

Dumas, Christelle

Conference Paper

Market imperfections and child labor

Proceedings of the German Development Economics Conference, Berlin 2011, No. 25

Provided in Cooperation with:

Research Committee on Development Economics (AEL), German Economic Association

Suggested Citation: Dumas, Christelle (2011) : Market imperfections and child labor, Proceedings of the German Development Economics Conference, Berlin 2011, No. 25, ZBW - Deutsche Zentralbibliothek für Wirtschaftswissenschaften, Leibniz-Informationszentrum Wirtschaft, Kiel und Hamburg

This Version is available at:

<http://hdl.handle.net/10419/48358>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Market imperfections and child labor

Christelle DUMAS *

January 6, 2011

JEL Classification: 012, 013, O15, J13, J43.

Key-words: Child labor, Market imperfections, Land, Labor, Credit, Madagascar.

Abstract

There is some indirect evidence that child labor is affected by market imperfections. This paper provides a theoretical model to discuss the effect of improvements on the labor market, when households cannot rely on neither the land nor the credit markets. The predictions differ by land ownership: landless or large landowners should decrease child labor when labor market imperfections decrease. Households who had chosen not to supply any labor on the wage market (households with intermediate-upper land levels) remain unaffected and households who combine farm work with wage work (households with intermediate-lower land levels) may either increase or decrease their child labor use. We use Malagasy data to estimate the relation between child labor and various measures of markets imperfections. We match those data with a municipality census so as to control for a large set of village characteristics. We find that on average market imperfections (labor but also land and credit) do indeed increase child labor and obtain heterogenous effects by land ownership that are consistent with the theoretical model. The results point to the fact that an improvement of markets competitiveness should decrease child labor (and even the more so for labor markets), which provides an alternative policy to fight against child labor.

*Université de Cergy-Pontoise, THEMA, F-95000 CERGY-PONTOISE. Email: christelle.dumas@u-cergy.fr

1 Introduction

According to the last estimates, child work has declined in the world with broadly 176 millions children aged between 5 and 15 who are economically active in 2008. However, sub-Saharan Africa is the only continent where the number of working children has increased between 2004 and 2008. Actually, even the share of working children has raised during this period: in 2008, 28.4% of children aged 5 to 14 are economically active in sub-Saharan Africa.¹

This takes place despite an average growth of 6% between 2004 and 2008 and despite a decrease in poverty rate.² Growth is therefore unlikely to be sufficient, at least in the short run, to eradicate child labor. Various policy options have been considered to fight child labor. Banning child labor is both impracticable and counter-productive if families rely on child labor for their subsistence; and given the limited trade-off between child labor and schooling, a conditional cash transfers policy would have small effects on child labor. This paper takes another route and discusses the effects of market imperfections on child labor. If we were able to pinpoint which market inefficiencies lead to child labor, an alternative policy would be to reduce those market imperfections.

An important body of the literature has already discussed the impact of credit constraints on time allocation choices of children, showing that the less competitive the credit market, the more children work (Baland and Robinson, 2000; Ranjan, 2001; Jafarey and Lahiri, 2002). Some empirical papers have confirmed this view by displaying evidence that households who face shocks tend to make their children work more (Beegle et al., 2004; Dumas, 2009)³ or that households are unable to smooth their consumption against future incomes (Edmonds, 2006). There is in comparison relatively

¹Source: Diallo et al. (2010).

²Source: World Development Indicators. Gross national income corrected for PPP was \$1521 in 2004 and \$1973 in 2008; poverty headcount ratio at \$1.25 a day was 55% in 2002 and 5.9% in 2005.

³Jacoby and Skoufias (1997) have also shown that children from households who have received shocks get less educated.

little on the impact of imperfections prevailing on other markets such as land and labor markets.

Some papers have shown that time children devote to work may increase with land owned by the household (Mueller, 1984; Bhalotra and Heady, 2003; Dumas, 2007; Basu et al., 2010) or with the production goods prices (Kruger, 2004; Duryea and Arends-Kuenning, 2003; Cogneau and Jedwab, 2008), which should not take place if land and labor markets were competitive, because of the separability property (Singh et al., 1986). This is therefore some indirect evidence that markets are non competitive in developing countries and that this affects children's time allocation. However, the theoretical papers addressing the relationship between land and labor market imperfections are fairly rough: they only derive time allocation choices when households face perfect markets and when markets do not even exist. None of them tries to identify the effect of a marginal improvement in market imperfections. In addition, no paper has so far tried to identify empirically the effect of market imperfections on child labor nor explored which of these imperfections has a prominent effect on child labor.

This paper adds to the existing literature in both ways: it derives a model where the labor market exists but is imperfect (but assumes that there is no land market) and shows that an improvement on the functioning of this market leads to less child labor for all the population except for the children whose parents combine a wage work with farm work. For this last category, a decrease in labor market imperfections can lead to more child work. The second contribution is an empirical one: we evaluate the average effect of land, labor and credit market imperfections on child labor as well as heterogeneous effects. The strategy we use is a control one but we match two sets of data in order to rely on a very large set of villages' characteristics as controls. We find that households who face higher market imperfections use more child labor and that this effect is unevenly distributed among households. However, no occurrence of cases in which an improvement on the markets leads

to an increase in child labor is found, which suggests that policies aiming at reducing market imperfections would not have detrimental effects.

The paper is organized as follows: section 2 discusses the sources of imperfections in markets in rural areas of developing countries and derives a model where households face no land nor credit market but an imperfect labor market. Section 3 describes the data while section 4 provides the results.

2 Market imperfections and child labor

2.1 Market imperfections and their effect of child labor

Where do market imperfections come from? In developing countries, information asymmetries are the main source of market imperfections. The most important ones are described hereafter but see Ray (1998) for a detailed presentation. Let us start with labor markets. Agricultural output variation due to weather shocks or pests makes it difficult for the landlord to uncover his tenant's effort. As a consequence, transaction costs are high and there might be a price-band (de Janvry et al., 1991), in which the landlord prefers not to hire any labor force. The seasonality of the activity generates an additional issue: if land is distributed rather equally, then all the farming households have the same tasks to do at the same time. This synchronicity prevents households to exchange labor and the households owning a large amount of land face a supply shortage. In that case, the price band in which no exchanges are observed is even larger.

Land markets are also recognized as imperfect. Information asymmetries about land quality can create differences between the rent a landlord can obtain and the land's productivity. In addition, renting out is associated with a risk of land deterioration and, in a context where land rights are not very well defined, with the risk of being expropriated. Sharecropping has been shown to provide some solutions to these issues but we also know that it

suffers from the Marshallian inefficiency, namely a sub-optimal labor supply. It will be interesting to see what the side effects of such an organization are. That is for the tenancy market. Regarding the sales market, most of the issue lies in the fact that land value can include a non productive part (collateral, prestige). Insofar as some of this non productive part cannot be bought when the buyer needs a credit with collateral (thereby offering the land he buys as a guarantee), land exchanges are reduced. In addition, non certification of land plots makes also transfers more costly, since the buyer bears the risk of not buying the land from its true owner.

Lastly, credit markets also suffer from imperfections due to asymmetries of information between the bank and the borrower. In a world of limited liabilities, the borrower can default quite easily. For this reason, banks lend very little to poor people living in rural areas, which generates a credit shortage. Since in general banks require some collateral, this tends to worsen imperfections in land market. Microfinance has greatly improved access to credit in rural areas and generally does not require any collateral.

Market imperfections' influence on child labor When land and labor markets are competitive, production and consumption decisions are separable⁴ (Singh et al., 1986): child labor decisions depend on production factors insofar as they affect households' profits. If the household owns land or labor in excess, it relies on the market to rent/sell this excess endowment. For instance, households with more land are wealthier and therefore use less child labor. When only one of these two markets is imperfect, it has been shown that the separability holds (Sadoulet and de Janvry, 1995): if households face some labor market imperfections but a competitive land market, they can rent out the land that they cannot farm given their labor force endowments; production and consumption decisions are separable. Conversely, a household facing only land market imperfections could compensate via the

⁴Production decisions are taken separately from households' preferences and consumption decisions only depend on preferences and profit generated by the activity.

labor market if the latter is competitive: it would hire external labor force instead of renting out. Consequently, we will focus on the case where both markets are imperfect.

To keep it simple, we assume that no land nor credit market is available and discuss the changes induced by a worsening of the labor market imperfections. A discussion on the effect of the imperfections bearing on the other markets is postponed after the model. Bhalotra and Heady (2003); Dumas (2007) or Basu et al. (2010) have only considered the 2 polar cases with perfect and competitive labor markets or with absence of labor markets. We start by filling this gap with an analysis of the effect of a continuous change in labor market imperfections.

2.2 A model with no land market and an imperfect labor market

To model imperfections, we consider that the household faces a transaction cost on the labor market. In practice, we assume that the wage a household member would earn on the market (\underline{w}) is strictly lower than the wage they would have to pay if they hired external workers on their farm (\overline{w}). This transaction cost is due to asymmetries of information regarding the effort made by the worker and therefore the supervision cost they induce. As we will see this transaction cost implies a price-band in which the household prefers autarky.

The household is made of one adult and one child and maximizes its utility:

$$U(C, l_c) = \phi(C) - l_c$$

which is assumed to be additively separable. The marginal utility of consumption (C) is assumed to be independent from the level of child labor (l_c) and vice-versa.⁵ Also, $\phi' > 0$ and $\phi'' < 0$. The adult is assumed to provide

⁵This utility is the one chosen by Basu et al. (2010). Results similar to those of Basu have been obtained with utility function that do not make such assumptions; it is therefore

one unit of labor. However, he will choose how to share this unit between own farm production and wage labor.

The production depends on land (k) and labor (l). Once taken into account supervision costs, all types of labor are assumed to be perfect substitutes and

$$F(k; l) = F(k; l_a + \delta l_c + l_e)$$

where l_a is the time spent by the adult on the farm, l_c is child work hours, δ is the productivity ratio between an adult and a child, l_e is external workers hours on the farm. We assume: $F_k > 0$, $F_l > 0$, $F_{kl} > 0$ and $F_{ll} < 0$.

The budget constraint is:

$$C = F(k; l_a + \delta l_c + l_e) + \underline{w}(1 - l_a) - \bar{w}l_e.$$

Implicitly, we assume that children cannot sell their labor force outside the household, which is likely to be the case in rural areas. Of course, the household faces some constraints on time endowments: $0 \leq l_a, l_c \leq 1$ and $l_e \geq 0$. These constraints will define different regimes. If the two wages \underline{w} and \bar{w} differ, no interior solution can be found: either the household sells labor or he buys it but would not do both at the same time.⁶

Actually, we have four regimes and the regime of a given household depends on wages \underline{w} , \bar{w} and the amount of land they own k (which is assumed to be given).

1. if the marginal production of labor on land is lower than \underline{w} : the adult sells all his time endowment on the labor market; the child might work on the farm; no external worker is employed on the farm;
2. if the marginal production of labor on land equals \underline{w} : the adult shares his time endowment between farming his plot and wage work; the child

essentially made for the sake of simplicity.

⁶Indeed, for an interior solution, we find for the household member that $F_l = \underline{w}$ and for the external worker that $F_l = \bar{w}$, which is not compatible.

- might work on the farm; no external worker on the farm;
3. if the marginal production of labor on land is greater than \underline{w} but lower than \bar{w} : the adult devotes all his time to the farm; the child might work on the farm; no external worker on the farm;
 4. if the marginal production of labor on land is equal to \bar{w} : the adult devotes all his time to the farm; the child might work on the farm; some external workers are hired.

Since we assume that marginal production of labor increases with land, these 4 cases are ranked by size of owned land. It is also important to note that cases (2) and (4) are not reduced to one value for k : when k increases, marginal productivity of labor increases, therefore leading to a higher use of labor, keeping the marginal productivity of labor constant. Finally, we do not take into account the corner solutions induced by the limitations for the child's time endowment since they do not generate very interesting cases. We should just keep in mind that child labor might be censored between 0 and 1 in its variations.

We define k_1 , k_2 and k_3 as the thresholds in land for switching from regimes 1 to 2, 2 to 3 and 3 to 4 respectively. Let us start by describing carefully how households behave in each of these regimes and then how these thresholds depend on market imperfections. In regime 1, the adult worker is simply a wage earner, whose child may work. The household maximizes $U = \phi(C) - l_c$ subject to $C = F(k; \delta l_c) + \underline{w}$. As a consequence, they simply equate child's marginal productivity to his marginal substitution rate between consumption and leisure:

$$\delta F_l = \frac{1}{\phi'(C)}; \tag{1}$$

this equation will hold true in each regime. We easily show that l_c decreases with the wage earned by the adult, \underline{w} , due to an income effect; but the effect of a variation in k is unclear. The income effect (more land generates more

income for the same amount of labor) is partly or fully offset by the price effect (more land leads to a higher marginal productivity of labor, that leads to more labor) (see proof A.1). The overall effect is unknown but we should mention that very simple production functions such as the Cobb-Douglas lead to an increase in l_c if k augments. To sum up, in regime 1:

$$l_c = l_c(\underline{w}, \underline{k}, \bar{w}). \quad (2)$$

In regime 2, the adult worker shares his labor time between the wage market and his farm. The household maximizes his utility subject to $C = F(k; l_a + \delta l_c) + \underline{w}(1 - l_a)$. The first-order conditions are eq. (1) and:

$$F_l = \underline{w}. \quad (3)$$

Quite interestingly, this regime is very different from the previous one. We can show that l_c decreases with k : the effect in this regime is similar to a pure income effect since the adult is able to fully compensate for a change in marginal productivity of labor (see proof A.2). However, a change in \underline{w} leads to an income effect, as before, but also to a price effect. To take advantage of an increase in \underline{w} , the adult has to withdraw some of his time from farm, needing to be replaced (see proof A.3). In regime 2:

$$l_c = l_c(\underline{w}, \underline{k}, \bar{w}). \quad (4)$$

In regime 3, the adult worker would like to spend more time on his farm but is limited by his time endowment: he has now become a pure entrepreneur. The budget constraint is given by: $C = F(k; 1 + \delta l_c)$. The first-order condition is given by eq. (1) and $l_a = 1$. In this regime, l_c does not vary with \underline{w} nor \bar{w} . A change in k generates an income effect (more land generates more income for the same labor) but also a price effect (more land leads to a higher labor marginal productivity) that cannot be accommodated

by the adult since his time endowment constraint is saturated (see proof A.4).

In regime (3):

$$l_c = l_c\left(\frac{w}{0}, k, \bar{w}\right). \quad (5)$$

In regime 4, the household hire external workers and is subject to the budget constraint: $C = F(k; 1 + \delta l_c + l_e) - \bar{w}l_e$. The first-order constraints are eq. (1) and

$$F_l = \bar{w}. \quad (6)$$

We easily show that when k increases, only an income effect takes place (an increase in the labor marginal productivity leads to more non household labor on the plot; see proof A.5). When \bar{w} increases, child labor increases since profit decreases (see proof A.6). In regime 4:

$$l_c = l_c\left(\frac{w}{0}, k, \bar{w}\right). \quad (7)$$

If, for an increase in k , the price effect does not offset the income effect in regimes 1 and 3, then l_c decreases with k over the whole range of values. This has proven wrong in different studies (Bhalotra and Heady, 2003; Mueller, 1984; Dumas, 2007; Basu et al., 2010). This is not very surprising: when income is low, we expect consumption to be much more valued than child leisure. Let us turn therefore to the opposite situation: when the price effect is larger than the income effect (in regime 1 and 3). We plot l_c against k in such a setting (graph 1): the question marks underline the fact that the decrease in regimes 1 and 3 is only putative.

A by-pass product of this model is to highlight the fact that all households do not suffer from the same market imperfections. For households in regimes 2 and 4, they behave as if they were facing competitive markets. The easiest way to see this is to notice that child labor decreases with land since there is no price effect associated to land when marginal productivity

is equated to the wage: this is due to the fact that they participate in the market. Households in regimes 1 and 3 however are constrained by market imperfections. For households in the first regime, it is due to the fact that we assumed that the child could not sell his labor force. The most interesting case for us is the third one: when the household would like to hire or to work more but none of these two options is possible. In that case, they rely on child labor and households more endowed in land may make their children work more than poorer households.

Now, to understand the effects of a change in market imperfections, we should not only look at the variation of l_c in each regime with the wages but also look at the effects of these wages of the land thresholds, which determine the regime the household falls in. We therefore study the effect of changes in \underline{w} and \bar{w} : the smaller $\bar{w} - \underline{w}$, the more competitive the market.

If \underline{w} increases, then the marginal productivity of labor has to be higher to switch from regime 1 to regime 2. Therefore, the land threshold k_1 increases with \underline{w} . Again, if \underline{w} is higher, then farming one's own plot is less attractive and the level of land (k_2) for which the adult spends his full unit of time farming his plot has to be higher. Finally, if \bar{w} is higher, then the marginal productivity of labor has to be higher for choosing to employ non household labor and k_3 has to be higher.

$$k_1 = k_1\left(\frac{\underline{w}, \bar{w}}{+0}\right) \quad (8)$$

$$k_2 = k_2\left(\frac{\underline{w}, \bar{w}}{+0}\right) \quad (9)$$

$$k_3 = k_3\left(\frac{\underline{w}, \bar{w}}{+0}\right) \quad (10)$$

If there is an improvement in the labor market, then \underline{w} increases and \bar{w} decreases. This implies that the extent of regimes 1 and 4 increases and that the extent of regime 3 decreases. Only the change in the extent of regime 2 is unknown. In regime 3, child labor does not depend on wages since the

household chooses to be in autarky. As a consequence, for households who remain in this regime, the level of child labor is the same. In regime 4, a decrease in \bar{w} leads to a decrease in child labor. In regime 1, an increase in \underline{w} leads to a decrease in child labor. As a consequence, for households who remain in these regimes, the level of child labor is lower than when the labor market is characterized by more imperfections. However, the effect of an increase in \underline{w} is unknown in regime 2. Actually, a continuity argument proves that there is a range in which child labor is higher with less labor market imperfections. To conclude, an improvement in the labor market functioning should lead to a lower use of child labor for households with very little land and households with a high amount of land, should left unchanged households choosing autarky and has a mitigate effect for children from households owning some land (see graph 2).

2.3 Imperfect land and credit markets

The previous model assumes that land and credit markets do not exist. In this section, we discuss the effect of their imperfections.

Land market imperfections We mentioned already that if at least one of the two markets was competitive, then households were able to compensate the imperfections of one of the two markets by transactions made on the other. As a consequence, only households who are constrained by the labor market will truly benefit from an improvement on the land market. In regime 1, households are constrained by the labor market since they would like to sell child's labor. An improvement on the land market would allow these households to buy or more likely rent in some land, which is expected to result in an increase in child labor. Indeed, extremely poor households are expected to have a high marginal utility of consumption and therefore to use more child labor in order to take advantage of this new opportunity. In regime 3, households again are constrained by the labor market and the

marginal product of their labor is higher than the wage they can obtain on the market. They would like to sell or rent in and produce a higher output with the same amount of labor. Whether these intermediate households would choose to increase consumption or child leisure is an empirical question. We expect children households belonging to regimes 2 and 4 to be moderately affected by an improvement on the land market since they have access to the labor market.

Credit market imperfections Even if there is a credit supply in a community, it is quite unlikely that households can borrow against their children's human capital. However, if households suffer from idiosyncratic shocks, then access to credit could help them smoothen their income over periods without using child labor as a safety net, as it has been proven households do (Beegle et al., 2006). Obviously, an insurance market would be even more powerful, but given that it does not exist in rural areas, a credit market can be an imperfect substitute for it. As a consequence, access to credit should reduce child labor use.

However, if credit also improves ability to invest, then it may have counter-intuitive effects on child labor. This will be the case if investment improves farm productivity and if households have to rely on their offspring to take advantage of this improvement, namely if land and labor markets are imperfect and if the household is well-endowed in land. This has to be qualified: if a household chooses to invest in a device that is a substitute for child labor (like weedkiller), then this would lead to a decrease in child labor.

The global effect of an improvement on the credit market will be a decrease in child labor if the insurance mechanism predominates but is unknown if major changes in investment choices take place. An empirical analysis is therefore needed to assess how credit market imperfections correlate with child labor.

3 Data and empirical strategy

3.1 What we do

This paper adopts a fairly simple approach. The idea is to assess how child labor varies with each type of market imperfection. Most of these imperfections coexist and reinforce each other. However, from a policy perspective, it is interesting to know which of these imperfections is associated with highest levels of child labor. This calls for an estimation where all of them are taken into account simultaneously, which necessitates a large amount of data. Indeed, interlinkages between markets as well as covariation in market imperfections would make it difficult to estimate the impact of only one type of imperfections. The main difficulties we face are the following ones: being able to describe the imperfections and being able to control for external factors that could spoil the results. For the latter, we expect some characteristics of the village to be correlated both with market imperfections and child time use: among others, remoteness of the village, general level of development, agricultural practices and distance to schools are good candidates for omitted factors.

Our strategy is the following one: we will control for regions or districts fixed effects so as to pick up major differences between areas and we will also rely on a very uncommon source of information in which municipalities characteristics are extremely detailed.

3.2 Data

We combine two datasets in this paper. The first one, named "Enquête Périodique auprès des Ménages" (EPM), surveyed 11781 malagasy households spread out in 561 villages or districts.⁷ The survey was stratified along the 22 regions and whether the village is located in an urban or a rural area. It is representative of the malagasy population. In this paper, since we are

⁷The EPM survey has been designed and collected by the malagasy national institute of statistics INSTAT.

particularly interested in market imperfections' consequences on child labor, we will not consider the major urban centers, where agriculture is unlikely to be an important source of income. We also drop 6 localities from secondary urban centers where no surveyed household owns agricultural land. This leaves us with 514 localities and 10794 households. In the EPM survey, all household members older than 6 are interviewed and we know their activities, the number of hours they work, their status in the job. In addition to this, we know how much land they own, if it is registered in the cadaster, how they acquired the land, if they rent it, sharecrop it or farm it on their own. By averaging all this information at the level of the village (21 households are surveyed per locality), we build the share of households who receive some land in sharecropping, who lease in, who bought their land, the share of adults (defined as aged between 17 and 45) who engage in wage work along with the median wage for an hour of work.⁸ However, the data do not include any measure for the paid wage (\bar{w} in the model) and we are therefore unable to build a measure of labor market imperfections that proxies $\bar{w} - \underline{w}$. As detailed in the next section, we rather use the fact that a limited number of transactions on the market are the sign of imperfections. Regarding the credit market, a bank is said to be available to the households if at least 3 of them in the locality said so; same is applied to define the availability of microcredit or of a usurer.

We will also be able to control for a number of individual or household characteristics, such as: household composition, father's education, age, gender, wealth⁹, whether the household has some debt, and some limited information on the community such as the distance to primary and secondary school.

In addition to this, more detailed information on the localities are needed.

⁸We exclude each household from the average when building the village average variables that will be its determinants.

⁹We compute an index of wealth or permanent income, thanks to information collected on their consumption durable goods or housing (Sahn and Stifel, 2003).

For this purpose, we use a “municipality census”, that was collected in 2001.¹⁰ This survey gathers a lot of very detailed information on infrastructures, agriculture, work opportunities, development and so forth. However, a municipality does not match a village since several fokontany (villages) are grouped into one municipality. We have to assume that the information collected at the level of the municipality are also relevant at the level of the villages. This additional dataset allows us to control for

- the municipality’s population, the extent of migration, whether the municipality is close to a lake or the sea, close to a forest, the distance between the municipality’s administrative center and its most remote village, whether a farmer association exists, the duration of SOUDURE, the share of households who suffer from hunger during this period, and whether the municipality is classified as dangerous;
- the availability in the municipality of a health post center, of a road, of a bush taxi, of a daily market, of a phone (either a landline or a satellite coverage), and of a drinkable water system;
- the rent to pay for a hectare of ricefield, the price to pay for buying a hectare of ricefield, the average price of rice and its seasonal variation;
- the main crop in the municipality, the availability of chemical fertilizers, of non traditional agricultural equipment (plow, for instance), of pesticides or weedkillers, of veterinary products, of improved rice varieties;
- whether it is possible to extend rice cropping within the municipality, and other cropping;

¹⁰The municipality census in Madagascar was organized by the Ilo program of Cornell University at the end of 2001. The survey was organized in collaboration with the National Center for Applied Research for Rural Development (FOFIFA) and the National Statistical Institute (INSTAT). A large part of the data are available at the following url: <http://www.ilo.cornell.edu/ilo/data.html>

- the number of cattle, the share of farmers who use cattle for pulling, for stalling in ricefields and whether a common place is devoted to water the cattle.

As a consequence, few unobservable characteristics are likely to drive the results. The most important limitation comes from the discrepancy in dates between the household and the municipality survey. However, development is slow in rural Madagascar and most characteristics (and especially those related to agriculture) are expected to remain stable. A second limitation comes from the fact some of the villages belong to a municipality that had not been surveyed in 2001, even though this was supposed to be a census. We will therefore check that the sample of villages that were surveyed in 2001 does not statistically differ from the full sample.

3.3 Markets in the data

Table 1 provides some descriptive statistics regarding markets' functioning. Among the 10710 households used in the analysis, few of them have access to credit. Microcredit associations are more available than banks. The land market is characterized by large imperfections since 44% of land is not titled nor registered in a cadaster and 58% of households live in a municipality where no land is rented. However, some transactions take place since only 29% of households live in a municipality where no surveyed household bought some land. About 40% of households live in a place where sharecropping happen, which is the sign that some land market imperfections are combined with labor market imperfections. Finally, the extent of the labor market varies a lot from one municipality to another since 39% of households face a labor market in which more than 25% of adult males are participating while 45% of the households face a labor market where less than a quarter of adult males participate in; the remaining 16% rely on a very limited labor market since there is no wage work in the municipality.

When looking at the correlations between the variables, we find indeed

that some of them are significant (municipalities with a bank are also more likely to host a microcredit association or municipalities with a large share of registered land also have a higher share of wage workers in the population, see Table 6 in appendix). However, none of these correlations is so large that it should prevent us from identifying the effect of one imperfection measure conditional on the others.

4 Results

4.1 Specification

The specification is the following one: we regress the number of hours of work performed by children on market imperfections measures and on the set of child, household, and community characteristics. We define children as individuals aged between 6 and 13. We adopt a fairly flexible specification with both linear and quadratic effects of each measure (except for credit since the measures are dummy variables). This allows us to take into account mechanisms that have not been modeled: if the labor market is really competitive then children could take the opportunity to sell their workforce. The effect of an increase in the extent to which households rely on the market is therefore likely to depend on the starting level.

In addition to municipalities characteristics, we also control for region or district fixed effects. There are 22 regions in Madagascar and 1?? districts. Districts on average cover ??? hectares, which is broadly twice New York City's area. This conditioning is therefore quite fine and allows to identify the effect of market imperfections on within district differences. The number of municipalities per district in the data ranges from 1 (for 3 districts) to 15. However, we cannot rule out endogenous placement (of banks, for instance) or existence of remaining unobserved heterogeneity at the municipality or fokontany level and this prevents us from asserting that the estimated effects are causal.

We will first estimate the average "effect" of market imperfections on child labor and then look into heterogeneity in this effect, depending on land ownership.

4.2 Average impacts

The impact of control variables is given in appendix in Table 8, except for land area and wealth, which are of particular interest and are displayed in Table 2. We find that wealth decreases child labor and rice land, conditional on wealth increases child labor, as expected. However, "tanety" land (deforested hill) does not affect child labor. In a specification that we do not include in the paper, we also find that unconditional on wealth, children belonging to households with more riceland work more.¹¹ This is an average effect on the whole population but this suggests that indeed the price effect overcomes the income effect when households face a labor market failure.

Table 2 gives the estimates of markets imperfections on child labor. The first column includes region fixed effects while columns 2 and 3 allow for district fixed effects. The difference between column 2 and 3 lies in the fact that we control for 2001 municipalities characteristics and hence use a smaller sample. Most of the results are qualitatively similar throughout specifications.

Among different sources of credit, only the availability of a formal bank is associated with a lower use of child labor. This could come from a greater ability of the bank to move capital across space in case of major aggregate shocks. Regarding the "effect" of the other market imperfections measures, it is easier to look at Table 3, which provides the effect of a marginal change in the measure at the mean, the 10th and the 90th percentile of the measure. We find that an increase in the share of titled land or in the share of households who rent in land are associated with lower levels of child labor. However, no association is found on the sale market. Sharecropping, in con-

¹¹Riceland are not exclusively used for farming rice, since there are some intercrops.

trast, is associated with higher levels of child labor, which is consistent with the fact that it has been shown to prevail when markets are imperfect (Bardhan and Srinivasan, 1971; Schultz, 1965). The labor market itself plays a role since a larger share of adult wage workers is associated with lower levels of child labor. When the share is high, the marginal effect is positive though but not significant.

These results point to the fact that, on average, land, labor and credit market imperfections lead to higher child labor. If these figures are taken as causal effects, it would mean that policies that reduce transaction costs on land sales would be inefficient. In order to compare the other options, we perform the following exercise. Imagine we take a village where none of the three markets exists and compare the effect of improving each measure by one standard deviation. In that case, an improvement by one standard deviation in the share of titled land would lead to $-1381 \cdot 0.23 = -318$ hours of child labor, one additional standard deviation in the share in rented land would lead to $-1752 \cdot 0.11 = -193$ hours, while one standard deviation in the wage work share would lead to $-1759 \cdot 0.23 = -405$ hours and a standard deviation in credit availability (for the sake of comparison) induces $-428 \cdot 0.35 = -150$ hours less in child labor (per year per child). Determining which option is the best would require a cost benefit analysis which is beyond the scope of this paper. However, we can notice that policies that improve the labor market competitiveness are good candidates for a reduction in the use of child labor.

4.3 Impact of market imperfections by land area

The theoretical model gives different predictions depending on how much land the household owns. However, it is very difficult to choose the right land thresholds: from a theoretical point of view, they depend on market imperfections. We therefore start by refining the first result that child labor increases with land by estimating a non parametric relationship between the

two so as to detect more local variations. Graph 3 plots positive values of child labor against land area¹² and shows that the curve is decreasing for levels of land lower than 20 ares, increasing between 20 and 60 ares and decreases above 60 ares of rice land. This suggests that we do not observe households from the first regime, that households who have to rely on wage work are those who have broadly less than 20 ares of land, that households who are pure entrepreneurs have between 20 and 60 ares of land and households who hire external workers have more than 60 ares of land. We cannot check that directly in the data since we do not know whether a household hires some workers. Given that the median household is composed of 4 persons (two adults and two children), these figures seem plausible.

Our priors are that a decrease in labor market imperfections should left unchanged child labor for households in the third regime (between 20 and 60 ares), and decrease child labor for households who own more land than 60 ares. A decrease in land market imperfections should lower child labor for households with large land endowments. An improvement of the credit market should help first the less endowed households since they are the ones the most constrained by their lack of collateral. We therefore estimate a similar equation to the ones presented before but allow for different effects of market imperfections depending on the regime. In order to do this, we split the sample in three sub-samples and run the same regressions.¹³

Table 4 provides the results of the estimations and Table 5 provides the marginal effects at mean. Credit market imperfections have a greater impact on households who own less land. The share of titled land impacts child labor for households who own more than 20 ares of land, as expected, but the effect is larger for the intermediate category, which was less expected. The land tenancy market seems to mainly affect children's labor supply from the intermediate category as well. Households from the intermediate category

¹²The number of observations with zero hours of child labor flattens dramatically the curve.

¹³The share of household who bought some land is omitted from the regressions since it was never significant.

have a labor's marginal product between \underline{w} and \bar{w} : they are constrained on the labor market. If they can rely on the land tenancy market, they would rent in some land so as to increase their output with the same level of labor. The result shows that this would lead to a decrease in child labor. The association between sharecropping and child labor vanishes when splitting the sample. Regarding labor market imperfections, we find that a higher share of adult wage workers and therefore a more competitive labor market leads to less child labor only when the household is well-endowed in land. This does not come as a surprise since the effect for the intermediate category is predicted to be nil and the effect for the lower category is a mix of a positive and of a negative effect.

5 Conclusion

In this paper, we show both theoretically and empirically how market imperfections play a role in the use of child labor. We offer a simple model that describes how child labor varies with changes in labor market imperfections. We find that households are spread in four different categories: households with no or a very small amount of land (in which adults do not farm their land) should decrease their amount of child labor following a decrease in labor market imperfections, households with a mid-lower amount of land (in which adults combine wage work with farm work) should have differing behaviors, households with a mid-upper amount of land (in which the household is in autarky) should be left unchanged and finally households with a large amount of land (who employ wage workers) should also decrease their child labor use. The discussion on land market imperfections suggests that mainly households constrained on the labor market should take advantage of a decrease in land market imperfections and finally that availability of credit should decrease child labor use mainly for the less-endowed households. Both the model that depicts the effects of a marginal change in market imperfections and the discussion of the distributive effects of such changes

are new.

Most of the predictions obtained in the model are validated by the estimation of a child labor supply equation on rural areas of Madagascar, where market imperfections are assessed by averages computed at the village level. We find no household in the first regime, which suggests that, as soon as some land is available, adults farm it. While the model predicted that, for small ranges of households, improvement on markets could lead to increase in child labor use, the empirical fails to detect such cases. This suggests that policies aiming at improving markets functioning should reduce child labor. In addition, we show that most efficient leverage would consist in improving the labor market rather than the land market. Finally, we show that the households who would reduce their child labor use following a change in the labor market are the ones with a large level of land (those who used to rely on child labor because access to external workforce is costly) while households who reduce their child labor use following an improvement on the land market are mainly with an intermediate level of land (because they are constrained on the labor market).

In the empirical analysis, while the thresholds for each regime are not ad-hoc chosen but non-parametrically estimated (by plotting how child labor varies with land), we fail to take into account the fact that they should vary with market imperfections. Endogenizing thresholds is left for future research. Similarly, it would be of interest to describe how households' characteristics impact their ability to access the market. This, again, is left for future research.

6 Figures and Tables

Figure 1: Child labor against land area

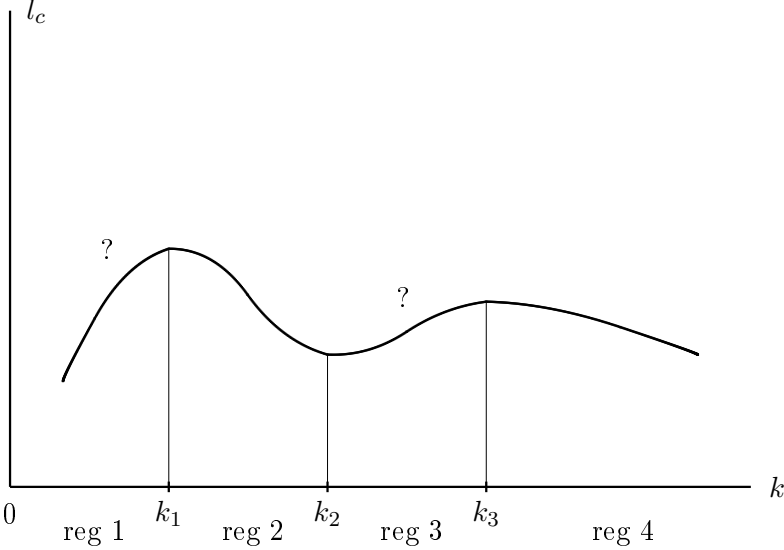


Figure 2: Child labor with less market imperfections

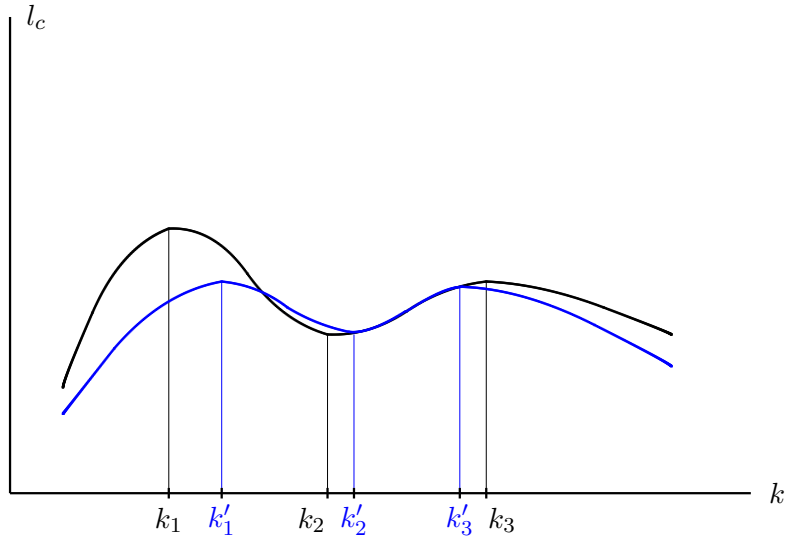


Figure 3: Child labor hours against riceland area

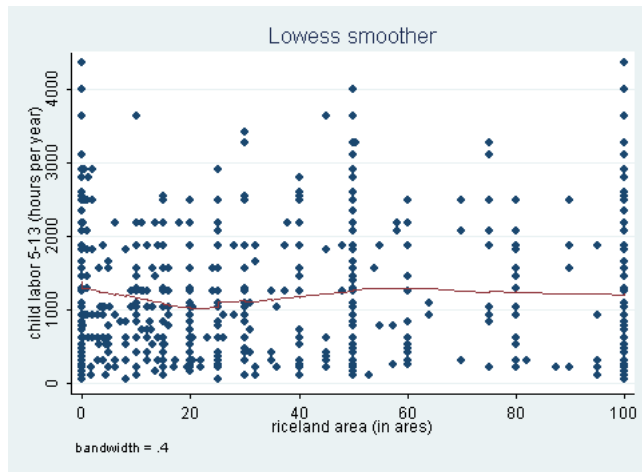


Table 1: Markets

Credit	
bank available	17.4%
microcredit available	37.4%
usurer available	15.1%
Land	
share of titled land = 0	43.7%
$0 < \text{share of titled land} \leq 25\%$	33.7%
$25\% < \text{share of titled land} \leq 50\%$	11.8%
$50\% \leq \text{share of titled land}$	10.7%
share of hhs who rent in land = 0	57.8%
$0 < \text{share of hhs who rent in land} \leq 25\%$	35.9%
$25\% < \text{share of hhs who rent in land}$	6.2%
share of households who bought their land = 0	28.1%
$0 < \text{share of households who bought their land} \leq 25\%$	49.3%
$25\% < \text{share of households who bought their land} \leq 50\%$	14.4%
$50\% < \text{share of households who bought their land}$	6.0%
Land + labor	
share of hhs who sharecrop = 0	60.4%
$0 < \text{share of hhs who sharecrop} \leq 25\%$	29.9%
$25\% < \text{share of hhs who sharecrop}$	9.7%
Labor	
share of adult wage workers = 0	16.0%
$0 < \text{share of adult wage workers} \leq 25\%$	45.2%
$25\% < \text{share of adult wage workers} \leq 50\%$	25.0%
$50\% < \text{share of adult wage workers}$	13.9%

Table 2: Child labor supply and market imperfections

	Child labor 6-13 (hours per year)		
bank available	-618.2*** (112.7)	-369.4*** (125.0)	-427.6** (204.5)
microcredit available	25.25 (78.24)	-143.6 (94.87)	-116.2 (111.3)
usurer available	57.16 (99.35)	118.5 (118.9)	90.27 (149.2)
share of titled land	-1,257*** (412.0)	-1,849*** (477.5)	-1,381** (617.0)
share of titled land ²	161.8 (576.4)	1,909*** (646.8)	1,980** (940.9)
share of hhs who rent in land	-436.9 (719.9)	-461.4 (874.6)	-1,752* (1,012)
share of hhs who rent in land ²	102.8 (1,667)	72.50 (2,218)	1,624 (2,496)
share of households who bought some land	-94.93 (417.1)	414.4 (478.6)	-263.8 (582.2)
share of households who bought some land ²	200.9 (602.7)	226.0 (673.8)	815.0 (836.0)
share of hhs who sharecrop	1,184** (584.8)	1,140* (676.6)	1,402* (818.8)
share of hhs who sharecrop ²	-1,310 (1,065)	-1,316 (1,193)	-2,486* (1,437)
share of adult wage workers	-2,364*** (434.1)	-1,206** (492.4)	-1,759*** (581.0)
share of adult wage workers ²	3,015*** (545.7)	1,396** (623.8)	2,187*** (709.0)
rice land area	0.618*** (0.168)	0.477*** (0.174)	0.289 (0.213)
tanety land area	-0.137 (0.137)	-0.181 (0.138)	-0.262 (0.160)
wealth	-169.8*** (19.55)	-175.2*** (19.87)	-165.0*** (24.09)
# Observations	11781	11781	9428
Pseudo R^2	0.05	0.06	0.06
Children's and household characteristics	yes	yes	yes
Fixed effects	region	district	district
Community's characteristics	no	no	yes

Note: Estimation performed by maximum likelihood (tobit). Additional control variables are the full set of age dummies interacted with gender, households characteristics, ***, ** and * respectively mean that the coefficient is significantly different from 0 at the 1%, 5% and 10% level.

Table 3: Marginal effects of market imperfections on child labor supply

Market imperfection measure	effect at mean level	effect at 10%	effect at 90%
share of titled land	-804.1**	-1381**	580.6
share of hhs who rent in land	-1543**	-1752*	-1068*
share of households who bought some land	-9.6	-263.8	468.5
share of hhs who sharecrop	1059*	1402*	159
share of adult wage workers	-753.1**	-1759***	740.2**

Note: Computation based on column 3, Table 2 (covariates are individual's and household's characteristics, community's characteristics and district fixed effects). ***, ** and * respectively mean that the coefficient is significantly different from 0 at the 1%, 5% and 10% level.

Table 4: Child labor supply and market imperfections, by land ownership

	Child labor 6-13 (hours per year)		
	Rice land < 20	20 ≤ Rice land < 60	60 ≤ Rice land
bank available	-848.6** (411.8)	-1,089*** (376.2)	-144.5 (433.0)
share of titled land	366.1 (1,020)	-2,770* (1,505)	-5,151*** (1,337)
share of titled land ²	-992.2 (1,646)	2,719 (2,112)	10,714*** (2,467)
share of hhs who rent in land	-1,955 (1,687)	-11,043*** (2,648)	1,897 (1,781)
share of hhs who rent in land ²	3,524 (4,404)	21,053*** (6,281)	-4,737 (4,039)
share of hhs who sharecrop	325.6 (1,227)	731.7 (2,716)	807.5 (1,842)
share of hhs who sharecrop ²	-102.4 (2,045)	4,194 (5,971)	-2,484 (3,929)
share of adult wage workers	-1,182 (859.3)	1,423 (1,545)	-4,443*** (1,149)
share of adult wage workers ²	1,307 (1,019)	-1,725 (1,818)	5,178*** (1,371)
rice land area	12.92 (8.335)	6.900 (5.258)	0.938 (0.790)
tanety land area	-0.230 (0.287)	0.0174 (0.685)	-0.342 (0.238)
wealth	-98.63*** (33.31)	-183.4*** (62.69)	-166.6*** (44.69)
# Observations	4210	1758	3200
Pseudo R^2	0.08	0.10	0.08
Children's and household characteristics	yes	yes	yes
Fixed effects	district	district	district
Community's characteristics	yes	yes	yes

Note: Estimation performed by maximum likelihood (tobit). Additional control variables are the full set of age dummies interacted with gender, households characteristics, ***, ** and * respectively mean that the coefficient is significantly different from 0 at the 1%, 5% and 10% level.

Table 5: Marginal effects of market imperfections at mean on child labor supply, by land category

Market imperfection measure	Rice land < 20	$20 \leq$ Rice land < 60	$60 \leq$ Rice land
share of titled land	77.11	-1979*	-2031***
share of hhs who rent in land	-1502	-8341***	1286
share of hhs who sharecrop	311.4	1310	464.7
share of adult wage workers	-581.2	630	-2062***

Note: Computation based on Table 4 (covariates are individual's and household's characteristics, community's characteristics and district fixed effects). ***, ** and * respectively mean that the coefficient is significantly different from 0 at the 1%, 5% and 10% level.

References

- Baland, J.M., and J. Robinson. 2000. "Is Child Labor Inefficient?" *Journal of Political Economy* 108: 663–679.
- Bardhan, Pranab K., and T.N. Srinivasan. 1971. "Cropsharing Tenancy in Agriculture: A Theoretical and Empirical Analysis" *American Economic Review* 41: 48–64.
- Basu, Kaushik, Sanghamitra Das, and Bhaskar Dutta. 2010. "Child Labor and Household Wealth: Theory and Empirical Evidence of an Inverted-U" *Journal of Development Economics* 91: 8–14.
- Beegle, Kathleen, Rajeev Dehejia, and Roberta Gatti. 2004. "Why Should We Care About Child Labor? The Education, Labor Market, and Health Consequences of Child Labor" Working Paper 10980 National Bureau of Economic Research.
- Beegle, Kathleen, Rajeev H. Dehejia, and Roberta Gatti. 2006. "Child labor and agricultural shocks" *Journal of Development Economics* 81: 80–96.
- Bhalotra, Sonia, and Christopher Heady. 2003. "Child Farm Labour: the Wealth Paradox." *World Bank Economic Review* 17: 197–227.
- Cogneau, Denis, and Remi Jedwab. 2008. "Family Income and Child Outcomes: The 1990 Cocoa Price Shock in Cote d'Ivoire" CEDI Discussion Paper Series 08-13 Centre for Economic Development and Institutions (CEDI), Brunel University.
- de Janvry, A., M. Fafchamps, and E. Sadoulet. 1991. "Peasant household Behaviour with missing markets: some paradoxes explained" *The Economic Journal* 101: 1400–1417.
- Diallo, Yacouba, Frank Hagemann, Alex Etienne, Yonca Gurbuzer, and Farhad Mehran. 2010. "Global child labour developments: measuring trends from 2004 to 2008" Technical report International Labour Office, International Programme on the Elimination of Child Labour (IPEC) Geneva.
- Dumas, Christelle. 2007. "Why Do Parents Make their Children Work? A Test of the Poverty Hypothesis in Rural Areas of Burkina Faso." *Oxford Economic Papers* 59: 301–329.

- . 2009. “Chocs et Dynamiques des Choix d’Allocation du Temps des Enfants au Sénégal” *Les Cahiers du Cedimes* 3: 83–96.
- Duryea, Suzanne, and Mary Arends-Kuenning. 2003. “School Attendance, Child Labor and Local Labor Market Fluctuations in Urban Brazil” *World Development* 31: 1165–1178.
- Edmonds, E. 2006. “Child Labor and Schooling Responses to Anticipated Income in South Africa” *Journal of Development Economics* 81: 386–414.
- Jacoby, H., and E. Skoufias. 1997. “Risk, financial markets and human capital in a developing country” *Review of Economic Studies* 64: 311–335.
- Jafarey, Saqib, and Sajal Lahiri. 2002. “Will Trade Sanctions Reduce Child Labour? The Role of Credit Markets” *Journal of Development Economics* 68: 137–156.
- Kruger, Diana. 2004. *Trabajo Infantil: Teoría y Evidencia desde Latinoamérica* chapter Child labor and schooling during a coffee sector boom : Nicaragua 1993-1998 Mexico: Fond pour la culture économique.
- Mueller, E. 1984. “The value and allocation of time in rural Botswana” *Journal of Development Economics* 15: 329–360.
- Ranjan, Priya. 2001. “Credit Constraints and the Phenomenon of Child Labor” *Journal of Development Economics* 64: 81–102.
- Ray, Debraj. 1998. *Development Economics* Princeton University Press.
- Sadoulet, Elisabeth, and Alain de Janvry. 1995. *Quantitative Development Policy Analysis* The John Hopkins University Press.
- Sahn, David, and David Stifel. 2003. “Exploring Alternative Measures of Welfare in the Absence of Expenditure Data.” *Review of Income and Wealth* 49: 463–489.
- Schultz, Theodore W. 1965. *Transforming Traditional Agriculture* New Heaven, Connecticut: Yale University Press.
- Singh, I., L. Squire, and J. Strauss. 1986. *Agricultural Household Models* chapter 10 Washington, D.C.: World Bank. 79–83.

A Proofs

A.1 Regime 1: $\frac{\partial l_c}{\partial k}$

In regime 1, labor marginal productivity is lower than \underline{w} and $l_a = l_e = 0$. Child labor is chosen such as $\frac{\partial F}{\partial l_c} = \frac{1}{\phi'(C)}$. Hence:

$$\chi = \frac{\partial F}{\partial l_c} - \frac{1}{\phi'(C)} = \frac{\partial F}{\partial l_c} - \frac{1}{\phi'(K(k, \delta l_c) + \underline{w})} = 0.$$

Since $\frac{\partial \chi}{\partial l_c} dl_c + \frac{\partial \chi}{\partial k} dk = 0$,

$$\begin{aligned} \frac{\partial l_c}{\partial k} &= -\frac{\partial \chi / \partial k}{\partial \chi / \partial l_c} \\ \frac{\partial \chi}{\partial l_c} &= \frac{\partial^2 F}{\partial l_c^2} + \frac{\phi''(C)}{\phi'(C)^2} \cdot \frac{\partial C}{\partial l_c} \\ &= \delta^2 F_{ll} + \frac{\phi''(C)}{\phi'(C)^2} \cdot \delta F_l < 0 \\ \frac{\partial \chi}{\partial k} &= \delta F_{kl} + \frac{\phi''(C)}{\phi'(C)^2} F_k \end{aligned}$$

The second term of the last expression is negative but the first is assumed to be positive. Hence the total effect, as $\frac{\partial l_c}{\partial k}$ is of unknown sign and depends on whether the substitution effect overcomes the income effect.

A.2 Regime 2: $\frac{\partial l_c}{\partial k}$

In regime 2, the FOC are such that

$$\begin{aligned} \mu &= F_l - \underline{w} = 0 \\ \nu &= \frac{\partial F}{\partial l_c} - \frac{1}{\phi'(C)} = \delta F_l - \frac{1}{\phi'(C)} = 0 \end{aligned}$$

Total derivatives are therefore equal to zero:

$$\begin{aligned} \frac{\partial \mu}{\partial l_a} dl_a + \frac{\partial \mu}{\partial l_c} dl_c + \frac{\partial \mu}{\partial k} dk &= 0 \\ \frac{\partial \nu}{\partial l_a} dl_a + \frac{\partial \nu}{\partial l_c} dl_c + \frac{\partial \nu}{\partial k} dk &= 0 \end{aligned}$$

Hence:

$$\left[\frac{\partial \mu}{\partial l_c} \cdot \frac{\partial \nu}{\partial l_a} - \frac{\partial \nu}{\partial l_c} \cdot \frac{\partial \mu}{\partial l_a} \right] dl_c + \left[\frac{\partial \mu}{\partial k} \cdot \frac{\partial \nu}{\partial l_a} - \frac{\partial \nu}{\partial k} \cdot \frac{\partial \mu}{\partial l_a} \right] dk = 0$$

Since

$$\begin{aligned} \frac{\partial \mu}{\partial l_c} &= \delta F_l; & \frac{\partial \mu}{\partial k} &= F_{kl}; & \frac{\partial \mu}{\partial l_a} &= F_l; \\ \frac{\partial \nu}{\partial l_c} &= \delta^2 F_{ll} + \frac{\phi''}{\phi'^2} \cdot \delta F_l; & \frac{\partial \nu}{\partial k} &= \delta F_{kl} + \frac{\phi''}{\phi'^2} \cdot F_k; & \frac{\partial \nu}{\partial l_a} &= \delta F_l \end{aligned}$$

we get:

$$\begin{aligned} \frac{dl_c}{dk} &= - \frac{\delta F_{kl} F_l - (\delta F_{kl} + \frac{\phi''}{\phi'^2} F_k) F_l}{\delta^2 F_{ll}^2 - (\delta^2 F_{ll} + \frac{\phi''}{\phi'^2} \delta F_l) F_l} \\ &= - \frac{F_k}{\delta F_l} < 0 \end{aligned}$$

A.3 Regime 2: $\frac{\partial l_c}{\partial w}$

μ and ν are the same functions as in the previous section. By taking total derivatives with regard to l_a , l_c and w , we show that:

$$\begin{aligned} \frac{dl_c}{dw} &= - \frac{\frac{\partial \mu}{\partial w} \cdot \frac{\partial \nu}{\partial l_a} - \frac{\partial \nu}{\partial w} \cdot \frac{\partial \mu}{\partial l_a}}{\frac{\partial \mu}{\partial l_c} \cdot \frac{\partial \nu}{\partial l_a} - \frac{\partial \nu}{\partial l_c} \cdot \frac{\partial \mu}{\partial l_a}} \\ &= - \frac{\delta + \frac{\phi''}{\phi'^2} (1 - l_a)}{\frac{\phi''}{\phi'^2} \delta F_l} \end{aligned}$$

The last expression has the same sign as $\left[\delta + \frac{\phi''}{\phi'^2} (1 - l_a) \right]$ and it is positive when l_a is close to 1.

A.4 Regime 3: $\frac{\partial l_c}{\partial k}$

In regime 3, the household maximizes its utility subject to $C = F(k, 1 + \delta l_c)$. The unique FOC is

$$\chi = \delta F_l - \frac{1}{\phi'(C)}.$$

As a consequence,

$$\begin{aligned}\frac{dl_c}{dk} &= -\frac{\partial\chi/\partial k}{\partial\chi/\partial l_c} \\ &= -\frac{\delta F_{kl} + \frac{\phi''}{\phi'^2} F_k}{\delta^2 F_{ll} + \frac{\phi''}{\phi'^2} \delta F_l}\end{aligned}$$

which is of the sign of $\delta F_{kl} + \frac{\phi''}{\phi'^2} F_k$.

A.5 Regime 4: $\frac{\partial l_c}{\partial k}$

In regime 4, the household maximizes $U = \phi(C) - l_c$ subject to:

$$F(k, 1 + \delta l_c + l_e) - \bar{w} l_e = C$$

The FOC imply that:

$$\begin{aligned}\mu &= F_l - \bar{w} = 0 \\ \nu &= \delta F_l - \frac{1}{\phi'(C)} = 0\end{aligned}$$

The total derivatives are therefore equal to zero:

$$\begin{aligned}\frac{\partial\mu}{\partial l_c} dl_c + \frac{\partial\mu}{\partial l_e} dl_e + \frac{\partial\mu}{\partial k} dk &= 0 \\ \frac{\partial\nu}{\partial l_c} dl_c + \frac{\partial\nu}{\partial l_e} dl_e + \frac{\partial\nu}{\partial k} dk &= 0\end{aligned}$$

Hence:

$$\frac{dl_c}{dk} = -\frac{\frac{\partial\mu}{\partial k} \cdot \frac{\partial\nu}{\partial l_e} - \frac{\partial\nu}{\partial k} \cdot \frac{\partial\mu}{\partial l_e}}{\frac{\partial\mu}{\partial l_c} \cdot \frac{\partial\nu}{\partial l_e} - \frac{\partial\nu}{\partial l_c} \cdot \frac{\partial\mu}{\partial l_e}}$$

Since

$$\begin{aligned}\frac{\partial\mu}{\partial k} &= F_{kl}; & \frac{\partial\mu}{\partial l_c} &= \delta F_{ll}; & \frac{\partial\mu}{\partial l_e} &= F_{le}; \\ \frac{\partial\nu}{\partial k} &= \delta F_{kl} + \frac{\phi''}{\phi'^2} F_k; & \frac{\partial\nu}{\partial l_c} &= \delta^2 F_{ll} + \frac{\phi''}{\phi'^2} \delta F_l; & \frac{\partial\nu}{\partial l_e} &= \delta F_{le};\end{aligned}$$

we get:

$$\begin{aligned}\frac{dl_c}{dk} &= -\frac{F_{kl}\delta F_{ll} - (\delta F_{kl} + \frac{\phi''}{\phi'^2}F_k)F_{ll}}{\delta^2 F_{ll}^2 - (\delta^2 F_{ll} + \frac{\phi''}{\phi'^2}\delta F_l)F_{ll}} \\ &= -\frac{F_k}{\delta F_l} < 0\end{aligned}$$

A.6 Regime 4: $\frac{\partial l_c}{\partial \bar{w}}$

μ and ν are defined in the same way as in the preceding section. Total derivatives give:

$$\begin{aligned}\frac{dl_c}{d\bar{w}} &= -\frac{\frac{\partial \mu}{\partial \bar{w}} \cdot \frac{\partial \nu}{\partial l_e} - \frac{\partial \nu}{\partial \bar{w}} \cdot \frac{\partial \mu}{\partial l_e}}{\frac{\partial \mu}{\partial l_c} \cdot \frac{\partial \nu}{\partial l_e} - \frac{\partial \nu}{\partial l_c} \cdot \frac{\partial \mu}{\partial l_e}} \\ &= \frac{\delta F_{ll} + \frac{\phi''}{\phi'^2}(-l_e)F_{ll}}{(\delta F_{ll})^2 - (\delta^2 F_{ll} + \frac{\phi''}{\phi'^2}\delta F_l)F_{ll}} \\ &= \frac{\delta - \frac{\phi''}{\phi'^2}l_e}{-\frac{\phi''}{\phi'^2}\delta F_l} > 0\end{aligned}$$

since both terms are positive.

B Additional Tables

Table 6: Correlations between market imperfections measures

	bank	microcredit	usurer	registered	sharecropping	renting	selling	wage
bank	1							
microcredit	0.51*	1						
usurer	0.16*	0.22*	1					
registered land	0.22*	0.24*	0.15*	1				
sharecropping	0.01	-0.06*	0.12*	0.04*	1			
renting	-0.02	0.11*	0.06*	-0.01	0.24*	1		
selling	0.15*	0.19*	0.13*	0.10*	0.11*	0.12*	1	
wage workers	0.39*	0.36*	0.18*	0.20*	0.02*	0.05*	0.16*	1

Table 7: Descriptive statistics for the sample

Variable	# Obs.	Mean	Min	Max
EPM 2005 variables				
gender	12116	.499	0	1
age=6	12116	.149	0	1
age=7	12116	.134	0	1
age=8	12116	.133	0	1
age=9	12116	.112	0	1
age=10	12116	.138	0	1
age=11	12116	.103	0	1
age=12	12116	.120	0	1
age=13	12116	.108	0	1
# children younger than 5	12116	1.069	0	6
# children btw 6 and 10 y.o.	12116	1.625	0	6
# children btw 11 and 15 y.o.	12116	1.195	0	7
# children btw 16 and 20 y.o.	12116	.523	0	5
# males btw 21 and 60 y.o.	12116	.918	0	5
# females btw 21 and 60 y.o.	12116	1.060	0	6
father's education	12116	2.393	1	6
father's education missing	12116	.073	0	1
has some debt	11798	.056	0	1
mean wage	12116	948.35	0	13856.81
distance to primary school	12116	731.71	0	7000
distance to lower secondary	12116	23474.7	0	70000
rice land area (in ares)	12116	70.069	0	3700
tanety land area (in ares)	12116	84.267	0	10025
wealth index	12116	-.377	-3.160778	16.519
bank available	12116	.149	0	1
microcredit available	12116	.355	0	1
usurer available	12116	.146	0	1
share of titled land	12116	.145	0	1
share of rented land	12116	.064	0	.6
share of sharecropping	12116	.068	0	.823
share of adult wage workers	12116	.229	0	.939
share of hhs who bought land	12099	.155	0	1
Continued on Next Page...				

Table 7 – Continued

Variable	# Obs.	Mean	Min	Max
2001 Municipalities census variables				
population size	9784	19434.63	1226	175250
outward migration	9798	2.022	1	4
inward migration	9798	2.253	1	4
health post available	9798	.973	0	1
road available	9784	.848	0	1
daily market available	9798	.571	0	1
phone available	9798	.206	0	1
drinkable water available	9798	.607	0	1
price of 1 ha of riceland	9778	5563167	0	1.00e+08
rent for 1 ha of riceland	9798	421613.3	0	1.30e+07
mean rice price	9798	620.563	320	1250
dangerous area	9778	.333	0	1
use of non traditional agricultural equipment	9798	2.109	1	3
use of pesticide	9798	2.273	1	3
use of veterinary products	9798	2.007	1	3
use of improved rice varieties	9798	2.527	1	3
share of hhs who use cattle as a pull force	9798	45.343	0	100
cattle can be rented	9798	.447	0	1
common place to water cattle	9798	.702	0	1
lake or sea bordering the village	9798	.518	0	1
forest bordering the village	9798	.835	0	1
peasant organization	9798	.563	0	1
length of SOUDURE	9798	4.318	1	9
share of hhs who suffer from hunger during SOUDURE	9798	55.072	0	99
main crop is rice (ref)	9798	0.714	0	1
main crop is coffee	9798	.060	0	1
main crop is sweet potato	9798	.024	0	1
main crop is cassava	9798	.061	0	1
main crop is corn	9798	.040	0	1
main crop is other	9798	.098	0	1

Table 8: Estimates for control variables

Variable	Child labor hours (6-13)
boy	84.01
age=6	-1,068***
boy x age=6	7.829
age=7	-716.5***
boy x age=7	-64.25
age=8	-757.8***
boy x age=8	88.02
age=9	-659.5***
boy x age=9	117.7
age=10	-279.6*
boy x age=10	181.1
age=12	-23.45
boy x age=12	505.1***
age=13	-261.5
boy x age=13	724.1***
# children younger than 5	32.58
# children btw 6 and 10 y.o.	42.83
# children btw 11 and 15 y.o.	-99.57***
# children btw 16 and 20 y.o.	-64.98*
# males btw 21 and 60 y.o.	-34.62
# females btw 21 and 60 y.o.	81.33
father's education	-223.2***
father's education missing	-257.2**
has some debt	199.7
mean wage	-0.0987**
distance to primary school	0.113***
distance to lower secondary	0.00417***
population size	-0.00230
outward migration	140.4**
inward migration	97.80*
health post available	-630.6***
road available	220.0*
daily market available	-356.6***
Continued on Next Page...	

Table 8 – Continued

Variable	Child labor hours (6-13)
phone available	455.3***
drinkable water available	-98.12
price of 1 ha of riceland	-5.63e-06
rent for 1 ha of riceland	-3.29e-05
mean rice price	-0.189
dangerous area	-242.3**
main crop is coffee	-292.1
main crop is sweet potato	-535.7***
main crop is cassava	-1,369***
main crop is corn	48.87
main crop is other	-492.7***
use of non traditional agricultural equipment	283.8***
use of pesticide	-110.9
use of veterinary products	-68.75
use of improved rice varieties	141.3**
share of hhs who use cattle as a pull force	4.232**
cattle can be rented	-129.9
common place to water cattle	346.3**
lake or sea bordering the village	43.65
forest bordering the village	440.4***
peasant organization	185.1**
length of SOUDURE	15.93
share of hhs who suffer from hunger during SOUDU	0.557