance and extension services received over the previous year was created but it remained statistically insignificant.

2006-2009 have raised questions relative to the level of social cohesiveness that exists inside GPCs (Kaminski et al. 2009; p.16).

With the Malian cotton sector facing many challenges, such as widespread indebtedness, farmers were asked whether the situation will improve. Interestingly, producers expressing confidence in the future of the Malian cotton sector are more likely to be less efficient. One possible explanation is that these farmers are optimistic that the reforms will provide them with better support to access equipment and inputs on credit.

In our case study, the Burkinabe farmers are closer to their production efficiency frontier with an average TE score of 0.69, while Malian producers are further away from their own production possibility frontier with an average TE score of 0.46. Although the range of the TE scores is similar across both countries, more farmers are above the 0.50 threshold in Burkina Faso than in Mali. In comparison with other technical efficiency studies on cotton sectors in developing countries, the Burkinabe and Malian TE scores appear to be slightly higher and lower, respectively (Table 4-11).

The possibility of pooling the Malian and Burkinabe datasets is examined, since it will increase the number of degrees of freedom and will provide a greater space for comparisons. However, before pooling these two cross-sectional datasets together, it is important to test for homogeneity to determine whether pooling is appropriate to avoid biased estimates (Brobst and Gates, 1977). An F-test (a.k.a Chow test) based on the comparison of the residual sum of squares from the OLS individual country regressions with the residual sum of squares of the pooled OLS regression is estimated (Gould,

2005)[30]. Given that the null hypothesis of homogeneity is rejected at the 99% confidence interval, pooling of these two datasets is inappropriate. The coefficients in the two OLS country regressions are statistically different, and, therefore they should not be pooled into one single regression.

Concluding Statements

This study has discussed the main institutional changes that have taken place in the West African cotton sectors following the introduction and implementation of market reforms aimed to improve their performance. Traditionally, West African cotton sectors were characterized by the presence of a state-owned enterprise that was in charge of providing inputs, transporting, ginning, marketing, and exporting seed cotton. Interestingly, each country has undertaken the market-oriented reforms at a different pace and following a distinct path. Among the three countries, Benin has been the first one to reform, followed by Burkina Faso and further behind by Mali. Issues with the joint liability program prevailing inside cotton producer organizations are common to all three countries. Market structures, levels of farmer empowerment in the ownership of the privatized state-run companies and distribution channels for cereal and cotton inputs are the main distinguishing elements across these three West African cotton sectors.

A stochastic frontier production has been used to estimate and compare the technical efficiency score of producers in Benin, Burkina Faso, and Mali. Specifically, a one-stage estimation procedure is used to examine the effects of institutional environment on the technical efficiency scores at the farm-level in all three countries. Data used in this analysis are derived from surveys of cotton producers, conducted by

[30] $F(K, N_1+N_2-2K) \sim \frac{[RSS_p-(RSS_1+RSS_2)]/K}{(RSS_1+RSS_2)/(N_1+N_2-2K)}$ Fcritical(10, 118) ~ 2.95 < Fcomputed=6.06

the Cotton Sector Reform Project teams of the Africa, Power and Politics Programme in summer 2009. All production factors- labor, equipment, land, and inputs- have a positive sign and statistically impact the level of cotton output in the three countries. Higher production level could be achieved through better access to inputs on credit and equipment, such as traction animals

The empirical results from the stochastic frontier analysis suggest that Beninese farmers are fully technically efficient, whereas the presence of technical inefficiency is found in the Burkinabe and Malian datasets. Agricultural development policies focusing on reducing the inefficiency at the farm level in Mali and Burkina Faso should be adopted, whereas policies designed to shift outward the production frontier are more appropriate for the case of Benin. The estimated average technical efficiency (TE) scores in Burkina Faso (0.69) and Mali (0.46) are consistent with those reported in previous efficiency studies on cotton production in developing countries. The TE scores suggest that Burkinabe cotton farmers are closer to their own best production frontier given the particular country's conditions, while Malian farmers are further away from their production efficiency frontier. Technical assistance and human capital factors- literacy and farming experience-, do not statistically explain differences in inefficiency among producers in both countries. The absence of a significant relationship between these variables and efficiency has also been found in previous research. Even though all countries face some issues with the joint liability program prevailing in producer organizations, the dummy variable used to capture this institutional constraint is not statistically significant. Therefore, there is a need to develop a variable that will better capture the influence of group lending programs on cotton farmer efficiency.

In addition to the path and pace of the market reforms, the Burkina Faso and Mali cotton sectors can be differentiated in terms of their farmer inefficiency sources. In Burkina Faso, farmers that criticize the poor functioning of their producer organization are more efficient than those who think that they perform well. This new finding raises questions about whether these farmers are more driven by individualistic goals rather than group welfare, and whether the norms governing the functioning of producer organizations are more beneficial to the lower performing farmers.

In Mali, farmers that are food-secure and with more hectares of cereals are more efficient in producing cotton. These results support the argument that cotton and cereal crops have some complementary dimensions. Although cereal and cotton crops are directly competing for the allocation of land and inputs, they both benefit from improvement in labor, working capital, managerial and technical skills, and soil fertility from practicing crop rotation. Another interesting finding is that Malian cotton farmers who believe that the sector would improve with the market reforms are more likely to be technically less efficient. One possible explanation is that these farmers have lower endowment, and, therefore, have more to gain than to lose with the reforms.

Overall, the findings show the importance of considering environmental factors in stochastic frontier production and technical efficiency analysis. Although Benin, Burkina Faso, and Mali cotton sectors have some characteristics in common, their level of farmer technical efficiency differs. More importantly, the sources of inefficiency are different from one country to another. For the reforms to be successful in improving the performance of the West African cotton sector, they would have to work in concert with the local realities.

In Mali, a special attention should be given to the fact that cotton growers have been farming in integrated systems, where livestock production, cotton and cereal crops are strongly interconnected. Improving access to cereal inputs on credit for cotton farmers would be a first step to revitalize the cotton sector. One way to increase cereal inputs availability would be to provide initial support to the GSCVM in the handling of logistic and financial operations. This would require a certain level of engagement from the government and financial institutions, such as the BNDA. For instance, if GSCVM future payment were secured by the government and the BNDA, input suppliers would be more likely to deliver the quantity needed and to do it on time. Another option that requires a further investigation would be to transfer cereal input functions to the producer union, UN-SCPC. So far, cotton farmers in Burkina Faso have benefited from good access to both cereal and cotton inputs on credit through their producer union, UNPCB. This is an avenue that might be interesting for Malian cotton farmers too.

Improving social cohesiveness inside Burkinabe producer organizations, GPCs, would require structural and behavioral changes. One option that deserves more analysis would be the creation of several sub-lending groups (known as "*cercle de caution*") inside each GPC to facilitate peer-monitoring. Those sub-groups would be in charge of monitoring each other's behavior to ensure that the right quantity of inputs is purchased on credit and that they are used adequately and at the appropriate time. An ad-hoc committee could also be established to verify the work done by the GPCs' representatives in order to promote transparency and good governance. In some cases, this might even lead to prompter and higher farmer payment. This would require the

provision of training sessions to farmers to teach them how to prevent, detect, and deal with opportunistic behaviors at both farmer and GPC levels.

In brief, these findings suggest that a better understanding of local realities relevant to cotton farmers and the implementation of reforms that are consistent with them are important steps to revitalize West African cotton sectors while having the potential to induce economic growth and poverty alleviation.

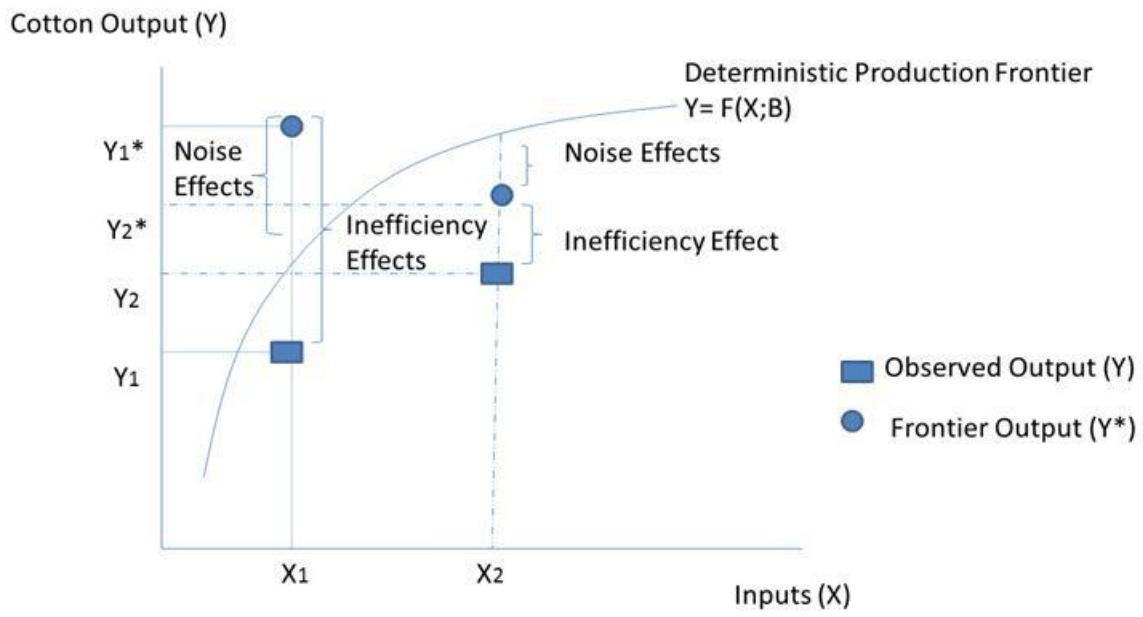

Figure 4-1. Stochastic Frontier Production

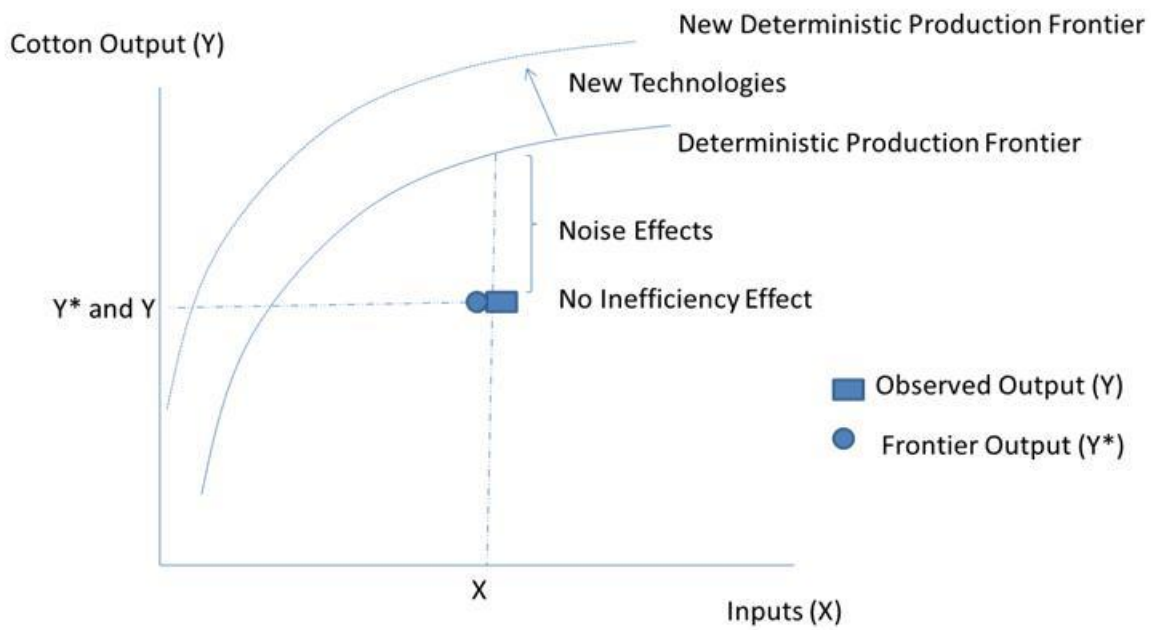

Figure 4-2. The Beninese Stochastic Frontier Production Case

Table 4-1. Changes in the Institutional Environments of West African Cotton Sectors

	Market Structure		Ownership		Input Supply		POs	
	Before	After	Before	After	Before	After	Before	After
Benin	SONAPRA	SODECO (10 gins) New gins: SOCOBE, ICB, CCB, IBECO, LCB, SEIBC, MCI, SODICOT	State 100%	State 33.5% Private 33.5% Citizen 17.5% Local authority 8.5% GVPCs 6% Workers 1% Private 100%	SONAPRA	Private 1-Cotton and cereals 2-Import and distribution are separated	GVs	GVPCs
Burkina Faso	SOFITEX	SOFITEX New gins: Faso Coton SONOMA	State 65% CFDT 34% Private 1%	State 35% Private 35% Farmers 30% Private 90% Farmers 10% Private 80% Farmers 20%	SOFITEX	UNPCB 1-Cotton and cereals	GVs	GPCs
Mali	CMDT	Southern (Sikasso+Bougouni) Northeastern (San+Koutiala) Central (OHNV+Fana) Western (Kita)	State 60% CFDT 40%	State 17% Private 61% Farmer 20% Workers 2%	CMDT	UN-SCPC 1-Cotton only GSCVM 2-Cereal only	AVs	SCPCs

Table 4-2. Production Factor Summary Statistics

Variables	Benin (N=81)		Burkina Faso (N=56)		Mali (N=82)	
	Mean (S.D)	Min-Max	Mean (S.D)	Min-Max	Mean (S.D)	Min-Max
Cotton Production (kg)	6250 (8849)	135-50000	3055 (2458)	400-14500	3571 (5513)	300-34739
Cotton Land (ha)	4.43 (4.87)	0.5-27	3.08 (1.88)	1-10	3.60 (4.62)	0.25-26.60
Yield (kg/ha)	1183 (665)	270-3429	950 (311)	360-1657	961 (400)	110-1878
Family Labor (person)	8.51 (7.43)	2-49	5.35 (2.72)	2-12	10.70 (11.96)	1-100
Hired Labor (dummy)	0.84 (0.37)	0-1	0.57 (0.49)	0-1	0.31 (0.46)	0-1
Equipment (CFA)	219274 (263126)	1000-925000	319006 (178396)	1000-746500	1111370 (1875026)	1000-1430000
Purchased Inputs (CFA)	394629 (523055)	15500-2800000	235619 (149070)	55740-844210	333361 (459156)	15000-3269365
Cotton Land Ratio (%)	33.74 (20.68)	3.44-88.88	50.70 (14.81)	21.59-80	27.33 (11.50)	7.14-63.15
Total Cultivated Land (ha)	14.16 (12.65)	1.9-85	6.13 (3.14)	2-16	12.04 (11.68)	1.5-69.6

Table 4-3. Institutional Environment Factor Summary Statistics

Variables	Benin (N=81)		Burkina Faso (N=56)		Mali (N=82)	
	Mean (S.D)	Min-Max	Mean (S.D)	Min-Max	Mean (S.D)	Min-Max
	Freq.	%	Freq.	%	Freq.	%
Cereal Land (ha)	5.17 (4.98)	0-25	2.82 (1.58)	0.5-6	7.46 (6.50)	1-39
Farming Experience (years)	19.16 (9.15)	1-45	10.89 (5.62)	2-31	23.03 (12.50)	2-50
Food Self-Sufficiency	0=39 1=42	48.15 51.85	0=22 1=34	39.29 60.71	0=29 1=53	35.37 64.63
Literacy	0=31 1=50	38.27 61.73	0=30 1=26	53.57 46.43	0=43 1=39	52.44 47.56
Coop Norms			0=12 1=44	21.43 78.57	0=78 1=4	95.12 4.88
Joint Liability	0=10 1=71	12.35 87.65	0=31 1=25	60.71 39.29	0=61 1=21	74.39 25.61
Technical Assistance	0=19 1=62	23.46 76.54	0=32 1=24	57.14 42.86	0=43 1=39	52.44 47.56
Optimistic	0=24 1=57	29.63 70.37	0=43 1=13	76.79 23.21	0=58 1=24	70.73 29.27

0 = no, 1=yes

Table 4-4. OLS and MLE Production Function Estimates, Benin (N=81)

Variables	OLS	Half-Normal	Exponential	Truncated-Normal
Constant	-1.349*	-1.338	Does not fit the data	-1.340
	(0.756)	(0.896)		(0.901)
Family Labor	0.252**	0.252**		0.252**
	(0.105)	(0.100)		(0.100)
Hired Labor	0.399**	0.399**		0.399**
	(0.182)	(0.173)		(0.173)
Equipment	0.087**	0.087**		0.087**
	(0.035)	(0.034)		(0.034)
Inputs on Credit	0.570***	0.570***		0.570***
	(0.081)	(0.077)		(0.077)
Cotton Land Ratio	0.216*	0.216*		0.216*
	(0.120)	(0.114)		(0.114)
Regions:				
Central	0.429*	0.429*		0.429*
	(0.235)	(0.223)		(0.223)
South	-0.373*	-0.373*		-0.373*
	(0.225)	(0.214)		(0.214)
Lambda	--------	0.025		----------
		(0.681)		
Sigma2	--------	0.267		0.268
		(0.043)		(0.002)
Sigma v	--------	0.517		---------
		(0.041)		
Sigma u	--------	0.0133		---------
		(0.673)		
Prob>F	0.000	0.000	----------	----------
R^2_{adj}	82.38		----------	----------

Log Likelihood	---------	-61.522		-61.522
Test u=0				
(Prob>chibar2)	---------	1.000		----------
(Prob ≤ z)				0.698

Note: Standard errors are in parentheses. *, **, and *** = statistically significant at the 90, 95 and 99-percent confidence levels, respectively. North is the omitted cotton region.

Table 4-5. OLS Production Function Estimates, Burkina Faso (N=56)

Variables	Model 1	Model 2
Constant	-2.491**	-2.664**
	(1.098)	(1.065)
Family Labor	0.169*	0.1651*
	(0.100)	(0.106)
Hired Labor	0.096	----------
	(0.091)	
Equipment	0.075***	0.076***
	(0.025)	(0.025)
Inputs on Credit	0.712***	0.775***
	(0.111)	(0.101)
Cotton Land Ratio	0.150	----------
	(0.147)	
Region	-0.374***	-0.328***
	(0.095)	(0.088)
Prob>F	0.000	0.000
R^2_{adj}	83.05	83.02
Likelihood	-8.993	-10.153

Note: Standard errors are in parentheses. *, **, and *** = statistically significant at the 90, 95 and 99-percent confidence levels, respectively. Hounde is the omitted cotton region.

Table 4-6. OLS and MLE Production Function Estimates, Burkina Faso (N=56)

Variables	OLS	Half-Normal	Exponential	Truncated
Constant	-2.664**	-1.403*	-1.539	Do not
	(1.065)	(0.849)	(0.997)	converge
Family Labor	0.1651*	0.135*	0.150*	
	(0.106)	(0.078)	(0.079)	
Equipment	0.076***	0.067***	0.065***	
	(0.025)	(0.018)	(0.023)	
Inputs on Credit	0.775***	0.721***	0.724***	
	(0.101)	(0.082)	(0.092)	
Region	-0.328***	-0.416***	-0.428***	
	(0.088)	(0.064)	(0.078)	
Lambda	--------	5.698	1.959	
		(0.094)	(0.131)	
Sigma2	--------	0.233	0.100	
		(0.057)	(0.033)	
Sigma v		0.083	0.143	
	--------	(0.042)	(0.060)	
Sigma u		0.476	0.281	
	--------	(0.064)	(0.079)	
Prob>F	0.000			
R^2_{adj}	83.02			
Loglikelihood	-10.153	-6.958	-8.053	
Likelihood ratio test sigma u=0 (Prob> Chibar2)		0.006	0.020	

Note: Standard errors are in parentheses. *, **, and *** = statistically significant at the 90, 95 and 99-percent confidence levels, respectively. Hounde is the omitted cotton region.

Table 4-7. Production Function and Technical Inefficiency Estimates, Burkina Faso (N=56)

Variables	Model 1	Model 2	Model 3	Model 4
Constant	-1.293	-1.011	-1.005	-0.554
	(0.900)	(0.909)	(0.929)	(0.803)
Family Labor	0.151*	0.172**	0.157*	0.087
	(0.084)	(0.078)	(0.089)	(0.083)
Equipment	0.055**	0.069***	0.060***	0.069***
	(0.022)	(0.021)	(0.022)	(0.022)
Inputs on Credit	0.723***	0.685***	0.695***	0.659***
	(0.083)	(0.084)	(0.085)	(0.080)
Region	-0.426***	-0.439***	-0.443***	-0.427***
	(0.077)	(0.077)	(0.074)	(0.063)
Constant	0.496**	0.441*	0.573**	0.765**
	(0.227)	(0.253)	(0.226)	(0.322)
Structural :				
Self-Sufficiency	-0.290	----------	-0.240	-0.189
	(0.208)		(0.185)	(0.192)
Cereal	----------	----------	----------	-0.029
Acreage				(0.076)
Human Capital :		----------	----------	
Cotton Farming	----------			-0.006
Experience				(0.020)
Literacy	----------	----------	----------	0.006
				(0.201)
Social :				
Cooperative	-0.331*	-0.387*	-0.376*	-0.356*
Norms	(0.200)	(0.223)	(0.211)	(0.207)
Institutional :				
Technical	-0.171	-0.224	-0.199	-0.197
Assistance	(0.173)	(0.201)	(0.193)	(0.209)
Joint Liability	0.189	0.200	0.161	0.112
	(0.181)	(0.193)	(0.177)	(0.183)
Situation	----------	-0.273	-0.188	-0.166
		(0.227)	(0.216)	(0.273)
Sigma-squared	0.137**	0.139*	0.132**	0.128***
	(0.065)	(0.070)	(0.060)	(0.041)
Gamma	0.953***	0.960***	0.959***	0.999***
	(0.062)	(0.056)	(0.063)	(0.000)
Loglikelihood	-2.095	-2.861	-1.639	0.693
LR Test- one sided error	16.115	14.583	17.027	21.694
# of restrictions	6	6	7	10
Mean Eff.	0.699	0.694	0.695	0.677

Note:Standard errors are in parentheses. *, **, and *** = statistically significant at the 90, 95 and 99-percent confidence levels, respectively. Hounde is the omitted cotton region.

Table 4-8. OLS and MLE Production Function Estimates, Mali (N=82)

Variables	OLS	Half-Normal	Exponential	Truncated-Normal
Constant	-2.818***	-1.823**	-2.246**	-2.042*
	(0.932)	(0.927)	(0.821)	(0.120)
Family Labor	0.344***	0.343***	0.337***	0.336***
	(0.095)	(0.087)	(0.085)	(0.087)
Hired Labor	0.371***	0.444***	0.441***	0.441***
	(0.126)	(0.124)	(0.120)	(0.120)
Equipment	0.274***	0.254***	0.262***	0.258***
	(0.060)	(0.045)	(0.049)	(0.050)
Inputs on	0.316***	0.282***	0.295***	0.291***
Credit	(0.079)	(0.077)	(0.071)	(0.077)
Cotton Land	0.718***	0.774***	0.762***	0.766***
Ratio	(0.148)	(0.145)	(0.149)	(0.147)
Regions:				
Northeastern	-0.191	-0.175	-0.148	-0.158
	(0.168)	(0.153)	(0.156)	(0.163)
	-0.233	-0.237*	-0.231*	-0.235*
Central	(0.147)	(0.134)	(0.134)	(0.134)
	-1.058***	-1.148***	-1.114***	-1.126***
Western	(0.211)	(0.211)	(0.190)	(0.206)
Lambda	--------	2.144	0.876	----------
		(0.264)	(0.159)	
Sigma2	--------	0.489	0.235	0.720
		(0.165)	(0.045)	(1.994)
Sigma v	--------	0.295	0.364	---------
		(0.103)	(0.066)	
Sigma u	--------	0.634	0.319	---------
		(0.170)	(0.104)	
Prob>F	0.000	---------	----------	----------
R^2_{adj}	0.750	---------	----------	----------
Log Likelihood	-56.192	-54.980	--55.047	-54.977
Likelihood ratio test u=0 (Prob>chibar2)		0.060	0.065	

Note: Standard errors are in parentheses. *, **, and *** = statistically significant at the 90, 95 and 99-percent confidence levels, respectively. Southern is the omitted cotton region.

Table 4-9. Production Function and Technical Inefficiency Estimates, Mali (N=82)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	0.947	1.019	0.633	-1.143*	-1.902
	(1.193)	(0.969)	(0.993)	(0.653)	(1.292)
Family Labor	0.084	0.086	0.092	0.176*	0.100
	(0.087)	(0.077)	(0.083)	(0.096)	(0.183)
Hired Labor	0.210*	0.203*	0.226*	0.382***	0.271
	(0.122)	(0.105)	(0.117)	(0.129)	(0.176)
Equipment	0.210***	0.206***	0.212***	0.231***	0.256***
	(0.042)	(0.035)	(0.039)	(0.041)	(0.059)
Inputs on Credit	0.128*	0.130*	0.143**	0.213***	0.262***
	(0.071)	(0.069)	(0.066)	(0.637)	(0.142)
Cotton Land	1.023***	1.015***	1.029***	1.050***	1.062***
Ratio	(0.132)	(0.136)	(0.147)	(0.149)	(0.327)
Regions:					
Northeastern	-0.336**	-0.375***	-0.315**	-0.097	-0.177
	(0.155)	(0.127)	(0.160)	(0.149)	(0.357)
Central	-0.356**	-0.401***	-0.356**	-0.288**	-0.277
	(0.135)	(0.111)	(0.134)	(0.132)	(0.427)
Western	-0.797***	-0.771***	-0.801***	-0.956***	-0.836
	(0.205)	(0.214)	(0.200)	(0.232)	(0.606)
Constant	1.651***	1.707***	1.541***	----------	0.476
	(0.316)	(0.245)	(0.316)		(1.109)
Structural :					
Self-Sufficiency	-0.309**	-0.298**	-0.308**	-0.627**	-0.531
	(0.139)	(0.128)	(0.137)	(0.293)	(0.705)
Cereal	-0.113***	-0.112	-0.112***	-0.144***	-0.147**
Acreage	(0.010)	(0.013)	(0.011)	(0.034)	(0.077)
Human Capital :					
Cotton Farming	0.004	----------	0.004	0.033***	0.028
Experience	(0.006)		(0.006)	(0.008)	(0.024)
Literacy	----------	0.064	0.064	0.358***	0.259
		(0.108)	(0.112)	(0.230)	(0.661)
Social :					
Cooperative	----------	----------	----------	-0.010	-0.026
Norms				(0.980)	(0.994)
Institutional :					
Technical	----------	----------	----------	0.325	0.175
Assistance				(0.255)	(0.811)
Joint Liability	0.205	0.223	0.211	0.472*	0.325
	(0.139)	(0.164)	(0.149)	(0.270)	(0.816)
Situation	0.160***	0.255**	0.281**	0.749***	0.562
	(0.034)	(0.118)	(0.130)	(0.231)	(0.743)
Sigma-squared	0.160***	0.160***	0.162***	0.383**	0.391**
	(0.034)	(0.033)	(0.038)	(0.146)	(0.196)
Gamma	0.812***	0.788***	0.812***	0.866***	0.822***
	(0.081)	(0.089)	(0.106)	(0.136)	(0.256)

Table 4-9. Continued

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Loglikelihood	-30.766	-30.988	-30.590	-39.121	-40.667
LR Test- one sided error	50.852	50.408	51.203	34.141	31.050
# of restrictions	7	7	8	9	10
Mean Eff.	0.442	0.443	0.463	0.617	0.597

Standard errors are in parentheses. *, **, and *** = statistically significant at the 90, 95 and 99-percent confidence levels, respectively. Southern is the omitted cotton region.

Table 4-10. Technical Efficiency Scores of Burkinabe and Malian Cotton Farmers

	Eff. ≤ 0.25	0.25< Eff. ≤ 0.50	0.50< Eff. ≤ 0.75	Eff. >0.75
Burkina Faso (n=56)	0	9	24	23
Mali (n=82)	14	37	20	11

Table 4-11. Review of Cotton Technical Efficiency Studies

Authors (year)	Country	# Obs.	TE Scores	TE Range
Ngassam et al. (2010)	Cameroon	202	0.602	0.11-0.91
Gul et al. (2009)	Turkey	79	CRS=0.720	0.23-1.00
			VRS=0.890	0.55-1.00
Audibert et al. (2003)	Ivory Coast	75[1]	0.547	0.02-1.00
		167[2]	0.466	0.03-1.00
Chakraborty et al. (2002)	USA	54	CRS=0.799	0.33-1.00
			VRS=0.886	0.43-1.00
			SFA=0.800	0.53-1.00
Shafiq and Rehman (2000)	Pakistan	120	…	<0.40- 1.00
Bravo-Ureta and Evenson (1994)	Paraguay	87	0.582	0.19-0.85

1= low malaria density infection, 2= high density malaria infection

CHAPTER 5
LIMITING FACTORS, CONSEQUENCES, AND INSTITUTIONAL CHANGES IN THE MALIAN COTTON SECTOR: AN APPLICATION OF JOHN R. COMMONS

Introductory Statements

In this chapter, the Malian cotton sector is described in detail from the independence of the country in 1960 until the ongoing reforms. The analysis of pre-reform institutional arrangements will provide insights not only on the roles and positions of the main stakeholders toward the reform process, but also on the chronology and pace of the latter. The structural adjustment programs (SAPs) proposed by the Bretton Wood Institutions to improve economic performance in least developed countries (LDCs) through increased competition and reduced transaction costs have not led to significant poverty alleviation and economic growth as promised. By dismissing both formal and informal institutions, policies based solely on neoclassical economic theory have proved to be ineffective and inappropriate (Saleth and Dinar, 2004; North, 1994). Although these market-oriented reforms have been well designed, they have been based on the assumption that economic reforms alone would lead to market efficiency and, thus, have ignored completely the need for and effect of other formal and informal institutional changes. With the limited successes of the SAPs promoting economic development, there is an emerging interest in the study of institutions. For example, several studies have analyzed the relationships between institutions and economic development, providing new perspectives on how to induce it (e.g. Broda, 2008; Nubukpo, 2008; Stein, 1994).

Within the schools of institutional economic thought, John R. Commons' theories are particularly relevant to the analysis of the agricultural economy in LDCs, especially in Africa, since he focused on the importance of public policies in the design and

achievement of a productive economy and political order (Parsons, 1985). Indeed, successes in agricultural development rely upon both farmers' access to technological advances, such as improved seed varieties, and the creation of a system that provides a stable social, economic, and political order. To effectively promote agricultural development, leaders in the social, political, and economic spheres of society should advocate for the resolution and avoidance of conflict. In addition to explaining the evolution of institutions, Commons' theory provides a framework to analyze the effects of institutions on resource allocation and distribution of income (Roumasset, 1978). Although Commons' economic theory is well-suited to study changes in institutional environments in the agricultural sectors of LDCs within the framework of the SAPs, there has been little practical application of his theory.

The objective of the study is to apply general concepts from the writing of Commons about the evolution of institutions to analyze key changes in the institutional environment of the Malian cotton sector. Given that Commons was reputed to be an applied practitioner, the assessment of the key institutional changes, the (un)intended consequences, and limiting factors to economic performance in the Malian cotton is supplemented with qualitative evidence gathered during fieldwork in May/June 2009 and March 2010. This analysis also provides useful insights about the types of interactions between the main cotton stakeholders, and how those interactions evolved through different institutional changes. Commons' evolutionary process is used to discuss the key institutional changes in the Malian cotton sector starting with the country's Independence in 1960 through the ongoing market-oriented reforms in 2010. The success of the reforms in revitalizing the Malian cotton sector relies upon a better

understanding of the limiting factors and their consequences on economic performance and institutions.

Chapter 5 is organized as follows. A brief review of the key concepts of Commons' economic theory, mainly from his book "Institutional Economics", is provided in section 2. Section 3 applies Commons' theory of institutional evolution to analyze the Malian cotton sector under four different institutional environments: 1) contract with the French parastatal following Mali's Independence; 2) nationalization of the cotton gin company; 3) establishment of a vertically integrated market structure; and 4) implementation of market-oriented reforms, within the structural adjustment policy framework. Section 4 concludes with policy alternatives that could improve the Malian cotton sector performance.

Commons' Key Economic Concepts

In Commons' institutional economic theory, transactions are the smallest economic units of investigation. Being based upon relationships between individuals and organizations[55] , transactions correlate together the economic, legal and moral aspects of economic outcomes. These social relationships involve conflict, dependence, and order. Economic decisions are made, through transactions, to avoid or resolve conflict between individuals that have mutually dependent interests and are based upon reliable inference drawn from previous experiences. Transactions are defined as "the alienation and acquisition, between individuals, of the rights of future ownership of physical things, as determined by the collective working rules of the society' (Commons,

[55] Commons defined organizations as: household, governmental units, firms under different forms (e.g., partnership, cooperatives, charities), and other customs and laws (Dahl, 1969; p.6).

1934, p.58). Transactions refer to the transfer of ownership, which may occur through material, debts, or expected opportunities[56].

Commons classified transactions into three categories: bargaining, managerial, and rational. Bargaining transactions involve the transfer of wealth, such as right ownership, between legally equal but not economically equal parties. The differences in economic power are explained by the alternative opportunities (Commons referred to them as being the limits of coercion) and bargaining power, such as the ability to withhold, available to both parties (Rutherford, 1983; p. 725). The rationing and managerial transactions involve differences in the legal power of both parties. Managerial transactions are based on production relationships and create wealth through the command of a legally superior party. The relationship between an employer and an employee is a typical example. Rationing transactions involve the apportioning of wealth or purchasing power by an authority legally superior to the parties (Commons, 1934; p.67-68). For instance, boards of directors of corporations, unions, and administrative governmental units.

These three types of transactions are interdependent and they create together a going concern. Following Commons' terminology, a going concern refers to the joint expectation of beneficial transactions united together by the working rules and by the control of the constantly changing limiting factors (Commons,1934). In other words, a going concern is "the institutional perimeter is which transactions take place" (Fiorito, 2008; p. 11), such as a family, church, farmer union or corporation. Transactions taking place in a going concern are governed by working rules of collective action designed to

[56] For instance, owners may have the opportunity to create scarcity by holding up their goods from the market in order to maintain high prices.

maintain order. A factor is considered to be limiting if its control at the right time, in the right place and in the right form stimulate the work of the other complementary factors (Commons, 1934). Once a limiting factor is controlled for, this latter becomes a complementary factor and a new limiting factor emerges. For instance, the inadequate provision of raw cotton during the Civil War in America was a limiting factor that led to the stoppage of cotton mills and to a high rate of unemployment in England (Commons, 1970; p.180). Another example of a limiting factor in agriculture is the insufficient quantity of applied potassium that if better control for, should improve cereal yield. Once the quantity of potassium is controlled, another complementary factor, let say magnesium, may become the limiting factor.

In Common's analysis, the choices and actions of individuals and of going concerns that are made within the context of one or more limiting factors are the driver of institutional changes (Figure 5-1). On one hand, these choices and actions can be constrained by informal institutions[57], such as social norms and customs, and by formal institutions such as laws, regulation, and electoral systems. On the other hand, institutions can serve as instruments to alter the choices and actions of both individuals and concerns. Therefore, institutional changes can be seen as something that emerges from actions made, given the existing state of knowledge, prevailing social norms, best existing practices, and political possibilities in the current institutional environment (Rutherford, 1983). This is a dynamic process since individual choices and actions vary with changes in the decision-making environment. An interesting element of Commons' analysis is that individual actions may result in unintended consequences which in turn,

[57] Commons defined institutions as "going concerns with working rules that keep them agoing"(Commons, 1934; p. 69)

give rise to new problems to be solved. Indeed, all institutions are not the result of conscious design and, therefore, unplanned and unintended consequences from human interactions exist (Hodgson, 2003; p. 564). Institutional changes are, therefore, neither necessarily progressive nor reasonable. Commons used the term reasonable to refer to more equitable outcomes. The interactions taken place in the society and their (un)intended consequences on economic performance can be analyzed through the three types of transactions. The (un)intended effects of institutions, for instance, on resource allocation, production, and distribution of income can be analyzed through bargaining transactions (transfer of wealth), managerial transactions (creation of wealth), and rationing transactions (apportioning of wealth).

Commons' Theory Applied to the Malian Cotton Sector

In this section, Commons' economic theory is applied to analyze the evolution of the institutional environment of the Malian cotton sector from 1960 to 2010. Key actions to control for limiting factors, and their (un) intended consequences on economic performance are identified and analyzed-starting with the contract agreement between the French parastatal and the Malian government following the country's Independence in 1960, to the nationalization of the cotton gin company in 1974, to the vertically integrated market structure in the 1980s to 1990s, and to the ongoing market-oriented reforms of the 2000s are discussed. The impacts of institutional changes on economic performance are assessed mainly through production measures, such as cotton output, yield, and acreage, export earnings, farmer, gin, and State's revenues, rural development, and provision of public goods, such as extension services, and research and development (R&D).

The analysis concludes with an assessment of the emerging key limiting factors to future economic performance given the ongoing privatization and liberalization reforms. This assessment will provide useful insights to policy-makers seeking to revitalize the Malian cotton sector.

Mali's Independence and CFDT Contract

The "Compagnie française pour le développement des fibres textiles"(CFDT)[58] was established in 1949 as a joint venture with the French State. This parastatal ginned and commercialized cotton production in Mali. In its early days, the CFDT competed for market share but gradually the other private operators withdrew (Fok and Tazi, 2004). Shortly after Independence, the newly formed Malian government contracted with CFDT to be the exclusive commercial cotton ginning company in all Mali.

The actions of individuals and going concerns. During the colonial period, cotton was not as popular as it is now in Mali (then known as French Sudan). One possible reason is that cotton production was then associated with violence and food shortage (Campbell et al., 2007). The expansion of this cash crop came with Mali's Independence in 1960. Under Keita's governance, who was the first elected President of Mali, an important institutional change took place with the signature of a 10-year contract agreement with the already established French parastatal in 1964. Under this rationing transaction, the Malian government entrusted the CFDT with the promotion of cotton by formalizing its monopoly rights over the purchase of all seed cotton and marketing of cotton fiber.

[58] The CFDT became DAGRIS in 2003 and then Geocoton with its privatization in 2008

Outcomes and economic performance. The period 1964 to 1973 corresponded with the introduction of a cotton value chain system, where the CFDT had considerable leverage over cotton farmers by controlling, for instance, access to inputs, grading and weighting of seed cotton. The CFDT also retained considerable power in terms of how revenues from cotton exports were distributed, as very little of these revenues were paid to the Malian government and/or reinvested in the rural development of Mali. In return, farmers were guaranteed a market for their production of cotton at fixed prices set by the government. The announcement of fixed pan-territorial prices before the planting season and the respect of those prices were measures taken to reduce farmers' risk aversion and to ensure that farmers would not delay their harvest in expectation of higher prices later in season, which would have jeopardized cotton quality (Fok, 2008). Even though this cotton system provided farmer incentives to produce cotton, these incentives were somewhat constrained by the lack of managerial decision making and bargaining power that farmers possessed.

In an effort to encourage farmers to grow cotton, the CFDT actively participated in the breeding of new seed varieties, in promoting the use of fertilizers and pesticides, and in investing in animal traction (Tefft, 2004). The absence of competition created incentives for the CFDT to provide extension services since benefits associated with higher cotton output and/or yield returned to them. During these years, rural economic development activities were limited to extension services and training provided by the CFDT to persuade farmers to grow cotton. The CFDT was successful in persuading Malian farmers, evidenced by major expansion and productivity growth that occurred in

the cotton sector during this period. Indeed, from 1958 to 1972, Malian cotton production shifted from 3 900 tons to 68 000 tons (Benjaminsen et al., 2010).

Key limiting factors. The institutional environment in the Malian cotton sector, following the country's Independence, was characterized by the high involvement of the French gin company, CFDT, at all operational levels. Through their monopoly status, the CFDT had a better control over their input supply, and, thus, was able to be economically viable. Although the period under the CFDT governance led to important increases in cotton production, the majority of these economic benefits were captured by the CFDT French owners. In addition to limited economic development due to the outflow of capital generated by the cotton sector, the absence of farmer voices in decisions related to cotton activities (such as access to inputs and the grading and weighting of cotton), was another limiting factor to economic performance.

Nationalization and Farmers' Empowerment

Looking for suitable measure to cope with internal economic problem and to induce economic development, many governments in LDCs started to get more involved in their agricultural sector in the 1970s. In this spirit, the Malian government decided to not renew its contract with the CFDT but rather to increase its level of intervention through the nationalization of the cotton sector (i.e., a rationing transaction). Concurrently to the nationalization, farmers became more organized through the formation of village associations and more empowered through the transfer of managerial responsibilities from the parastatal to farmers and their associations. The key stakeholders involved in the Mali cotton sector and their interactions following the nationalization of the CMDT are depicted in Figure 5-4 and are further explained in the next sections.

From CFDT to CMDT

The actions of individuals and going concerns. In 1974, the Malian government decided to nationalize its cotton sector and created the "Compagnie Malienne pour le Développement des Textiles" (CMDT) in which the Malian government owned sixty percent and the French company (CFDT) owned forty percent of the integrated company and its assets. Through nationalization, the Malian government gained control over many of the economic benefits generated by the cotton sector, and, consequently could now have some control over how to allocate (ration) these benefits. With this institutional change came a transfer of ownership and a new mandate. From its old mandate of persuading farmers to grow cotton, the new mandate of the gin company evolved to "promoting integrated rural development" (Tefft, 2004). As suggested by Commons, it appears that the need to control for limiting factors, in this case cotton revenues and their allocations, was the main driver behind this important institutional change.

Outcomes and economic performance. According to Bingen (1998) this transfer of ownership was not an example of radical nationalism since this institutional change was beneficial for both parties. On one hand, this partnership ensured a more regular supply of cotton and consistency in quality, which are both necessary, but not sufficient, conditions to the success of all cotton ginning and trading companies. On the other hand, the CMDT benefited from this joint venture in three different ways. First, it took advantage of all the technical expertise, as well as the research and development done by the CFDT since its founding in 1949. Second, it gained direct access to CFDT business partners, such as COPACO, a major international trading company, which handled most of African cotton exports (Figure 5-4). Third, its national monopoly status

in the ginning and marketing of cotton significantly contributed to State's revenues through export earnings. Through the nationalization, the Malian government gained power over a portion of export revenues and, then, the control over how and where to allocate these revenues.

Through its new mandate, the state-owned enterprise, CMDT, became highly involved in both agricultural and general development of the country by maintaining rural roads, ensuring access to drinkable water, providing stable income to cotton farmers, and negotiating purchasing prices, in addition to processing and selling cotton. Following its nationalization, the CMDT received support from the World Bank in order to strengthen its position as a public good provider (Campbell et al., 2007). Through this action, CMDT became a "State within a State" (Roy, 2010). Public foreign capital, coming mainly from the World Bank, was used to cover rural development and infrastructure activities, such as blacksmith training on ox-drawn agriculture devices, whereas private capital was free to be invested in activities that enhanced profitability (Fox, 2008; Bingen, 1998).

As a result of these investments, both cereal and cotton production grew due to increases in acreage and yields. As seen in Figure 5-2, the numbers of planted hectares of cereal and cotton followed an upward trend following the nationalization of the cotton gin company[59]. In addition to improved food security through the promotion of an integrated farming system, the high involvement of the State in rural development activities in cotton regions also contributed to increased literacy rates through the provision of literacy lessons to cotton farmers.

[59] However, the steep increase occurred with the improvement of inputs access on credit to farmers as it will be explained further in the next section (i.e., an interlocked input-credit-cotton system).

Key limiting factors. With the nationalization of the CMDT came its new mandate to induce rural economic development. This increase in responsibilities put increasing pressure on the cotton gin company's budget since the provision of these public goods brought extra costs but not necessarily extra revenues. Moreover, through its new role as a public good provider, the CMDT tightened its relationship with international agencies, such as the World Bank, which contributed to increased dependency upon public foreign capital. In addition to the high involvement of the CMDT in rural economic development activities, the rapid growth in cotton production also led to increased strains on the CMDT's managerial skills and on its capacities to develop and maintain a transparent and efficient operational system. Further, the importance of the monopoly parastatal, CMDT, in the Malian national economy created perverse incentives to rent-seeking behaviors and political inference.

Formation of village associations

The actions of individuals and going concerns. A major institutional change in terms of farmers' empowerment occurred in 1974. Dissatisfied with the cotton grading and weighting process (i.e., a limiting factor), cotton farmers, with the help of CMDT technical agents, organized their first protest (actions of individual and going concerns). Their request was heard, and the CMDT transferred cotton grading and weighting responsibilities to the newly formed producers' organizations, known as Associations villageoises, AVs, (village associations), located throughout Mali's cotton production regions (i.e., an institutional change).

Outcomes and economic performance. In addition to providing farmers better control over important cotton-related activities, this transfer of responsibilities has indirectly contributed to village development. After the harvest, cotton is transported

from the field to the village collection site, where it is graded and weighted before being loaded and transported to the nearest ginning plant. In exchange for their members' time and labor, the producer organizations receive a financial compensation that is more likely to be used on village-based collective developmental projects, such as schools, wells, and health centers. From the CMDT point of view, the main objective behind the transfer of cotton related activities to the Village Associations was not to empower farmers but rather to reduce their own operation costs.

Even though AVs became well established at the local level during this time, they did not have any legal status. Indeed, they were not governed by any official working rules. This reinforces Commons' idea that institutions do not have to be formal to set the working rules being followed by individuals and going concerns and even informal institutions play an important role in terms of economic development, in part, by maintaining order.

Key limiting factors. The cotton system established by the CFDT continued under the new nationalized cotton gin company. The CMDT was entrusted with monopoly rights while farmers were guaranteed the right and duty to sell all their production at a fixed pan-territorial price announced prior to planting. However, farmers had no formal bargaining power over the determination of seed cotton prices. Price fairness remained a concern for the Malian cotton producers. Due to the lack of financial resources, access to inputs was also a constraint to economic performance. Farmers wanted to get more involved in all critical cotton-related activities.

Vertical Integration

The vertical integration of Mali's cotton sector was completed during the mid-1980s to mid-1990s. Under this fully integrated structure, an interlocked credit-cotton-

input system to address farmers' financial constraints in accessing inputs on credit, and a new price mechanism and a stabilizing fund were implemented to better control for farmers' risk aversion. As discussed by Fok (2008), the integrated cotton system was gradually established to overcome cotton farmers' production constraints and concerns, such as price fairness, risk aversion, lack of financial resources, lack of competence, and high transaction costs.

Interlocked input-credit-cotton system

The actions of individuals and going concerns. To overcome problems related to imperfect credit and input markets, an interlocked system tying up inputs on credit with cotton production at the village level was formalized. Unlike in the 1970s, where loans were directly allocated to individuals, the new interlocked system granted loans to AVs, which acted as a group lender (Koenig, 2008). Under this new system, all members of the AVs were responsible for individual famer's loans received at the village level. Through the AVs, the CMDT provided inputs on credit, mainly seed, fertilizers, pesticides, and insecticides, to farmers at the beginning of the crop season on the promise of getting paid back at the harvest. After the harvest, the CMDT directly deducted credit from farmer's seed cotton payment. Loans were not directly granted by the CMDT but rather by the BNDA (Banque Nationale de Developpement Agricole). The CMDT played a facilitator role between the BNDA and producer organizations as seen in Figure 5-4.

Outcomes and economic performance. In addition to empowering AVs through the transfer of new responsibilities, the implementation of an interlocked system generated incentives to use inputs, since those were made more easily available. In addition to maintaining or improving soil fertility, better access and use of inputs partially

explained the high cotton yield reached during the mid-1980s to mid-1990s. As seen in Figure 5-3, cotton yields reached their peak in late 1980s, with an astonishing national average close to 1400 kg/ha. Concurrently, the number of planted hectares of both cereal and cotton rapidly increased. This might be explained by the fact that the quantity of inputs available on credit was proportional to the number of planted hectares.

Assuming that farmers' revenues from higher yields exceeded increased in production costs due to the use of inputs, this interlocked system enhanced farmers' standard of living. Given that cotton farmers were also growing their own food, such as sorghum, maize, and millet, to meet their families' needs, diversion of cotton inputs on cereal fields is more likely to have contributed to improved food security.

However, undesired outcomes also emerged from the implementation of a group lending scheme in the provision of inputs on credit. First, although cotton remained the principal sources of revenues to repay loans, all members of the AVs, which included cotton and non-cotton farmers, were able to obtain inputs on credit. This made credit recovery more difficult to manage. Second, the presence of opportunistic farmers selling inputs obtained on credit to the black market, assuming that others would cover their losses, contributed to indebtedness. Third, input diversion from cotton to cereal fields could also jeopardize farmers' capacity to cover their loans. Fourth, in the presence of an aggregate shock, such as flooding in 1999, entire villages defaulted on their credit due to cotton crop being damaged, and therefore, the CMDT was unable to recoup the BNDA loans.

Key limiting factors. Even though the establishment of AVs enhanced farmer empowerment by transferring some responsibilities, the absence of exclusive

membership and effective sanctions against opportunistic behaviors led to high rates of indebtedness at both producer and organization levels and created disincentive towards good performance. Indeed, due to the presence of a joint liability program, the highest performing farmers have seen their profits diminished, since a part of their profits was used to cover other members' loses. Interestingly, the village-wide memberships of the AVs and its potential unintended impact on economic performance have been criticized for a long time (McCorkle, 1986 cited in Koenig, 2008; p.204)

Price determination and stabilizing fund

The actions of individuals and going concerns. The establishment of a fully integrated structure also led to both the introduction of a minimum price for cotton producers, and a stabilization fund, managed by the CMDT in order to secure and stabilize producers' revenues over time (Bourdet, 2004). The stabilization fund created under the new pricing mechanism was designed to support minimal seed cotton prices during periods of low world prices and to be replenished during periods of high world prices. It was an important institutional change intended to reduce farmers risk aversion while limiting the CMDT ginning and marketing risks associated with fluctuations in the international market.

Outcomes and economic performance. This price mechanism provided relative stability to cotton growers, albeit at a high opportunity cost, in terms of development actions and lower long-term growth (Tefft, 2004; Badiane, 2002). With the sharp decline in international prices, the parastatal company had less room to maneuver to maintain the stabilizing funds and to pursue investment in profit-related activities. In addition to minimum prices too high in comparison to world market prices, mismanagement of the funds contributed to its limited success. Indeed, surpluses accumulated during high

world prices often disappeared when the money was needed to support floor prices guaranteed to producers (Goreux and Macrae, 2003). Due to mismanagement and/or corruption, the stabilization fund acted as a tax to producers in periods of high world prices while producers struggled to get compensated during periods of low world prices (Kelly and Tschirley, 2008). As a result, the government, with support from international donors, such as the French Development Agency (AFD)[60], injected money in the fund to keep it going.

The depletion of the stabilization fund due to the combination of low world prices and mismanagement shed light on the issues facing the pricing mechanism and more importantly, on the overall poor financial performance of the CMDT. The bailout of the stabilization fund was only the tip of the iceberg. Indeed, the Malian government and international donors both invested heavily in the CMDT to avoid its bankruptcy. Following each reinvestment, the State saw its share in the CMDT increased. Even though the CMDT benefited from the CFA currency devaluation[61], its financial situation remained critical with unsustainable debts in the mid-1990s. Given the differences in bargaining power and the lack of transparency in both the floor price determination and the transmission mechanisms, cotton farmers experienced only very limited benefits from the CFA devaluation. Indeed, following the CFA devaluation, producers received only a 30 CFA/kg increase while world prices augmented by 463 CFA/kg (Tefft, 2003). Not only could the low prices paid to farmers be qualified as unreasonable, they limited productivity. Lower prices reduced farmers' capability to acquire productive assets, to

[60] AFD is the French acronym for "Agence Française de Développement"

[61] Following the CFA devaluation in 1994, the CMDT increased its export earnings through the expansion of cotton export volumes resulting from the increase in prices.

use chemical inputs, and to refund their loans. In cotton sectors characterized by the presence of a monopolistic ginning company, such as in Mali, prices paid to cotton farmers are lower than under concentrated or competitive market structures (Tschirley et al., 2010).

Key limiting factors. Farmers remained discontent over the pricing mechanism, since it neither led to high enough prices nor led to a more reasonable distribution of the profit between farmers and CMDT. Mismanagement and lack of transparency in the cotton gin company led to rent-seeking and opportunistic behaviors. These combined with low international prices, contributed all to the disappearance of surplus in the stabilization fund and to the accrual of CMDT's deficit. The pricing mechanism did not succeed in securing and stabilizing producers' revenues in a sustainable manner over time or in limiting CMDT's correlated risk with changes in the world market. However, it did shed light on the poor financial performance of the CMDT, and, thus, contributed to put the reforms, within the structural adjustment program framework, back on the agenda.

First major farmer strike

The actions of individuals and going concerns. During this period, producer organizations grew more empowered, while their discontents with both short-standing issues (e.g., CMDT technical agent dishonest behaviors) and long-standing issues (e.g. cotton grading and pricing process) were on the rise, disturbing the social, economic, and political order[62]. By 1991, cotton farmers' frustrations reached their peak. Producers

[62] Some of the CMDT village technical agents received pay hikes after encouraging farmers to purchase equipment on credit. The CMDT wanted to be in charge of grading and pricing cotton at the ginning facilities rather than letting farmers do it at the village collection site.

united to demand resolution of 12 grievances on production and marketing issues and organized their first cotton boycott (i.e., actions of individuals and going concerns) just before the start of the season (Tefft, 2004). The farmers' action to protest was certainly induced by the inability of the previous reforms to take care of their concerns.

This first strike movement occurred at the same time as the modern advent of democracy in the country, following the coup d'état of March 1991. In accordance with Commons' reasoning, the market development in the cotton sector-, resulting from the actions of individuals and going concerns, was a driving force behind the democratic movement (Kemp, 2002).

The credibility of the new democratic era depended on the ability of the government "[…] to seek a compromise between the CMDT and the producers that balanced its commitment to democratic principles with the country's compelling economic and financial dependence upon cotton production and marketing" (Bingen, 1998; p.269). It is as true that the democratization process contributed to the emergence of the National Union of Cotton and Food Crop Producers (SYCOV[63]) as it is true that farmers' empowerment encouraged the new government to commit to democracy. This institutional change in the Malian cotton sector (emergence of SYCOV) has been shaped by the interaction between the agents of change (farmers demanding policy reforms) and the change in the institutional environment (from a military-led regime to a democracy).

Following the farmers' strike, 9 out of 12 grievances were quickly solved on the promise of pursuing the negotiation on the three other demands (Tefft, 2004).

[63] Syndicat des producteurs de coton et vivriers du Mali (SYCOV)

Discussion between CMDT, Malian and French governments and other donors led to the approval of a legally recognized producers' organization, SYCOV, which would be participating in all relevant CMDT decision-making units.

Outcomes and economic performance. The rise of producer representation in the decision-making process came along with the emergence of leaders that did little to serve and defend the interests of the majority. Unlike typical cotton farmers, SYCOV leaders were mostly all educated, knowledgeable of the bureaucracy rules, and able to communicate in French (Roy, 2010). An unintended effect of the creation of SYCOV was, therefore, the consolidation of cotton elite that had its own interests to defend before those of all cotton farmers.

Key limiting factors. Although the creation of SYCOV might have helped to increase farmer participation in important cotton decisions, it certainly led to the emergence of a "cotton elite". Roy (2010) argued that the principal progress made in farmer empowerment was not due to leaders' involvement, and even questioned their real motivation, given their well-known participation in clientelism, corruption, and cooptation. Thus, more work needed to be done to improve farmers' involvement in critical cotton decisions.

Ongoing Market-Oriented Reforms

In response mainly to the large accumulated deficits of both the CMDT and the State, the Bretton Wood Institutions strongly advocated for the ending of government support to the CMDT, and for the privatization and liberalization of the sector. Following Commons' theory on the evolution of institutions, the recommendations of the IMF and World Bank were "actions" to undertake in order to control for limiting factors that undermine economic performance.

Refocusing the CMDT activities mainly towards the cotton system, improving producers' participation in the cotton sector decision making process, opening capital to producers and the private sector, transferring critical functions to producers and private operators, and liberalizing the cotton and oleaginous sectors are the main strategies set up to fulfill the stated goals of the changes (ICAC, 2010). The stated reform goals can be summarized as: 1) control and reduce production costs at the farm and gin levels; 2) improve cotton yield; 3) strengthen producer organizations and the participation of the private sector; 4) increase cotton sector revenues; 5) reduce poverty; and, 6) fix prices on the basis of free negotiations among the stakeholders (Republic of Mali, 2003).

It is assumed that the liberalization and privatization of the cotton sector would enhance competitiveness and efficiency (Kovach and Fourmy, 2006). Increasing the degree of competition in the ginning activities by selling gin facilities to private operators should reduce incentives for rent-seeking and opportunistic behaviors and lead to higher efficiency. The establishment of a new pricing mechanism should also contribute to improve the financial situations of the ginning facilities, while reducing the government fiscal burden. With the dismantlement of the state-owned enterprise, input distribution and transport should be taken over by the private sector, and research and development activities would be taken over by the government. The gin facilities would be focusing only on ginning and marketing activities and, thus, would withdraw from rural development activities, which are considered to bring extra costs but not direct revenues.

Second major farmer strike

The actions of individuals and going concerns.

At the same time that the Bretton Wood Institutes started to advocate more strongly for institutional reforms, farmers were also showing sign of dissatisfaction toward the price mechanism and management of the Malian cotton sector by the late 1990s and early 2000s. In fact, discontent with low seed cotton prices and the discovery of embezzlement funds by the CMDT were key factors that led to the strike movement by cotton farmers during the crop campaign 2000/01. Discussions concerning whether or not SYCOV leaders should be re-elected, given their poor ability to defend farmers' interest and to negotiate higher prices also contributed to the farmers' protest (OECD, 2002).

Outcomes and economic performance. During the farmer boycott year, cotton production went down to 242,726 tonnes compared with 459,123 tonnes the previous year due to farmers' decisions about planting less hectares of cotton (Figure 5-2). This decline in cotton production had disastrous impacts on the CMDT and State revenues, while providing more incentives to the World Bank to push further on the privatization and liberalization reforms (Roy, 2010).

Interestingly, seed cotton prices went up for several years after the boycott movement, but this upward trend did not last. Following donor pressure to liberalize[64], a new price determination mechanism linking more directly farmer prices to world prices

[64] For instance, the World Bank withheld $50 million in aid in 2004 as a way to persuade the Malian government to implement a new price mechanism that would better link farm prices with world prices (Bergamaschi, 2008).

was introduced during the 2005/06 cotton season. Conditionality[65] has been one of the principal tools used to encourage the government to undertake major reforms in the cotton sector (Kovach and Fourmy, 2006). The use of conditionality can be seen as a measure of coercion, where the power of each in determining the level of exchange depends upon their relative power to wait for the other to give (Commons, 1934; p. 337). Given that the new liberalized price mechanism had negative consequences on poverty by increasing food insecurity and debts (Kovach and Fourmy, 2006) and on GDP through reduction in consumer spending (Keita and Nubupko, 2005), it was not prolonged after 2008.

In addition to the setting of more reasonable prices, the date of payment has become a new concern for farmers. Following the 2000/01 farmer strike, the fixation of higher seed cotton prices to please producers and to avoid another boycott has appeared to the CMDT, a more relevant strategy to encourage cotton production than timely payment. Therefore, farmers have experienced important delays in receiving their payment over the last decade (Chapter 3). Difficulties associated with the sale of cotton are limiting farmer production by exacerbating food insecurity, indebtedness, and access to inputs due to lack of liquidity. As results, Malian farmers have been either reducing the area planted or quitting cotton production.

Key limiting factors. In addition to still facing low cotton prices, farmers have been dealing with high input costs and important delays in receiving their payments (i.e., emerging limiting factors). Although the CMDT and State representatives acknowledged

[65] Conditionality is defined as “the application of specific, pre-determined requirements that directly or indirectly enter into a donor's decision to approve or continue to finance a loan or grant” (Bull et al., 2006; p.4)

the presence of important delays in farmer payment and their negative consequences on cotton supply during interviews conducted in June 2009, they mentioned their powerlessness to remedy it in the short-run. Indeed, they discussed the difficulties of paying farmers on time, in a period of tight budget and low international prices. Even though it is well-recognized that delays in farmer payment act as limiting factors to production (Fok, 2008), it is still unclear whether they are the outcome of external factors, such as low world prices, or of the lack of incentive from the CMDT to make credible commitments.

From village associations to cooperatives

The actions of individuals and going concerns. A key institutional change, brought in with the most recent set of cotton reforms, is the transformation of the informal village associations (AVs) into formal cooperative societies (SCPCs) in 2001 (Figure 5-5). In the pre-structural adjustment policy setting, many farmers and AVs suffered from internal indebtedness, due to mismanagement of credit, bad governance, and lack of accountability. Therefore, changes in the producer organization's legal structure can be seen as a response to control for the indebtedness. Unlike the AVs, the cooperative societies have legal status and are financially autonomous. Members are voluntarily chosen, representatives are democratically elected, and benefits (and risks) are collectively shared (Republic of Mali, 2001). Through the joint liability program that prevails, members of a SCPC are all liable for each other's debts. Producers with similar affinities can regroup to form their own cooperative and can legally exclude undesirable ones (e.g., highly indebted farmers). Although there was only one AV previously per village, more than one cooperative might now exist under the new

working rules. The legal status also confers rights to the SCPCs to make transactions with market operators such as financial institutions, on their own account.

Outcomes and economic performance. Some of the AVs facing internal conflicts, mainly due to internal indebtedness and divergences in economic interests, split up into several SCPCs (Lacy, 2008). However, information collected during interviews conducted in March 2010 suggests that only a minority of the conflicting AVs broke up into multiple cooperatives. The exclusion of insolvent cotton growers from a cooperative seems, a priori, a solution, but the strength of the social relations prevailing in villages might prevent it from happening. Indeed, the presence of strong social interconnections among farmers makes exclusion a more theoretical than practical option. Even though some producers argued that traditional norms have started to erode and that familial values have slowly been substituted by individual ones, it is unlikely that a farmer would rationally put himself in the delicate position of excluding a relative from the cooperative. Solidarity remains an important feature inside villages, which has its own advantages and disadvantages. On one hand, farmers in difficulty to make payment can count on the strong mutual support from their kin to help for a few installments (Montgomery, 1996). On the other hand, it is more difficult to restrain farmers with bad credit recovery, due to underperformance and/or opportunistic behaviors, to free ride on performing farmers when tight relationships exist. Therefore, some cooperatives still struggle to efficiently manage internal credit. Although Commons acknowledged the presence of problems related to free-riding behaviors in collective action, his ideas remain underdeveloped (Rutherford, 1983; p. 735).

The rapid pace, at which the AVs were transformed into cooperatives, has been openly criticized by many NGOs. There was a lack of training, information and consciousness from all actors, but more visibly at the producer level. According to an AOPP's[66] representative, over 70% of cooperatives still worked with an AV's logic, which partially explain why the establishment of cooperatives has not fully succeeded in resolving indebtedness issues facing many producers and their organizations. High rates of credit default still persist at the farmer and cooperative levels. Given the presence of joint liability programs within the SCPCs, profits made by high performing cotton farmers have been used to cover losses from underperforming ones. The joint liability programs have been the source of tension among farmers and have resulted in the abandonment of cotton farming by some. Producers who are members of financially healthy cooperatives are really pleased with the new institutional structure whereas producers who are members of indebted and conflicting cooperatives are still desperately waiting for major improvement.

Key limiting factors. The problem of credit defaulting among farmers and their organizations was not completely addressed by the transformation of the AVs into SCPCs. Three different explanations were often cited during interviews with the key stakeholders to explain farmers' indebtedness. First, the lack of consumption market mechanisms, such as access to personal credit, has been pointed as one of the principal reasons for farmers' debts. Second, the degradation of moral values has been

[66] AOPP is the acronym for the Association of Professional Producer' Organizations. The AOPP has two major roles: 1) to defend producers' interests at the regional, national and international political levels, and 2) to educate farmers and their organizations on their new responsibilities in the decision-making process.

mentioned as a main cause of credit default. Indeed, it is well-recognized that some producers unscrupulously borrow money knowing that they will be incapable of paying it back. Free-riding is a common problem facing collective action and is present in this environment. Third, late payment to farmers combined with low seed cotton prices and high input costs put them in a difficult position to recover their loans, and thus, rekindles issues with the joint liability program prevailing in farmer cooperatives.

This period is associated with a loss of social capital, which is reflected by the degradation of cooperative norms at the village level and by the increase in pessimism at the producer level within a context of high uncertainty and changes. In addition to the withdrawal of many producers from growing cotton, excessive tension inside cooperatives is harming social capital among members (Giné and Karlan, 2008).

Pyramidal union structure

The actions of individuals and going concerns. To improve farmers' representativeness in the decision-making process, a new pyramidal union structure was implemented at the same time as cooperatives were introduced at the village level. The SCPCs are the first of five levels characterizing the new union structure implemented with the ongoing reforms. The second level is the communal union, and encompasses the SCPCs from different villages, but sharing a same commune. Then, different communes are grouped into sectoral unions, which are then merged into four different regional unions. Finally, the last level is the national union, UN-SCPC[67], composed of the four regional unions. That is, representatives elected from the SCPCs form the UN-SCPC, and so on.

[67] UNSCPC means National Union of Cooperative Societies of Cotton Producers (Union nationale des sociétés coopératives des producteurs de coton).

The former farmers union, SYCOV[68], is not longer a major stakeholder under the new institutional arrangement (Figures 5-5 and 5-6). Although SYCOV still exists, it does not any longer represent the cotton farmers' voice in the formal cotton governance setting. Indeed, the UN-SCPC has been chosen to solely represent and defend cotton growers' interests in all decisions-making bodies and authorities (APCAM, 2008). The UN-SCPC is considered to be a more democratic structure and, therefore, should provide a better voice to farmers through increases in bargaining power. From a Commons' perspective, unions are "an attempt to gain a reasonable equalization of bargaining power" (Rutherford, 1983; p. 732).

With the privatization and liberalization process, new responsibilities have been gradually transferred to the UN-SCPC. In addition to participating in the fixation of seed cotton prices, the UN-SCPC is in charge of negotiating, purchasing, and distributing agro-chemical products before the start of a new cotton season. Through a formal stakeholder group, the Interprofession (IPC[69]), quality, quantity and prices of agro-chemical products to purchase are negotiated between UN-SCPC, the professional association of cotton companies of Mali (APROSCOM[70]), and input supplier companies. The final decisions should be reached through consensus. With the establishment of the IPC and this transfer of responsibilities to the UN-SCPC, the State is not supposed to interfere in any decisions related to agro-chemical inputs and seed cotton prices,

[68] There are three other main union organizations. However, SYCOV has been previously the most influential one in the cotton sector.

[69] IPC is the French acronym for "Interprofession du coton au Mali".

[70] APROSCOM is the French acronym for "Association professionnelle des sociétés cotonnières du Mali".

anymore. Following Commons' reasoning, decisions made through collective actions, such as those within the IPC, should lead to more reasonable outcomes (Broda, 2008).

Outcomes and economic performance. In many villages, the SCPCs leaders are the same as under the AVs. Therefore, this new structure has indirectly contributed to maintain or even reinforce the social domination of cotton elite at the village level. Theoretically, everyone has the potential to be elected as president of a cooperative. But in reality, required qualifications, such as being literate and being from the appropriate caste, restrain some individuals to be more involved in the social structure of their village, while acting as an entry barrier protecting the interests of the cotton elite. This supports Commons' idea that informal institutions, such as norms and custom, can constrain individual choices and actions.

The success of the new producer union structure in serving and defending interests of the majority of cotton farmers is also mitigated. During fieldwork, the lack of effective representation of farmers' interests by the UN-SCPC constantly emerged from discussions at the village level. Cotton growers mentioned that their union leaders defend them poorly, since they do not take into account their local realities. Producers wonder whether it is due to incomplete transmission of the information by the intermediary to the leaders, or whether leaders are aware of farmers' concerns, but just do not respond to them. Farmers believe that political realities are more important to their union leaders than their local realities. These findings of a highly politicized union structure from fieldwork are consistent with those reported by Roy (2010).

Given that the subscription of many cooperatives to the UN-SCPC is paid by the State rather than by farmers, it might explain why leaders are likely to listen more

carefully to the politicians than to the base. The lack of good representativeness is even greater when considering that UN-SCPC leaders do not perceive the farmers' discontent. During interviews with union leaders, there was no mention of differences between farmers' interests and those defended. To strengthen their good work, the union leaders talked about the strong voice that farmers have earned, and gave as examples the 2000/01 farmers strike and their recent involvement in input supplies. These examples are debatable.

Being composed of cotton producers, the UN-SCPC possesses a great body of knowledge on production, but has a major lack of experience in contract negotiation. Therefore, there is divergence of opinions on the success of the UN-SCPC regarding the input distribution process. According to some NGO representatives and farmers, this transfer of activity is a failure, since there are major delays in input distribution, which negatively impact activities such as sowing and weeding, and therefore, yields. For the union leaders and some farmers, this new responsibility is seen as positive, since it gives more power and independence to the producers. Nevertheless, they are aware that the UN-SCPC needs help and guidance in order to efficiently and promptly provide inputs to farmers.

Key limiting factors. Although reforms brought higher expectations on the role that the union structure can assume (e.g., management of credit and purchase of input supplies), they have not generally succeeded in meeting them (Akiyama et al., 2003). The rise of cotton elite and of a more politicized union structure has contributed to the loss of trust between the producers and their leaders, who are criticized for serving and defending their own interests first. Moreover, the low seed cotton prices and high input

prices are reminders that more work has to be done to achieve more reasonable outcomes from a farmer perspective.

Liberalization and privatization of the CMDT

The actions of individuals and going concerns. The proposed institutional change that has drawn the most attention from both cotton stakeholders and the general public is indisputably the dismantlement of the CMDT, which would ultimately lead to its privatization. Under the market-oriented reforms, the state monopoly has gradually withdrawn from rural development (e.g., road maintenance and literacy lessons) and production activities (e.g., technical assistance, R&D) to focus its efforts mainly toward ginning and marketing. Since the disengagement of the CMDT in the provision of public goods, neither public –private partnerships nor NGOs, have fully stepped in to ensure their continuation The provision of inputs for cereals has been transferred to the cotton and cereal producer union group, GSCVM, which regroups the main 4 unions in Mali, including SYCOV. The task of supplying cotton input on credit is being gradually transferred to the UN-SCPC. Once this transfer of responsibility is completed, the UN-SCPC would be solely responsible to call to tender, distribute, and supply cotton inputs to producers through their cooperatives.

With the reform process, the CMDT has been split into four regional monopolistic affiliates[71] (Figure 5-6). Once the privatization is fully completed, each affiliate will be independently managed and owned. Each monopolistic firm will be owned at 61% by a private operator, 20% by cotton producers, 17% by the State, and 2% by the gin's

[71] The four regional monopolistic zones are: Northeast, which includes the regions of Koutiala and San, Southern which includes the regions of Bougouni and Sikasso, Central, which includes the regions of Fana and OHNV, and Western, which includes the region of Kita.

employees (ICAC, 2010). Commons would argue that this new form of ownership should better protect the interest of the non-monopolistic actors, for instance the farmers, by increasing their bargaining power (Parsons, 1985, p. 758). From being previously administrated as a socio-economic developmental project, the cotton sector would now be established as a private industry, with profit maximization as the main objective in each zone.

Outcomes and economic performance. Given that the privatization of the cotton company has not occurred yet, it is too early to conclude whether it will lead to reduced costs through enhanced efficiency and competitiveness. The withdrawal of the CMDT in the provision of public goods has certainly reduced its operation costs. However, there is an indirect cost associated with this disengagement. Indeed, no other entity has stepped in to provide them yet. Therefore, cotton farmers have experienced a decline in rural developmental activities and in extension services received over the years. For instance, due to the disengagement of the State in the provision of extension services, 82% of cotton farms received technical support during 2008/09 compared to over 95% during the four previous crop years (CMDT, 2009).

The transfer from the CMDT to the GSCVM of all activities related to inputs meant for cereal crops have had unintended consequences. Difficulty in farmer access to cereal inputs has occurred from the inexperience of GSCVM in handling the purchase, distribution, and payment activities and from the lack of collateral that farmers can offer to input suppliers (IFDC, 2004). Before the reform process, cotton farmers were encouraged to farm in an integrated system, that encompasses livestock production with cotton and cereal cultivation, and they had access to both cereal and cotton inputs

through the CMDT. Although input diversion is not a new phenomenon, it appears to have gained popularity with the recent reforms. Indeed, it is not uncommon for many Malian cotton farmers to divert some of their cotton inputs toward their cereal fields. It might be due to either the insufficient quantity of cereal inputs available thought the GSCVM or the easiness to access cotton inputs on credit through the SCPCs and/or both. Nevertheless, a sub-optimal quantity of inputs is generally applied to cotton fields due to input diversion but also due to the high input prices. The combination of sub-optimal input use with soil fertility degradation in cotton regions have led to declines in cotton yields over the last decade.

The period during which the CMDT has gradually withdrawn from the provision of public goods, such as technical advices and extension services, coincided with a decline in cotton yield as seen in Figure 5-3. Lower yields mean that many of the stated reform objectives have not been met yet. In addition to reducing efficiency and competitiveness, the decline in yields is reflected in lower cotton revenues for the farmers, the CMDT, and the State. However, the impact of lower cotton productivity on poverty remains unclear since this latter depends on the other sets of alternatives available to farmers. For instance, input diversion might lead farmers to get lower cotton yields but higher cereal yields, which depending on the production costs and price ratio might be more profitable.

Key limiting factors. In addition to the lack of technical assistance and extensions services provided, Malian cotton farmers are facing low farm prices[72] and high input costs, which generates incentives to apply sub-optimal dosages of fertilizers

[72] This study analyzes the Malian cotton sector from 1960 /61 to 2009/10. Note that local and world cotton prices have been rapidly increasing since the crop season 2010/11.

and pesticides on their cotton fields. The application of a smaller dosage than recommended intensifies soil fertility degradation, while reducing cotton yields. Even though many cotton producers mentioned a keen interest to convert to organic[73] in order to cut their costs of production, it is not the panacea solution to reverse the low yield trend. Indeed, producing cotton organically requires extra labor work[74] that only a few farmers are willing to do. Despite being contrary to the liberalization policies recommended by donors, fertilizer inputs have been subsidized to encourage cotton production and to increase yields on several occasions. However, some NGOs' representatives consider this action of subsidizing fertilizers as being motivated by political rather than agronomic interests. With the perpetual objective of being elected at the next electoral campaign, politicians particularly covet the support of three million cotton smallholder farmers. Under uncorrupted and democratic elections, cotton farmers, due to their large representation, have political power to skew the electoral results.

Concluding Statements

Throughout his life, Commons worked upon drawing policy inference from his research. Therefore, to do justice to Commons' work, this research concludes by drawing relevant policy recommendations that should revitalize the Malian cotton sector based on the knowledge of (un)intended consequences and their economic impacts

[73] Even with the assumption that organic cotton prices would be similar to conventional ones (no organic bonuses), farmers maintained their statement.

[74] Growing organic cotton requires extra labor work to stock, transport and apply manure, to weed, to control pest management, etc. To illustrate, a producer reported transporting 100 carts of manure to his field in order to farm 2 hectares of organic cotton.

from key institutional changes that have occurred from the country ‘s Independence in 1960s to the ongoing reforms in 2000s.

The lack of adequate technical advice and extension services, high rates of indebtedness at the farmer and producer organization levels, inadequate access to inputs, discontent about low seed cotton prices, delays in the date of payment, and the highly politicized structure of the UN-SCPC, are all factors limiting economic performance in the Malian cotton sector. However, they are not all critical to economic performance in the same way at all moments.

Farmers’ concerns in terms of indebtedness at both the farmer and organization levels and of unreasonable pricing mechanism are limiting factors that have persisted over the reforms. The transformation of the AVs with open membership to the cooperative structures with restricted membership to cotton producers only have not solved the problem of high credit default. The presence of strong social relationships makes exclusion of poor performing farmers a more theoretical than practical option. Opportunistic behaviors, such as selling inputs obtained on credit on the black market, have not been eliminated due to the lack of both credible sanctions and enforcement mechanisms. Given that cotton remains the main source of revenues for farmers, diversion of cotton inputs on cereal fields contributes to indebtedness, assuming that a sub-optimal quantity of inputs applied to cotton fields leads to lower yields, and, thus, revenues.

The implementation of a linked cereal-credit system to facilitate access to cereal inputs on credit should reduce incentives to divert cotton inputs while improving farmers’ loan repayment rates without compromising food security. The application of fertilizer

and pesticide dosages closer to the optimal level should increase cotton yields. With higher cotton yields, farmers' revenues should increase while reducing farmers' risk of defaulting on their loans and lessening risk of conflict within cooperatives. However, improving access to cereal inputs on credit for cotton producers would require more involvement from key cotton stakeholders such, as the Ministry of Agriculture, financial institutions, and gin companies. Sub-lending groups should also be created within cooperatives to facilitate peer-monitoring and discourage opportunistic behaviors.

The unreasonable pricing mechanism is a persistent farmers' concern that led twice to a boycott movement. Indeed, farmers' strikes in 1991 and 2000 were mainly induced by farmers' discontent toward the sector's inability to set reasonable seed cotton prices. The implementation of a more liberalized price determination mechanism in the mid-2000s as proposed by the Bretton Wood Institute was not as beneficial to farmers as initially expected. Given its unintended consequences, such as increased food insecurity and reduced GDP, the liberalized price mechanism was discontinued. Setting prices that appear reasonable to both farmers and CMDT remains an important challenge for the Malian cotton sector. Following Commons' reasoning, increasing farmers' bargaining power should lead to a better protection of their interests, including the settlement of more reasonable prices and prompt payment. Moreover, assuming that the newly implemented Interprofession works as intended, decisions made through this collective action should lead to more reasonable outcomes.

An important unintended consequence that came with the rise of farmers' participation in the decision-making process is the emergence of cotton elites. Even though the implementation of a pyramidal union structure (UN-SCPC), with leaders

elected through elections, was intended to be more democratic than the former union (SYCOV), it has maintained the social domination of cotton elites. Indeed, few farmers met the required qualifications to become leaders.

Improving literacy rates among farmers would be a first step to address this problem by increasing the number of potential candidates to representative positions. However, with the restructuration of the cotton sector, the CMDT has withdrawn from providing literacy lessons and neither the private sector nor the government has fully stepped in yet.

Through the privatization and liberalization reform process, the CMDT has refocused its activities mainly toward cotton ginning and marketing and, thus, has gradually withdrawn from providing extension services and conducting R&D. The combination of sub-optimal quantity of inputs applied to cotton fields and lack of adequate technical supports offered to producers has certainly contributed to lower yields over the last decade.

Addressing this problem would require finding the right balance between providing services that bring extra costs but not directly extra revenues for the cotton gin company. Extension services to disseminate information on new production technology and to assist farmers in the adoption of improved cotton production techniques are vital elements to increase cotton yields. So are R&D activities to develop production technology more appropriate to the Malian agro-climatic conditions, such as drought-resistant seeds. However, these services come with a cost that the cotton gin company should not bear alone. Partnerships with the Ministry of Agriculture and universities

should be fostered to make sure these essential services are provided without jeopardizing the financial situation of the CMDT.

In accordance with Commons' institutional economic theory, the actions of individuals and going concerns to control for limiting factors have been the drivers of institutional changes in the Malian cotton sector from 1960 to 2010. These actions have had both (un)intended consequences impacting economic performance at the farm, gin, and State levels, which in turn, led to the emergence of new liming factors. With the ongoing privatization and liberalization reforms, lack of adequate technical advice, indebtedness, and issues related to input access, discordance between farmers and their union' leader representatives, low seed cotton prices, delays in payment and low cotton yields have emerged as the new key limiting factors.

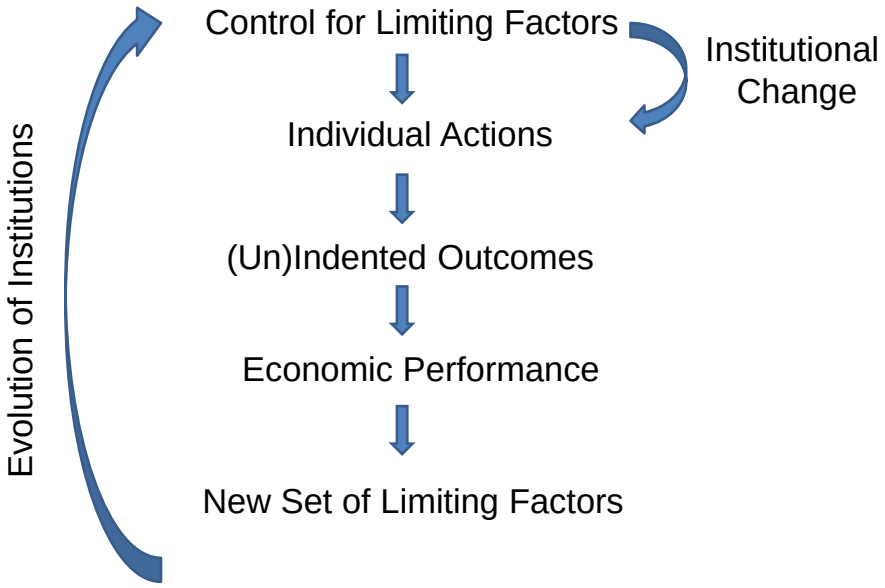

Figure 5-1. Commons' Evolution of Institution Theory (Source: Author)

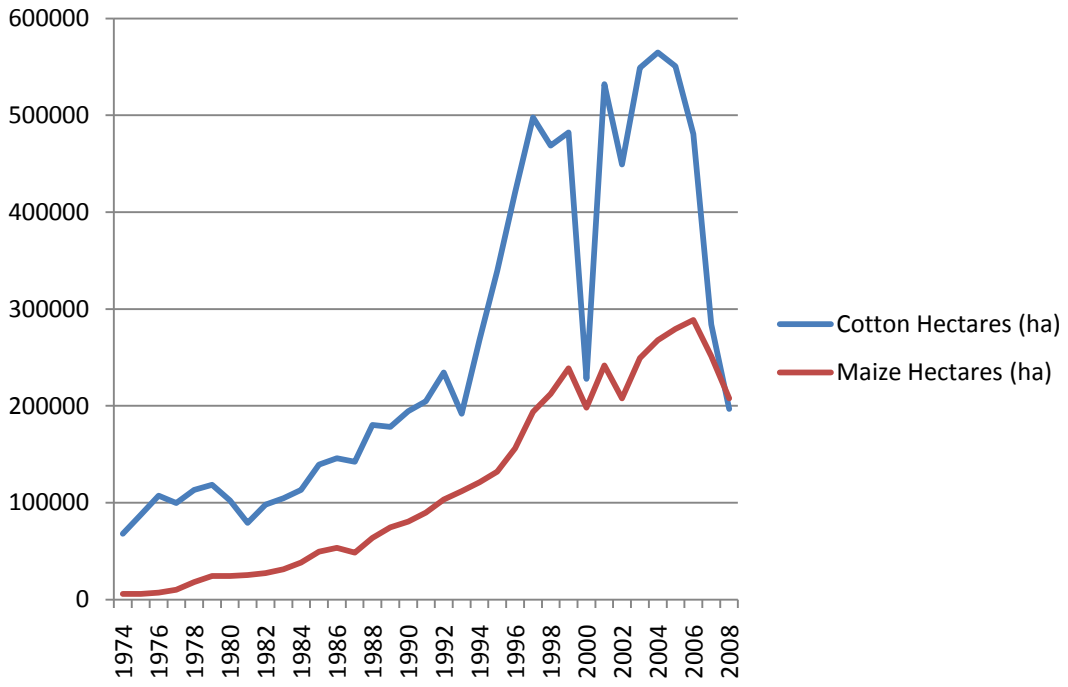

Figure 5-2. Evolution of Cotton and Maize Hectares, 1974-2008 (Source: CMDT)

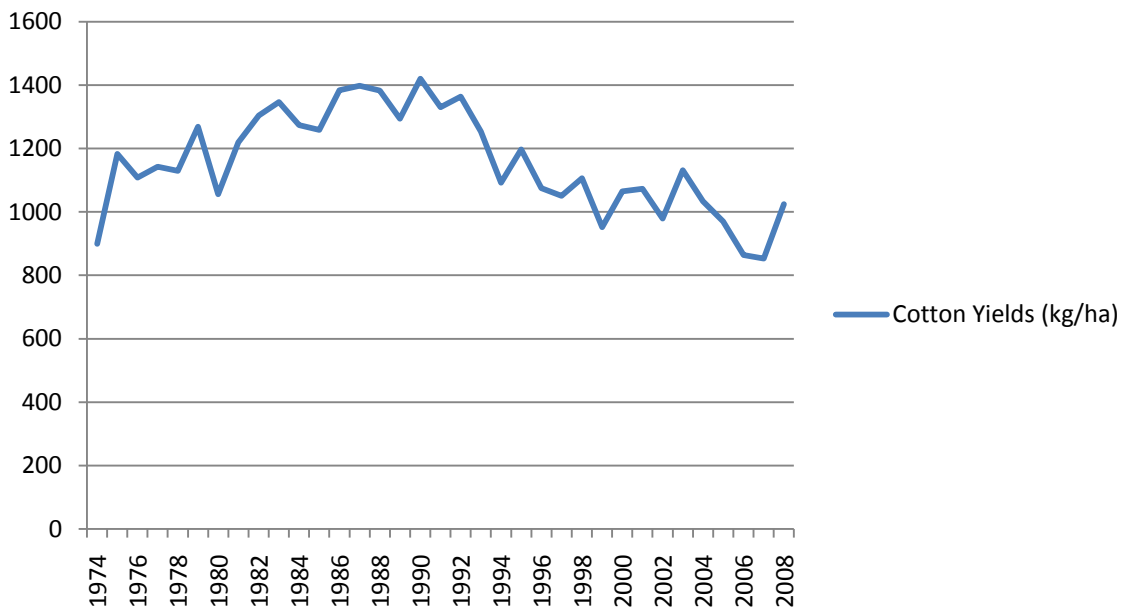

Figure 5-3. Evolution of Cotton Yields, 1974-2008 (Source: CMDT)

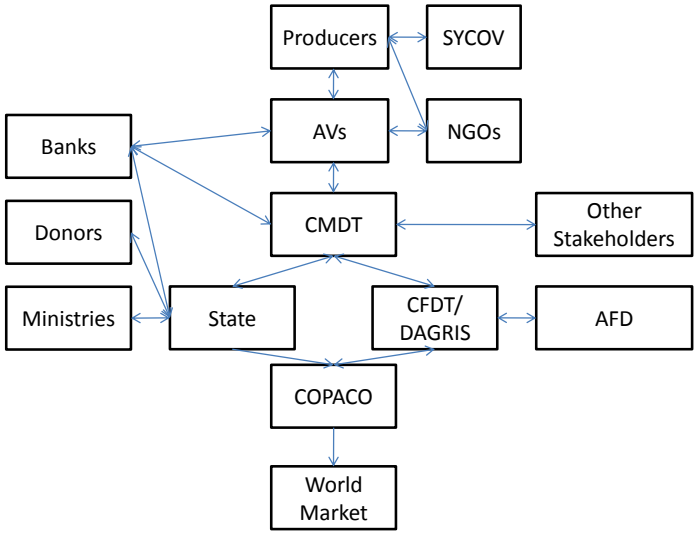

Figure 5-4. The Malian Cotton Sector after Nationalization (Source: Author)

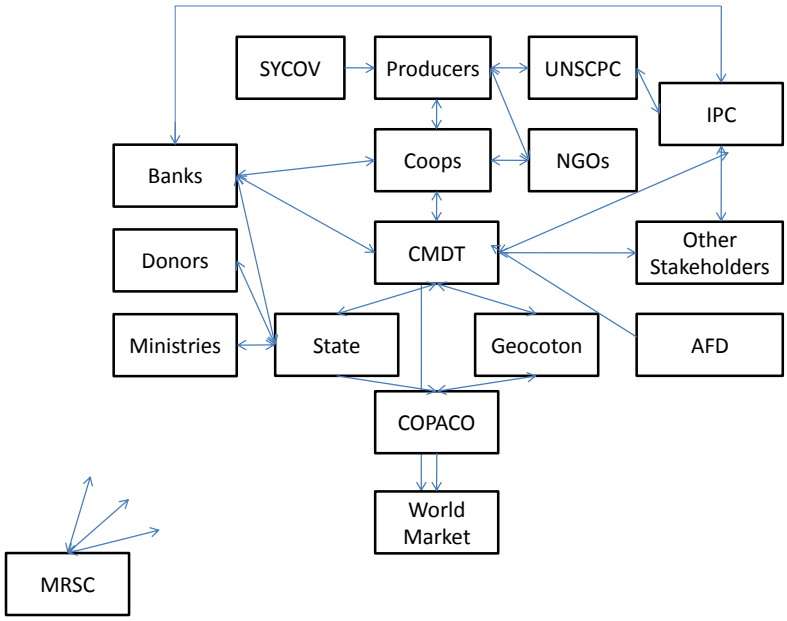

Figure 5-5. The Malian Cotton Sector in Transition (Source: Author)

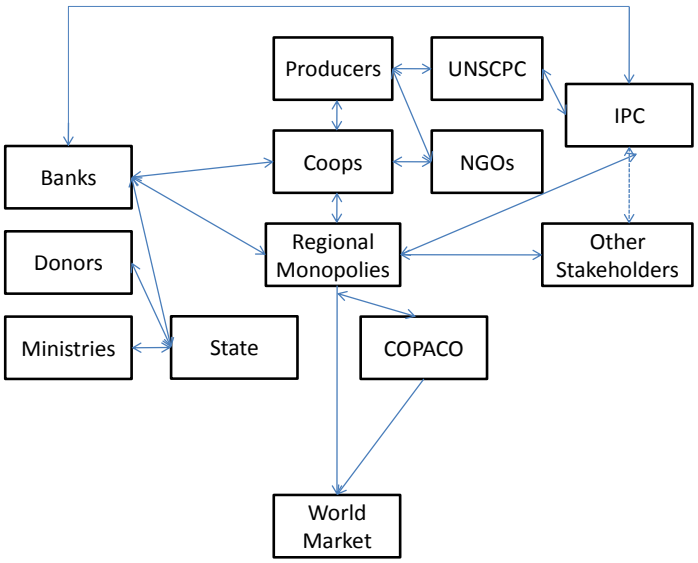

Figure 5-6. The Malian Cotton Sector as Expected after Privatization (Source: Author)

Note: Double arrows mean that there exists a strong interaction between two stakeholders. They are a part of a feedback loop, where the action of one affects the outcome of the other, and vice-versa. For instance, cotton producers need financial services offered by the banks to access inputs on credit and, in turn, the repayment rates of farmers impact banks' profitability. The one-ended arrow means that the interaction goes only in one direction. For instance, COPACO sells on the world market, but cannot strongly influence the world market

CHAPTER 6
CONCLUSIONS

By focusing on market operations and overlooking how incentives embodied in institutions influence economic performance, policy recommendations based solely on neoclassical economic theory have had limited success in alleviating poverty and inducing economic growth in LDCs. Considering that economic choices are embedded in social, cultural, and political systems, and that markets are the results of various and complex interactions between individuals and organizations, approaches derived from institutional economics are able to overcome some of the limits associated with efforts that are based entirely in neoclassical economics. As a result, successful economic development lies in a better understanding and application of both institutional and neoclassical economic theories. To this aim, this study contributes to the advancement of the literature by analyzing how the evolution of institutional arrangements has influenced economic performance and by empirically estimating the effects of institutional change on the Malian cotton sector.

The Malian cotton sector is relevant to the analysis of institutions, since reforms have been undertaken that have the potential to induce social and economic development through cotton production and exports. Cotton is vital to the Malian economy by being both the principal source of livelihood for millions of smallholder farmers and a major source of export revenue for the government. The specific objective of this research is to analyze both qualitatively and quantitatively how the evolution of institutional arrangements (i.e., formal and informal rules governing date of payment and access to fertilizers and pesticides) influenced both the reform process and economic performance (i.e., production, hectares) in the Malian cotton sector.

As described in Chapter 3, price and non-price factors significantly influenced farmers' production decision over the last decade (1998 to 2008). Results from the fixed effect estimator suggest that delays in farmers' payment and low credit recovery rates negatively impact cotton hectares and production levels. The farmers strike movement to protest against low cotton prices and the mismanagement of the CMDT explain a large part of the decline in cotton hectares and production during the crop year 2000/2001.Given the presence of an interlocked cotton-input-credit system, a decline in cotton prices significantly reduces production but not the number of hectares of cotton. This finding supports the assumption that producers react less strongly to decline in cotton prices, in terms of hectares, in order to keep their access to inputs (i.e., fertilizers, pesticides) on credit. However, this result does not indicate the proportion of cotton inputs obtained on credit diverted toward cereal fields. From this empirical analysis, it appears that removing inefficiencies in the institutional environment by encouraging prompt payments, increasing credit recovery rates, and by relaxing constraints in the input-credit system would improve cotton performance.

The cross-sectional analysis of the Benin, Burkina Faso, and Mali cotton sectors in Chapter 4 discusses the key institutional changes that have occurred with the recent market-oriented reforms and estimates and compares farm efficiency across countries. Maximum likelihood results from the stochastic frontier production suggest that while no technical inefficiency exists among Beninese farmers, Burkinabe farmers are technically efficient at 69% compared to 46% for the Malian farmers. Therefore, agricultural development policies focusing on reducing the inefficiency at the farm level in Mali and Burkina Faso should be adopted; whereas policies designed to shift outward the

production frontier seem more appropriate in Benin. Interestingly, institutional environment factors explaining variations in efficiency scores differ across Burkina Faso and Mali. Cotton farms that are food self-sufficient and that cultivate larger areas of cereal crops appear to be more efficient in Mali. Although cereal and cotton crops compete for land and chemical inputs, their relations with other productive factors, such as labor and equipment, have important complementary dimensions. Malian farmers, who express confidence that the reforms will improve the cotton sector, are technically less efficient. They may have fewer resources and, thus, hope that more support will be provided with the reforms to facilitate access to equipment and inputs. Burkinabe farmers, who are dissatisfied with the management of their producer organizations, are more efficient. Therefore, changes in the norms governing them should be considered to achieve better performance. In sum, this cross-country analysis shows that efforts to promote efficiency would have to work in concert with the local realities and institutional contexts in each country in order to be successful.

Applying John R. Commons institutional economic framework, Chapter 5 analyses the evolution of the key institutions in the Malian cotton sector starting with the CFDT contract following the country' Independence in 1960; then the nationalization of the cotton gin company, CMDT, in 1974; then the completion of a vertically integrated market structure from the mid-1980s to mid-1990s; and finally to the current state of the market-oriented reforms in 2010. In accordance with John R. Commons' economic theory, institutional changes in the Malian cotton sector have led to both intended and unintended consequences impacting economic performance at the farm, gin, and State levels, which in turn, has contributed to the emergence of new limiting factors. At

present, the limiting factors to desired economic performance in the Malian cotton sector are: the lack of adequate extension services, high rates of indebtedness at both farmer and cooperative levels, difficulty in farming in an integrated system due to the limited access to cereal inputs on credit, low yields, delays in payment, and discordance between farmers and their union' leaders. Although all these factors are limiting potential economic benefits, they are not necessarily equally critical in the same way across time.

Policy Implications

As discussed throughout this study, the evolution of the institutional environment, in which Malian farmers grow cotton, has influenced both the reform process and economic performance. From the quantitative (Chapters 3-4) and qualitative analysis (Chapter 5), important factors for revitalizing the Malian cotton sector that were identified include: improving farmers' access to inputs on credit for both cereal and cotton crops, enhancing credit recovery rates, and ensuring timely payment and reasonable prices for farmers.

Given that cotton is produced by poor smallholder farmers who typically farm in integrated systems, where cotton, cereals and livestock production are all strongly interconnected on the same plot, improving access to cereal inputs on credit is an important step to revitalizing the cotton sector. Improved access to cereal inputs would be directly beneficial to the cotton sector by improving cotton yields due to less input diversion, and would reduce farmer technical inefficiency through increased food security (Chapter 4). There are at least two possible options on how to facilitate access to cereal inputs on credit to cotton farmers. First, initial support to the GSCVM in the handling of logistic and financial operations could be provided to ensure an adequate

quantity of inputs is offered to producers at reasonable cost. This would require a certain level of participation from the government and financial institutions. Second, the provision of cereal inputs could be transferred to the cotton producer union, UN-SCPC, as it is done in other West African countries. Through this new institutional arrangement, farmers would be able to get both cereal and cotton inputs on credit at the beginning of the cotton season, and, all credits would be directly deducted from farmers' cotton paycheck after the harvest.

High rates of indebtedness remain an important issue at the farmer and cooperative levels (Chapters 3, 4, and 5). Changing the social norms to facilitate the exclusion of underperforming farmers appears to be a more theoretical than practical option in the short-run. Incentives to peer-monitor and to enforce credible sanctions against opportunistic behaviors could be implemented. Sub-lending groups (known as '*cercle de caution*' in French) inside each cooperative could be created to facilitate peer-monitoring. Each sub-group would be responsible to monitor other members' behavior to ensure that the right quantity of inputs is purchased, that it is use appropriately on cotton fields at the right time. Any resulting improvement in input management would improve farmers' ability to repay debt.

The pricing mechanism and date of payment are limiting factors to farmers' performance (Chapters 3 and 5) that have to be addressed to revive the Malian cotton sector. Increasing farmers' bargaining power and their level of participation in critical decisions could lead to the setting of more reasonable prices. Incentives could also be implemented to encourage CMDT to pay farmers in a more timely fashion. Improvements in the negotiation of prices and more prompt payments would make

growing cotton a more attractive economic activity. In addition, such reforms would also reduce farmers' financial constraints and enhance their ability to repay their loans.

Limitations of this Research

In West Africa, the majority of cotton is produced by smallholder farmers on less than 5 hectares. Traditionally, cotton has been part of an integrated farming system encompassing livestock and cereal production. Indeed, cotton, historically, has been grown in rotation with cereal crops such as maize, sorghum, and millet. In addition to being a main staple in farmers and their family diet, surpluses from cereal production are sold on the domestic market for additional revenues and plant residues have been used to feed livestock. In turn, cattle provide draught power for cultivation, manure to maintain and/or improve soil fertility, and animal products used for either personal consumption and/or sale. Both livestock and cereal production have historically benefited from the highly institutionalized environment characterizing the cotton sector through better access to extension services and inputs on credit, among other benefits.

Although both livestock and cereal production are influenced by changes taking place in the cotton sector, they did not receive much attention in this study. Indeed, this research mainly focused on the effects of institutions on economic performance in the cotton sector, and, thus, did not analyze their impacts on food security and farmers' livelihoods. For instance, the joint liability programs prevailing inside cooperatives might have positive effects on food security, but these were not specifically estimated. This work was based on a partial equilibrium analysis of the cotton sector rather than on a general equilibrium analysis of the West African farming system.

Another important element to keep in mind is the static nature of the empirical analysis. Indeed, this research quantitatively assessed the effects of institutions on

cotton performance for specific time periods. Chapter 3 analyzed the impacts of institutions on Malian cotton supply from 1998/99 to 2008/09. Chapter 4 examined the role of institutional environments on West Africa cotton sectors during the crop year 2008/09. Feedback and time delays, which are features of a dynamic market, are not explicitly taken into account in Chapters 3 and 4. However, Chapter 5 followed a more dynamic approach by discussing the evolution of institutions and their impacts on the Malian cotton sector performance from 1960 to 2010.

Future Area of Research

Throughout this study, the interaction between social institutions and the joint liability program prevailing in the farmers' cooperatives is discussed. As also discussed, the presence of a caste system and strong kinship bonds make exclusion of underperforming and/or opportunistic members less likely to occur in Malian cotton farmers' cooperatives. A future extension to this work would be to further investigate the relationship between farmers' propensity to engage in opportunistic behaviors relative to their social and economic status. For instance, is there a significant difference in free-riding behaviors between one cotton producer, who is the village chief's son (superior caste) and another who is a blacksmith (inferior caste)?

Even though an extensive literature exists on joint liability, especially in relation to the characteristics of lending groups (e.g., size and homogeneity), differences in social power have been the subject of less research, and it is often assumed that all borrowers are alike. By examining group dynamics and performance when relaxing this assumption and taking into account the social and economic differentiations that prevail among villagers in Mali, future attention on these dynamics would complement research done on collective action in African cotton sectors.

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BIOGRAPHICAL SKETCH

Veronique Theriault received her Bachelor of Science degree in Agricultural Economics and Management at Université Laval in Quebec, Canada in 2005. She obtained her Master of Science degree in Resource Economics and Policy at the University of Maine in 2007. At Maine, her thesis focused on the changes in the Quebec maple syrup industry and on their economic implications for Maine and the U.S. She then pursued a Ph.D degree in Food and Resource Economics at the University of Florida. She received the Outstanding International Student Award, from the College of Agricultural and Life Sciences, at the University of Florida in 2008.

Veronique's dissertation analyzed the impact of institutional changes and market reforms on the economic performance of the Malian cotton sector. During her doctoral studies, she had the opportunity to participate in fieldwork in Mali and in ethnographic training in Niger. Her fields of specialization are in economic development, production economics, agricultural economics, and institutional economics, with a special interest in West Africa.